Michigan Elementary School Facility Quality and Its Impact on Student Achievement

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MICHIGAN ELEMENTARY SCHOOL FACILITY QUALITY
AND ITS IMPACT ON STUDENT ACHIEVEMENT

by

Brett A. Geier

A Dissertation
Submitted to the
Faculty of The Graduate College
in partial fulfillment of the
requirements for the
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Dr. Sue Poppink, Advisor

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Studies on school facility quality and its impact on student achievement have been conducted throughout the nation with varying results. Some studies conclude a significant relationship exists between facility condition and student achievement, while others refute this potential phenomenon. Much of the research concludes that not enough analyses have been conducted to make appropriate generalizations. This research study focused on the condition of elementary schools in Michigan and utilized the Michigan Educational Assessment Program (M.E.A.P.) examinations in reading and mathematics at the third, fourth and fifth grade levels as the dependent variable to assess the relationship between building condition and student achievement. Three independent variables (socio-economic status, student density and median income) were used in addition to building condition to control for the other elements that are representative of the factors that comprise a student’s education.

This research study defined the condition of elementary schools in Michigan, determined if any significant difference exists in building condition among the geographic regions of rural, urban and suburban using multiple definitions of building condition, analyzed the variance of student achievement attributed to building condition
and defined what areas are in the greatest need of repair as identified by the respondents on the survey.

Key findings were that Michigan schools have buildings that are in definite need of repair and there are significant discrepancies in the quality of buildings among rural schools and its counterparts. In order to compare the three geographic areas in terms of building condition, an analysis of variance was employed for each building condition variable. Using a multiple regression technique, it was determined that building condition contributes very little to how students achieved on the reading and math M.E.A.P. examinations at the third, fourth and fifth grade levels. Finally, pie charts are presented by geographic region that describe the responses from the principals as to what features are in most need of repair.
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Brett A. Geier
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CHAPTER I
INTRODUCTION

Background of the Study

The Built Environment and Student Achievement

Education in the United States has changed dramatically over the past decade. Mandates from the federal and state government regarding student achievement have caused much concern among educators. All schools are attempting to adjust instruction based upon standardized test scores to meet the ever-increasing requirements imposed by the state and federal governments. However, the potential penalties implemented by the No Child Left Behind Act (NCLB) of 2001 puts increasing pressure on all schools to attain certain standards or risk losing funding and/or even being restructured by state entities. In addition to the governmental requirements that educators are forced to comply with, schools are encountering children with increasing problems unrelated to pedagogical programming. Societal issues, such as many students from single-parent homes with low socio-economic status, affect how students perform. Recognizing the fact that schools are limited in how much they can control societal issues, it becomes ever more important for schools to provide the most effective and efficient education possible. This means developing appropriate curriculum, providing beneficial experiences, employing competent instructors, and many other elements that most experts would agree compose a quality school. However, one variable that is often overlooked by researchers, yet may be one of the most crucial factors in providing an appropriate education, is the condition of the facility in which students receive instruction.
Jonathan Kozol (1991) described in graphic terms the differences in the quality of school facilities among school districts in his book *Savage Inequalities*. Joe Fernandez (1993) described the importance of clean, well-kept school facilities. Almost a half-century ago, the famous psychologist Abraham Maslow investigated the behavior of subjects in three different rooms: a "neutral" control room; a "beautiful" room; and an "ugly" room. Observations revealed that the subjects in the "ugly" room performed in measurably different ways from the others. Maslow concluded that the "ugly" environment produced feelings of discontent, fatigue, and a desire to escape (Tennessee Advisor, 2003).

Analysis and observation suggests that the physical environment an individual lives, works, or attends school in impacts the success of the individual. If that is the case, then it is critical to analyze the impact the built environment has on the achievement of students in schools.

A compelling question that often arises regarding the physical building and student achievement is the effect the quality of the building has upon the performance of students. Many educators and architects believe that building quality impacts student achievement. The remaining concern is the degree of influence and what model can be created to detect any statistical significance. Picus, Marion, Calvo, and Glenn (2005) state, "Conventional wisdom suggests that a school's physical environment has an impact on student learning…" (p. 73) However, Picus et al. (2005) qualifies the declaration by saying, "…researchers have had difficulty demonstrating statistically significant relationships between the physical environment and student outcomes" (p. 73).
In recent years, the number of studies analyzing the potential relationship between building condition and student achievement has increased. While there has been some promise as to identifying a statistical significance between the two factors, researchers agree that not enough studies have been completed to identify strong relationships so generalizations can be made (Picus et al., 2005; Earthman, 1998). There are several reasons why these types of studies have struggled to become accepted research. First, many of the studies that have been conducted do not present conclusive findings. That is, when the study has been completed, there are still many questions that remain unanswered. Secondly, when one disaggregates building condition, the characteristics that define building condition are somewhat difficult to separate. Lastly, controlling for confounding variables is of the utmost importance when one analyzes building condition and student achievement. While the number of studies has increased over the past several years, there are a number of variables that could be responsible for student learning that are unrelated to building condition, thus causing results that are inaccurate and can not be generalized.

