

# EXAMINING METHODOLOGICAL DIFFERENCES: RESEARCH ON THE RELATIONSHIP BETWEEN SCHOOL BUILDING CONDITION AND STUDENT ACHIEVEMENT

Glen I. Earthman

*Virginia Polytechnic Institute & State University*

## ABSTRACT

*Research in the field of Education has produced a corpus of studies dealing with the specific relationship between school building condition and student achievement reporting positive results. Yet, studies have been completed reporting no significant difference in achievement scores from students in buildings in poor and good condition. The differences in research findings may lie in the methodology employed. The most important difference might be in how the building is assessed and the instrument utilized to make that assessment. An instrument that reports those building elements that have a direct research relationship to student performance provides better data on the actual learning condition of a school building, resulting in better findings. Further, the measurement of student achievement presents unique problems to the researchers. In some instances researchers were unable to use the mean of student scaled scores and were forced to use the percentage of students passing the examination. The percent of students is not an accurate measure of student achievement, but is often the only measure available. A few researchers have used the percentage of student attendance as a proxy for student achievement with some success.*

## INTRODUCTION

In the past quarter century, a considerable amount of research in the field of education has been generated dealing specifically with the relationship between school building condition and student achievement. In addition to student achievement, other variables have been utilized to find out the extent of influence the school building condition might have upon students and teachers. These variables have included student attitudes, student health, and student achievement. However, this paper deals only with the variable of student achievement.

Those individuals who are interested and involved in the instruction of students most certainly are concerned about how the physical environment can possibly influence how a student learns under varied conditions. Likewise, those individuals who are responsible for designing the physical environment in which students will study are interested in the research findings dealing with the influence the physical environment has upon students. In designing schools and classrooms, members of the design profession utilize the research findings in this area of investigation to provide the best possible learning space for students.

When research findings regarding how the physical environment influences learning are explicit and concise, it is possible for educators and design professionals to rely upon the findings with assurance, thus, permitting these professionals to create a favorable physical learning environment for students. On the other hand, when there are conflicting research findings that show no significant difference in student academic scores when they are in buildings assessed in good or poor condition, it is not easy to definitely depend upon any of the findings in this area of research.

The purpose of this manuscript is to review the differences in research methodologies in studies examining the same phenomena and to ascertain why researchers have different findings

given the same basic data and methodology in the study. For instance, some researchers examining the relationship between school building condition and student achievement have found significant differences in achievement scores of students in school buildings rated as being in good and poor condition (Bullock, 2007; Cash, 1993; Crook, 2006; Earthman, Cash & Van Berkum, 1996; Edwards, 1993; Fuselier, 2008; Geier, 2007; Hines, 1996; Jackson, 2005; Lanham, 1999; O'Sullivan, 2006; Phillips, 1997; Sheets, 2009; Taylor, 2009). The findings of these and other studies enable researchers to state that the school building condition does influence student performance. Conversely, other researchers have not found such differences (Picus, Mario, Calvo, & Glenn, 2005; Lewis, 2001; O'Neill, 2000; McGowen, 2007). Normally one might expect researchers to find different results in their research if different methodologies were utilized. Such has not been the case. Conversely, researchers in this field of inquiry have utilized the same basic methodology to complete their research.

The answer to the question of differences in research findings undoubtedly has to be in the data gathered and methodology utilized. If the premise of the study is to find out if the condition of the building influences student performance, then a measurement of both the condition of the school building and the achievement of the students in that building has to be made. Statistical analysis of the data generated by such measurements must be completed to determine if there are any significant differences. If the statistical analysis of the data produces differing results, there must be some reason for this to happen and it might well be in the source of the data utilized, the data that are gathered, and in the method of treating those data. These components of methodology can be the reason researchers have differing research findings from similar studies. In a synthesis of the effect of building condition on student academic achievement Gunter and Shao (2016) found that the measurement of the building condition, assessment instrument type, subject area measured, and grade level affected the association between the two variables. In addition, some researchers have not employed the control variables such as SES, teacher quality, student ethnicity, curricular offerings that contribute to student learning in their studies. Studies that do not control for these variables are less robust than studies that employ them. This may contribute to the differences in results when comparing the mean scores of students in schools that are rated in either poor or good condition. However, control of confounding variables in a study does not explain the main reason for differences in mean achievement scores of students in the two categories of school buildings. Control of confounding variables does influence the results of the study, but studies that do not control for confounding variables may produce the same results as one that has control. The results may be slightly different.

Still, there can be confusion and doubt about the influence the condition of a school building may have upon student health and performance when research studies report there is no difference in student scores in school buildings in good or poor condition. In a meta-analytical synthesis of research studies dealing with the relationship between school building condition and student achievement, Stewart (2014) reviewed a total of 42 studies and found only 38% of the studies (16) dealt with that relationship and reported a relationship that was significant in differences between student scores. But Stewart further reported:

There was a positive relationship between the independent variable of building condition and the dependent variable student learning in 50% of the analyses found in the studies included in this meta-analysis. The researcher identified 16 specific analyses on the association between these two variables in the 42 studies that constituted the data set. Of these 16 analyses, eight reveal a positive relationship. Among the remaining analyses,

six (38%) revealed no relationship between building conditions while two of the analyses (12%) actually reported an inverse relationship (e.g. students in substandard buildings experienced higher achievement than students in standard or above standard buildings). It can be concluded that this meta-analysis suggest a weak association between building conditions and student learning (p. 56).

While this analysis of studies is correct, simply counting the number of studies that showed a significant relationship and comparing that number with the number of studies that did not report a significant relationship is not very precise or revealing, especially when the researcher included only an extremely limited number of studies. The number of studies that are available that actually deal with the relationship between school building conditions and student performance is far greater than the limited 42 studies in the data set Stewart included and the further limited analyses of 16 studies done in the study. A simple review of the resources of any of the four major clearinghouses on educational facilities or other reliable sources will reveal a much larger number of studies completed on this subject. Hewitt (2017) found over 103 research studies that dealt solely with the relationship between school building condition and student achievement.

There are many more studies that deal with the relationship of student achievement and other variables such as age of building, selected building elements, indoor air quality, color of classroom walls, or other such variables. Yet the 50% of studies reported by Stewart (2014) that did not reveal a significant difference in student scores causes some people to believe there might not be a significant relationship between the two variables or at very best a weak association. In essence, these studies tend to make readers believe that the physical environment may not have any influence upon student health or performance. Stating that no relationship exists between school building condition and student achievement scores, however, is basically overstating the data and is incorrect. When such studies report that there is no relationship between school building condition and student achievement, readers tend to believe what they read or at least doubt existing research that report the reverse. The studies reporting no evidence of differences in student scores are completed by very competent researchers using exactly the same methodology to obtain their findings (O'Neill, 2000; Lewis, 2001; Picus, Marion, Calvo & Glenn, 2005; McGowen, 2007). As a result, the reader finds credence in what the researcher is reporting. The Picus, et.al. study is an example of a well-executed study that did not show a significant relationship between the academic scores of students in school buildings rated as being in either good or poor condition. Yet the researchers stated no relationship exists between the two variables. Although not necessarily identified as such, it is surmised, by some researchers, that methodological differences in the studies that do not report any significant difference in student scores and those that do demonstrate a difference in student scores might be the reason for not finding any significant differences in student scores when they are enrolled in school buildings assessed as being in either good or poor condition.

### **QUALITY OF RESEARCH**

There have been some critics who have stated that because so much of the research completed in the area of the relationship between school building condition and student achievement has been doctoral dissertations that the quality of the research is limited. The implication is that because the research is a dissertation there is some less quality to the work completed than if the study was published. This criticism is unjustified and mis-construes the meaning of acceptable research, because every doctoral dissertation is peer reviewed. Every dissertation is reviewed and approved by a panel of professors who are well versed in research procedures. This review

constitutes a peer review of the research. The resultant research is of good quality and the findings should be taken for what is reported.

Much of the dissertation research is not published for several reasons. In the first place, many of the candidates who complete the research are employed by the public schools or an organization that does not reward the employee for publishing manuscripts. There is no benefit for a public school employee to publish completed research. As a result, the research done by these students is typically not published. Lack of publication does not in any way diminish the findings of the research effort.

### **Major Methodological Questions**

The major differences in research methodology seem to center on certain questions such as:

1. Is it possible to accurately measure the physical environment?
2. For what purposes should the physical environment be measured?
3. Who can accurately evaluate school buildings?
4. Do the student academic scores accurately measure student learning?
5. Can substitute measures of student achievement be successfully utilized?
6. What statistical process is best utilized to determine significant relationships?