The condition of a facility can amplify the perception the school has toward educating students, and in many cases this can be perceived by the students upon immediate entry into the building. A child’s enthusiasm can be tempered or destroyed by the condition of the building. When a student enters a building that is in poor condition, the perception exists that the staff and faculty care very little about the learning environment, and that lack of concern translates into a lower standard of expectation for the organization. If a lower standard is the perception, then it is all together possible that a student or students will meet toward that expectation. Conversely, if a building meets a
high standard of quality, then the students may be more inclined to exceed expectations. Indeed, if the community in which the school is located articulates a perception that is in contrast with the actual condition of the facility, then a mixed message is sent, which is just as influential as the other examples.

Over the past seventy years, there has been an enormous amount of research attempting to correlate student achievement with the condition of the building. Researchers have conducted many studies to investigate the influence of various building components such as wall color, windows, HVAC (heating, ventilation, and air conditioning), pupil density, configuration, and furniture types upon student achievement in the desire to discover a relationship. The efforts of these researchers have been valuable in that many of their discoveries have been incorporated into the designing of new school buildings across the United States.

If there is a significant relationship between student achievement and facility quality, then it is ever more important to provide appropriate learning facilities for all students. As Earthman (1998) discusses:

...considerable improvement in the type of new school buildings have resulted. Students and teachers obviously have benefited from the infusion of research findings in new buildings. Yet the majority of students in the United States are not housed in new school buildings. The vast majority of students are in older buildings, many of which are approaching 50 years of age. These buildings do not, for the most part, have the essential components that have been found to be necessary for a good learning environment (p. 2).
In 1996, the United States General Accounting Office completed a report that described the condition of America’s schools (Health, Education, Human Services [HEHS], 1996). The report highlighted the fact that over one-third of the school districts reported needing extensive repair or replacement of one or more buildings. This one-third of U.S. schools services nearly 14 million students. At least 60% of America’s schools reported one major building feature in disrepair, needing to be extensively repaired, overhauled, or replaced. Most of these schools had multiple problems that qualified their buildings as major safety hazards. Many of the school districts that reported problems stated they had deferred vital maintenance and repair expenditures from year to year due to lack of funds.

**Michigan Schools**

To focus this analysis more precisely, school facilities in the State of Michigan will be reviewed as to their quality and adequacy for appropriate learning. The United States General Accounting Office reported a variety of descriptive statistics that highlighted many of the facility issues across the nation (HEHS, 1996). Michigan was a part of that report. In Michigan it was ascertained that 21.6% of all school districts reported at least one inadequate on-site building. The percentage rises to 51.8% for buildings reporting at least one inadequate feature. Inadequate features for this report were categorized as roofs, framings, floors and foundations, exterior walls, finishes, windows and doors, interior finishes, plumbing, HVAC (heating, ventilation and air conditioning), electrical power, electrical lighting, and life safety codes. Table 1 is a descriptive summary of the previously listed characteristics as reported as unsatisfactory in Michigan.
Table 1

*Estimated Percent of Schools with Inadequate Building Features in Michigan* (HEHS, 1996)

<table>
<thead>
<tr>
<th>Roofs</th>
<th>Framing, Floors and Foundations</th>
<th>Exterior Walls, Finishers, Windows and Doors</th>
<th>Interior Finishes</th>
<th>Plumbing</th>
<th>HVAC</th>
<th>Electrical Power</th>
<th>Electrical Lighting</th>
<th>Life Safety Codes</th>
</tr>
</thead>
<tbody>
<tr>
<td>20.3%</td>
<td>10.6%</td>
<td>22.2%</td>
<td>18.3%</td>
<td>21.8%</td>
<td>28.9%</td>
<td>24.2%</td>
<td>23.1%</td>
<td>13.4%</td>
</tr>
</tbody>
</table>

To further disaggregate the report, HVAC is divided into several components that comprise a category entitled environmental conditions. In Michigan 44.6% of all schools in 1996 reported one to four unsatisfactory environmental conditions in a school building. Table 2 is a description of the characteristics that define the environmental conditions for the USGAO study and the percentage of schools reporting an unsatisfactory condition.