It is necessary to examine these questions in a systematic order to address the concerns of the manuscript.

## **IS IT POSSIBLE TO ACCURATELY MEASURE THE PHYSICAL ENVIRONMENT?**

### **School Building Assessment**

The first major question in this discussion related to the ability of researchers to adequately measure the physical environment in which students learn. This deals with the instrument utilized to assess the school building. There seems to be two different ways to measure the school building. One way is to try to determine if the school building contains certain building elements that directly relate to student achievement. These building elements would be those that have previously been tested through research to directly relate to student achievement.

The second method of determining the condition of the school building is by measuring the total physical condition of the building. This would entail determining the condition of the school building but also what needs to be repaired to keep the building in good order. Thus every broken window, worn section of carpet, non-operating doors, or missing floor tile needs to be identified and listed for repair. This would be in addition to identifying building elements missing, such as lack of air-conditioning, acoustical control, and proper lighting, for example.

In a review of research, Bailey (2009) stated that researchers who utilized a building assessment instrument that was designed to evaluate those building conditions that were directly related to student achievement found higher differences in student test scores between the two groups of students than in the studies where a maintenance or engineering type of evaluative instrument was used to assess the school building condition. In many research studies the condition of a school building is determined by using an engineering or maintenance type of assessment scale. These technical or engineering evaluation tools measure all parts of the building to determine what building components or items need to be repaired to keep the building in good condition (Roberts, 2013). These instruments provide data on the condition of various parts or components of the building which in turn can be listed on a maintenance/repair schedule for remedy. A large majority

of the items needing repair or replacement identified in such instruments do not necessarily relate to student learning, at least there is no research to indicate that these items have a bearing or influence on student learning.

For example, the worn carpeting in the classroom that needs replacing does not have a direct affect upon the academic achievement of students. At least there is no research to indicate such is the case. Other maintenance items such as the broken door latch, the window that needs replacing, and the chalkboard or whiteboard that is worn or not working does not have a direct influence upon the performance of students and teachers, at least there is no research to indicate such. Yet, such items may have as equal weight in the final score for the building as control of the thermal environment in the classroom, proper lighting, or daylighting in the classroom has. But the latter building features have a corpus of research to back up the claim that these building features or elements indeed directly influence the performance of students (Earthman, 2004; Englebrecht, 2003; Green, 1974; Hygge, 2003; Lowe, 1990; Mendell & Heath, 2004; Perez, Montano, Perez, 2005; Wei, 2003; Wyon, 2000; Schneider, 2003; Vilatarsa, 2004; Winterbottom, 2009)

### **FOR WHAT PURPOSES SHOULD THE PHYSICAL ENVIRONMENT BE MEASURED?**

In measuring the condition of the school building when the physical condition of the building is being compared to student health and performance, there needs to be a direct tie into that relationship (Hewitt, 2017). Superfluous building maintenance needs that do not directly relate to student achievement tend to marginalize those building components that do have a direct relationship. Therefore researchers that use such maintenance instruments may not be able to find a difference in student scores because the items of comparison do not directly relate to research on student health and performance. Roberts (2013) calls such assessment instruments as engineering-based evaluation instruments. He suggested that such types of instruments, while useful for the maintenance program do not provide the necessary data needed to determine if the building condition has an influence upon student performance.

In contrast, Roberts identifies building evaluation instruments that are designed to evaluate those building components and elements that directly influence student learning as mission-based instruments (2013). He further suggests that a mission-based instrument should be employed when conducting a study on how school building conditions influence student achievement. The maintenance or engineering based instruments Roberts refers to, such as the Council of Educational Facility Planners, International (CEFPI) Guide to the Evaluation of School Buildings (CEFPI, 1998), The Effective Learning Environment Assessment, (Dorris, 2011), Total Learning Environment Assessment (TLEA) (McGowen, 2007) or the Facility Condition Index (FCI) (Roberts, 2013), are designed for purposes other than research on how the school building influences student performance and behavior and to use such instruments for research purposes is not in keeping with good research protocol, because the researcher is not measuring only those building elements directly related to student achievement, but extraneous elements not related to student achievement. The ELEA and TLEA were both developed primarily for a research study dealing with the relationship between school building condition and student achievement. These instruments, however, contained items of building assessment that are not directly related to student achievement through previous research and therefore, can be classified as maintenance type of school building assessments. The findings from the two studies using these instruments did not produce significant differences in student achievement scores.

As further evidence of the effectiveness of a research type of school building assessment instrument, Roberts (2009) measured the quality of school buildings using two different types of assessment instruments in school systems in Canada. He established the quality of teaching and learning environment scale (QTLE) based upon those factors that directly relate to the educational efficiency of school buildings. He measured school systems in Canada based upon the QTLE and then used both an engineering type and educators' research assessment instruments to measure the same buildings. He found that the engineering type of assessment instrument did not directly relate to the QTLE of a school. He further found that the measurement using an educators' research type of assessment instrument directly related to the QTLE of a school building. Roberts reasoned there is little evidence to believe that engineering type of building assessment instruments can adequately assess the educational usefulness of school buildings, especially for research purposes.

### **School Building Classification**

Another reason for not finding a relationship between building condition and student achievement might reside in how the researchers establish the school building populations for comparison purposes. Normally the achievement test scores of students in buildings assessed as being in poor condition are compared with test scores of students in satisfactory schools to determine any significant differences between the two sets of student scores. Therefore, all of the school buildings in the population need to be assessed to determine its condition as being either good or poor. The school buildings assessed in each study normally have some sort of numerical total score assigned to each building as a result of the rating instrument. This might be a composite score of the assessment instrument or some type of summative score of the condition of the school building. The score of each building is then arrayed in some ordinal scale numbering from 0 to 100 or whatever the top number might be. The assessment rating number of each school building is normally a rank ordinal number in a scale. The building scores are the key to determining good and poor buildings for determining the two groups of schools to be used in the analysis of student scores. The researcher must then divide the schools in the list into two categories depending upon the score of the building. This determines whether the building is considered in poor or good condition. This presents a problem for the researcher as to where to draw the line between the two types of buildings. To divide the group of school buildings into to equal parts, bottom and top, might not present enough of a difference in building condition to result in significant differences in student scores. There is undoubtedly very little difference in the condition of a building that has an assessment score of 49 compared to a building that is numbered 50 on an ordinal scale.

There might, however, be a difference in the condition of buildings that are listed in the top quartile and the bottom quartile of the pool. This difference might produce more of a significant difference in student scores than if the researcher used the top one-half of all school buildings in the list and compared the student scores with the student scores in the bottom one-half of the total number of school buildings. In other words, comparing the scores of students in similar buildings might not produce the same results that comparing scores of students in school buildings that are dissimilar might produce. The gradation of the condition of the schools in the middle portion of the list of buildings might be too similar to produce fruitful results. Some researchers do not report how the school building population is divided for comparison purposes. In these cases, it is difficult to determine what the researcher was using to develop dissimilar groups of school buildings for comparison purposes. But the method of division might be an explainable reason why some researchers do not find any significant differences in student scores (Earthman, 2017).



## WHO CAN ACCURATELY EVALUATE SCHOOL BUILDINGS?

### Validating Building Assessments

In addition, Cash (1993) and Hines (1996) used a system of double rating of the building by the principal and the researcher. They found a very high inter-rater agreement on the assessment of the school building when utilizing the Commonwealth Assessment of Physical Environments (CAPE). This gives credence to the practice of having principals rate their buildings using the CAPE. This is especially true if the items on the assessment instrument are objective type of questions that can be answered by simple observation. Principals seem to realize the importance of those building elements or components that make a difference in student learning better than anyone else and can know if the building element or feature is present or absent. The results of studies in which a school principal has provided the assessment with an instrument that is related to research on student achievement have resulted in much more productive findings than studies where an outside evaluator or superintendent has been employed to evaluate the school buildings. Bailey (2009) reported as much in his synthesis of research studies related to building condition and student performance. (p.7)

### Building Assessment Responsibility

The third methodological variation regarding school building assessment might be in the individual who assesses the school building. In some of the recent studies the researchers have used superintendents, maintenance directors, engineers, or outside consultants to evaluate a building for educational worthiness. Picus, et. al. (2005) used the superintendent of schools to determine the educational value of the school buildings in their study plus outside consultants to assess the building using maintenance needs instrument.