Table 2

*Estimated Percent of Schools with Unsatisfactory Environmental Conditions in Michigan* (HEHS, 1996)

<table>
<thead>
<tr>
<th>Lighting</th>
<th>Heating</th>
<th>Ventilation</th>
<th>Indoor Air Quality</th>
</tr>
</thead>
<tbody>
<tr>
<td>12.0%</td>
<td>16.7%</td>
<td>25.3%</td>
<td>15.4%</td>
</tr>
</tbody>
</table>

As can be seen by the statistics provided in the GAO report (HHES, 1996), these are significant issues for Michigan as the state tries to provide appropriate facilities for children. If the facility has an impact on the achievement of students, then it is imperative to provide the best learning environment for students. Unfortunately, the concept of facility quality is tied directly with the financial status of the state and local districts. Since millions of dollars must be allocated for construction or maintenance, it is critical
that any correlation between student achievement and the quality of the facility be identified to justify its importance in the state and local school district budgets.

Funding Sources and Concerns for Facility Improvement

In the State of Michigan, funding for K-12 schools is based upon Proposal A, which was passed by the voters in 1994. Proposal A was designed to provide more funds for schools and bring about greater equity in terms of per pupil expenditures. However, Proposal A is a system of financing whereby the source of funding for schools relies greatly on the economic condition of the state. Therefore, the economy of the state can cause major adjustments in the amount of revenue available. If the economy is in a recession, then the funding source (a variety of taxes collected by the state) is severely limited compared to the funds available in a robust economy. In many school districts over the past five years, schools have dramatically reduced the expenditures due to the downturn in the state economy. Items that are often a first choice for reduction are the maintenance, repair, and construction of buildings. Yet, if it can be demonstrated that the quality of the facilities impacts student achievement, then it is important to reassess budgets and the manner in which monies are allocated for infrastructural improvements. The only other sources from which Michigan schools are able to raise revenue for facility construction or improvements is to have the voters of a local school district approve a bond issue, sinking fund or a recreational millage. Yet again, inequities exist because funds are raised based upon the taxable value of the district. If a district has a higher aggregate property tax value than a lower valued district, then the higher valued district is not required to levy as many mills to raise the amount of a lower valued district. As Michigan struggles to provide adequate financial resources to its districts, Picus et al.
(2005) believe that, "Understanding the impact of facilities on student learning will help policymakers determine the cost effectiveness of this undertaking." (p. 73) Thus, financial resources can be allocated appropriately to maximize the impact on student learning.

Statement of the Problem

In summation, schools across the nation are in very poor condition and Michigan is no exception. According to the data presented in the USGAO survey, many of Michigan’s schools have numerous characteristics that prevent them from being considered a quality facility. The cost of repair, renovation, or new construction is high, and with all of the additional fiscal pressures placed on local school districts, maintenance and construction costs are often delayed for future years. Because the budgets for these areas are so costly, it is important to isolate what impact a facility has on the achievement of students in a particular building. As any educator who is responsible for developing a school budget realizes, expenditures must impact student achievement positively, and those expenditures that do not will be deferred until budgets permit, or are forgotten altogether. Therefore, if the condition of the building significantly impacts the achievement of students, it is important to determine the amount of variance associated with building condition, so that budgets can be managed more appropriately, and electorates can understand the significance when deciding whether to support tax increases in support of renovation or new construction.

A general overview of student achievement as a function of building condition shows that there are many variables that define the phenomenon. As Picus et al. (2005) summarized, researchers would ideally like to control for a host of other factors when
analyzing building quality and student achievement. Because all of these factors can not be controlled for, drawing definitive conclusions is very difficult. In this study the main independent variable will be building condition. Building condition incorporates many attributes like wall color, plumbing, and roofs to name a few. A possibility exists that building condition is related to the geographic area it is located. Whether the building is considered urban, suburban, or rural may impact the condition of the school.

Building condition is a critical component of education in Michigan because as buildings continue to deteriorate they will need to be remodeled, renovated or constructed. This takes numerous financial resources to complete this task. With the economy in Michigan struggling, justifying the expenditure is important. As previously discussed in this chapter, the manner in which facilities are financially constructed in Michigan is limited. Appropriate school buildings are quite costly, and when options to construct them are limited, quality research must be available to support the need for new school buildings. If there is not significant research that supports building condition as a major factor influencing student achievement, then it is possible that policymakers should allocate the resources to other initiatives.

The dependent variable of student achievement in math and reading on the third, fourth, and fifth grade M.E.A.P. has many factors that determine the success of the students on the examination. Some of these factors are difficult to measure, such as teacher quality. However, three independent variables have been selected to control the variance unrelated to building condition. The three variables are socio-economic status of the students, the median income of the neighborhood in which the school is located, and
student density. Controlling for these variables will help isolate the relationship building condition has on student achievement.