Some research has indicated the principal is probably the most knowledgeable person about the real condition of the building. Brannon (2000) found that the knowledge principals had about the condition of the school building far exceeded that of anyone else in the school system, including the superintendent. In Brannon's study the superintendent of schools, director of maintenance, and the principal of the individual school building all assessed the condition of the school building using the same instrument. The results of these data sources were compared with the assessment of the building by an independent educational consultant. The assessments of the principals correlated with the assessments of the independent educational consultant to a greater degree than the rest of the individuals. Principals of a school building are knowledgeable about the condition of the school building because they live with it each day.

## DO THE STUDENT ACADEMIC SCORES ACCURATELY MEASURE STUDENT LEARNING?

### Student Achievement Scores

The reason some of the latter research on school building condition and student performance has not been able to report a significant relationship or have found a diminished difference between student academic scores might be the use of a measure other than actual student scaled scores on a standardized test. The studies that showed the most robust difference in student achievement scores were completed in the decade 1990-2000 (Hewitt, 2017). Such studies as Edwards (1993), Cash (1993), Earthman et. al. (1996) Hines (1996,) indicated differences of student scores from 3% to over 10%. Whereas the studies, such as Lanham, (1999), O'Neill (2000), Lair (2003),

Crook, (2006), Bullock, (2006), O'Sullivan, (2006), Wilson (2008), Fuselier, 2008) completed in the next decade, after the passage of the No child Left Behind (2001) legislation indicated a smaller difference in student scores. The reason for these diminished differences in student scores may well be the result of the change in reporting student scores. Additionally, many of the tests are directly aligned to the state curriculum and the teaching/learning is more intentionally focused on the test may well influence results of comparison.

### **CAN SUBSTITUTE MEASURES OF STUDENT ACIEVEMENT BE SUCCESSFULLY UTILIZED?**

Recently some states have used and reported the percentage of students in a class who have passed the standardized academic test rather than actual student scaled scores. The percent of students passing is a gross measure that does not accurately measure student achievement as such. Rather, it is simply a measure indicating how many students achieved a certain score on the assessment instrument. In addition, some states permit students to re-take the examination or assessment if they do not pass it on the first administration. Of course, this practice is very sound educationally, because the student is given repeated opportunities to achieve a passing score. Such practices, however, do not provide accurate data for the researcher, but on the contrary provides for contaminated data for the researcher. Some students score well above the passing mark on the assessment instrument, and other students just meet the passing mark, yet all are considered as passing the examination at the minimal passing score. These test reporting practices may be sound pedagogical practice, but do not provide the researcher with data that can be precisely compared.

Student performance is normally judged on the actual score of students on a standardized achievement test that is norm referenced (Creighton, 2007). Such scores are normally given for each sub-test of the instrument as well as a composite score for the entire instrument. As can be seen, the percent of students passing an examination does not compare in accuracy with actual student scores on a standardized test. Researchers often have to be content, however, with using the percent of students passing as a measure of achievement for the entire school because the school system may not publish any other data. Some of the research studies that have been completed in the latter part of the past decade have been required to use the percent of students passing as the measure of achievement because that is the only student achievement measure available (Bullock, 2007; Crook, 2006) Such studies have found a difference in the percent of students passing when comparing student achievement in schools assessed as being in either poor or good condition, but the differences have been more diminished than the researchers before 1997 have found. Using the percent of students passing may contribute to diminishing differences in student achievement scores and result, in some studies, to find no statistical significant difference. This could well explain the inability of the researcher to find any difference in student scores.

Can substitute measures of student achievement be successfully utilized?

### **WHAT STATISTICAL PROCESS IS BEST UTILIZED TO DETERMINE SIGNIFICANT RELATIONSIPS?**

#### **Statistical Procedures**

For the most part all of the studies dealing with the relationship between school building condition and student achievement have used the same statistical analysis of the data. The normal process is to identify the independent variable which is the condition of the school building or the



age of the structure. Data on the condition of the school building is obtained by various means and by using various assessment instruments. All methods of obtaining school building data assess the building in some way of the other. These data usually become the independent variable (Earthman, 2017).

The dependent variable is normally data from some measure of student performance or academic outcomes. These measures vary considerably from nationally normed instruments to state normed instruments and in some cases teacher grades. These data can also be supported by using student attendance data. Duran-Nurwicki (2008) in a study comparing school building condition with student attendance and student achievement in New York City found a high correlation between the two dependent variables of student attendance and student achievement. In addition, she found that both student attendance and achievement had a significant difference between scores of students in buildings that were in good and poor condition. She stated that attendance rate could be a highly predictable substitute or surrogate for student achievement when student scores are not available. The rationale Duran-Nurwicki used was that students learn while in attendance at school and do not learn when absent. Although student attendance percentage are not the same as student scaled scores, the percentage of attendance can be used as a measure of comparison to building condition to indicate differences in attendance of students in building rated as being in either poor or good condition.

Normally, in studies dealing with the relationship between building condition and student achievement, the dependent variable of student mean scores on academic measures in the two types of buildings are compared using either a t-test of independent samples. If more than two variables are used an ANOVA is employed to determine significant differences in scores of students enrolled in good or poor school buildings. These two statistical procedures seem to be the appropriate ones to use where two or more variables are compared to one another (Roval, Baker, & Ponton, 2013). In at least one study (Lewis, 2001) the researcher used a different method of comparing scores and could not find a significant difference in student scores. To define relationships of two variables, correlation analysis or regression analysis is normally used. This type of analysis is not normally employed in studies dealing with more than two variables.

In studies dealing with the relationship between school building condition and student academic achievement that have not controlled for such confounding variables as student minority status, percent of students in poverty, quality of the teaching staff, community factors or similar variables the findings have been slightly different. The findings of studies that did not control confounding variables are not considered as robust as the findings of studies that did try to control confounding variables. Nevertheless, many of these studies found significant differences in student achievement scores.

If the preponderance of the studies dealing with the relationship between school building conditions and student achievement has used the same or similar statistical methodology to determine difference in student scores, it would seem that the statistical methodology does not contribute to differences in research findings of studies that did and did not find a significant relationship in student scores. Something other than statistical methodology would be the contributing factor. This factor could well be in the manner in which the school building is assessed and categorized

### **Size of Findings**

Some researchers have suggested that the amount of differences in student achievement scores of students in good and poor buildings is insignificant. (Picus, et. al., 2005) The size of

findings of many researchers ranges from 3% to 17%. Even accounting for the outliers, many researchers (Bullock; 2007; Cash, 1993; Crook, 2006; Earthman, et al, 1996; Edwards, 1993; Hines, 1996; Lanham, 1999; O'Sullivan, 2006; Taylor, 2009) have found differences in student achievement scores ranging from 3% to 10%. Although these differences may seem small when compared to the overall variances by which student learn, one must realize that the school system can account for only a small percent of the variance. Berliner (2010) suggested the school can account for only about 20% of the variance in student achievement, while the parents, community, and other out of school factors account for more than 60% of the total variance (Berliner, 2010). If one accepts this ratio of variances then the 3-10% variance accounted for by the building condition seems to be much more significant than initially thought. The 20% variance that can be attributed to the school accounts for not only school buildings but also teacher quality and turnover, financial ability of the school system, availability of a constellation of school programs and services for students.

Of course, the school building condition is something school authorities are responsible for and can improve. The 60% variance attributed to the family and community is almost impossible to modify by the school organization. The school system does not have much control over the 60% variance contributed by the parents, home environment, and the community in which the student lives. When all of the school related variances in student learning are considered, perhaps 3%-10% of the student variances schools can account for seem more important.

In addition, the measures of differences in student scores that are reported in various research studies are simply a snap-shot of one year. When students spend more than one year in a school building rated as being in poor condition, the effect of the school building condition can be multiplied by every year. It is virtually impossible to measure the influence a school building in poor condition has upon students over a period of years because of the movement and maturation of students and possible changes in the building. Nevertheless, it can be assumed that the influence is cumulative.

## **SUMMARY**

Human beings instinctively believe that the physical environment influences their behavior as well as their thinking. The physical environment of the buildings that have been constructed can especially influence the users of the building. Winston Churchill is reported to have said we shape our buildings and thereafter the buildings shape us (Churchill, June 28, 1943). That said, however, trying to measure how our buildings influence the users is very difficult. Perhaps the reason is that researchers can use only the available data on human subjects which are variable at best.

Social science research is never as precise as in the so-called hard sciences. Measuring the influence of anything on humans is definitely less precise than measuring the strength of a metal. How an individual perceives the physical environment is very individualistic and changeable in nature. Yet, respectable research has indicated the condition of a school building can influence the performance of students. Students spend a great deal of time within the school building and because of that the building can have an influence upon them. In addition, students are young and very impressionable and the influence could be more pronounced for them.

Researchers have investigated the possible relationship between school building conditions and student health and productivity for many decades. A goodly number of researchers have found evidence of a significant difference in student achievement scores between students in buildings assessed as being in good and poor condition. These researchers report that there is a 3%-10% difference in student scores in buildings in good and poor condition. That percentage may seem

small at the outset, but when compared with the variance in student learning that can be attributed to school influence, these percentages are of importance. At least these percentages represent an area in which the school authorities have control.

There are some researchers who have not been able to find any significant difference in student scores when the students are enrolled in buildings assessed in good and poor condition. This does not mean there is no relationship between school building condition and student performance. It simply means that their data did not show any significant differences in student scores, because of methodological differences. The old saying that “absence of evidence is not necessarily evidence of absence” holds true in these cases (Burl, 2007, p.194).

The obvious reason for the difference in findings may reside in how data are gathered and treated in these various research studies. It would seem that methodological variations could explain why some researchers find significant difference in student scores in good and poor buildings while other researchers do not report any significant differences. These methodological differences may be found in a variety of data gathering methods. These differences seem to be related to how a school building is assessed, who assesses the school building, how the researcher develops two pools of buildings that are in either good or poor condition, student achievement assessment, and the lack of uniformity in student assessments. These variations may not be exhaustive, but seem to explain why there are differences.

The use of engineering type instruments to assess a school building for research purposes may not be the best instrument to use. Assessment instruments where the items of the instrument are research based have produced more robust findings than the use of an engineering type instrument. The reason given is that the engineering type instrument measures many elements that are not directly related to student learning and may marginalize those items that do have a direct relationship to student learning.

The individual who does the actual assessment of a school building condition is very important for good data results. Research has indicated that the principal is the individual who has better knowledge of the educational adequacy of a building than anyone else. This has been demonstrated by research findings and high inter-rater reliability between the building assessment of the school principals and other assessors.

The division of the assessed school buildings into two groups for comparing student scores is crucial in obtaining significant differences. Research has indicated that comparisons of student scores in buildings in the top and bottom quartiles of the list of school buildings produces better results than by comparing the top and bottom half of the total school building population. There apparently is little difference in the condition of schools in the middle of the building pool.

Finally the student achievement scores used in comparing students vary considerably. Many of the state assessments are state normed and the results cannot be used effectively in a meta-analysis. Many states report only the percent of students passing as the measure of student success. This measure is very gross and does not accurately measure student achievement. Because some states report only the percent of passing students the actual achievement of individual students is marginalized and merged towards the mean. In addition, all states now use a state adopted assessment instrument and this makes it difficult for researchers to develop a regional or national school population. All of this diminishes the rigor of research studies concerning the relationship between school building condition and student achievement.

All in all, the differences in methodology utilized in the studies on the relationship between school building conditions and student achievement do produce differences in findings. It is inevitable that if a school building is assessed in a way that marginalizes the differences between those elements of the school buildings that previous research has indicated to have a direct influence upon student learning, the researcher will have difficulty in finding significant differences in student achievement scores. In all of the studies analyzed by researchers, reviewing the existing research, the methods of assessing the school building is probably the most important measure of the study that will determine the findings of the study.

There is an ethical side to the reporting of research findings that needs to be observed by all researchers. Data obtained in a research study can demonstrate that there is a difference in student test scores or the data can show no relationship. If a difference in student scores is found, this would indicate that the independent variable might have an influence upon the dependent variable. Conversely, a researcher might find no difference in student achievement scores. This does not indicate there is no difference in the student test score, simply that the set of data utilized by the researcher did not show a difference. The researcher must then state that the data did not show a difference. However, the research cannot say with any certainty that there is no difference in student scores. To state that is going beyond what the data indicates.

The preponderance of research studies on the subject of the relationship between school building condition and student achievement indicate a positive relationship (Hewitt, 2017). Students attending school in buildings that are assessed as being in poor condition do not perform as well as students in school buildings assessed as being in good condition. The amount of difference ranges from 3 percent to 10 percent. This is a very astonishingly high ratio of difference in achievement scores. Additionally, students may attend school in such school buildings over a period of years and thus the discrepancy in achievement scores could well be multiplied many times. Yet, many students attend schools that are in poor condition and that is something school authorities can correct.

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