Purpose of the Study

The purpose of this study had several goals related to facility quality and student achievement. The first goal of the study was to create a description of elementary school facility quality in Michigan. This was completed by having the principal of each building in the sample complete a questionnaire that described the overall condition of the building as well as several individual facility characteristics. This information in turn was aggregated to provide an overall depiction of the condition of elementary school facilities in Michigan. Also, it highlighted the percentage of schools that reported inadequate building features in the same manner as the US GAO (1996) study except it was disaggregated by geographic location.

A second goal of this study was to determine if the condition of elementary schools in Michigan differed based upon its geographic location. Geographic location was defined as a school located in a rural, urban or suburban community. Determining whether building condition is statistically different depending on its geographic location is important as a component of building condition because if buildings are significantly higher or lower in quality in certain regions, then it is possible that only buildings in a certain geographic location are of adequate quality.

The third goal of the study, and the primary interest of this study, was to determine if building condition impacts student achievement, and if it does to what extent. The uniqueness of this model is that several independent variables have been accounted for as student achievement incorporates a variety of factors that could
potentially impact the outcome. The independent variables besides building condition that are being controlled for in this study are socio-economic status, the median income of the area the school is located in, and student density. These variables have been highlighted in literature as having a significant effect on student achievement.

The final goal of the study was designed to solicit responses by the principals who completed the survey instrument to determine the areas that are in the greatest need of repair in his or her respective building. This data was placed into pie charts to give an illustration of the primary areas in need of repair in Michigan elementary schools. This information can be cross referenced to determine if the areas in need of correction identified by the principals correlate with the building conditions identified by the survey instrument and prior studies.

This study addressed the following issues: (a) the condition of elementary schools in Michigan, (b) the condition of elementary schools depending upon their geographic location, (c) the areas in most need of repair, and (d) the relationship between the quality of the facility and student achievement. The study, therefore, will be guided by the following questions.

Research Questions

Question 1

What is the status of quality of elementary school buildings in the State of Michigan?

Question 2

Does the quality of school facility vary by urban, rural, and suburban location?

Question 3
Is there a relationship between the facility quality of an elementary school and student achievement as demonstrated on the Michigan Educational Assessment Program (M.E.A.P.) in reading and mathematics at the third, fourth, and fifth grade levels?

**Question 4**

What are the three primary needs as identified by the respondents on the survey that are in need of repair in elementary school buildings in Michigan?

**Research Problem**

This study has multiple reasons for having been conducted. Many school facilities are reaching their life expectancy as quality learning environments. In fact, many of the studies regarding this topic are obsolete because they were based upon the open schools movement of the 1970s and are no longer relevant (Picus, et al., 2005). Therefore, simply providing new research is critical in order to make appropriate generalizations. If the facility in which students learn impacts how they achieve academically, then it is essential to be able to effectively assess to what degree.

The phenomenon this study addressed was what impact school facility quality has on student achievement. This question has been addressed by various researchers with mixed results. What is definite to these researchers is that not enough studies have been completed that would allow for appropriate generalizations to be made and some of them like Earthman (1996) contend that certain models for assessing this relationship have been exhausted. Therefore, this study adds to the body of literature a new model of assessing this phenomenon that incorporates multiple independent variables as well as various building conditions. Previous studies have not utilized the model in this study, nor have they always taken into account the numerous building conditions that are
present. This analysis controls for variables that are highlighted as significant predictors of student achievement, yet have not always been controlled for simultaneously in previous studies. Those independent variables are socio-economic status, median income of the area the school is located in, and student density. Other researchers have conducted studies that attempt to make correlations, singly, between the various independent variables and student achievement. The effects these variables have on student achievement are presented, and by controlling for them, it not only brings clarity to the effect building condition has on student achievement, but also demonstrates, independently, the impact these independent variables have on the success of students.

This analysis specifically utilized Michigan elementary schools as the source of the sample. A description of the condition of Michigan’s elementary schools has been conducted, and this description is disaggregated by geographic region (rural, urban, suburban), not typically identified by researchers analyzing this subject. Therefore, a broad and specific description of elementary school facility quality in Michigan is presented.

Lastly, this study allows for the respondent of the survey to highlight the building conditions he or she believes are important to correct in order for the building to reach an acceptable learning standard. This is more of a qualitative approach, which allows the respondent to give precise features of the building that need improvement. These responses can be correlated with building condition as reported on the survey instrument, as well as the 1996 USGAO study, which detailed the percentage of schools that reported inadequate building features.
Conceptual Framework

The conceptual framework is essentially a map of the variables that will be taken into consideration for this particular study. The primary independent variable that is being addressed in this study is building condition. As can be seen in Figure 1, building condition incorporates a variety of factors labeled as structural and cosmetic. Beyond that, the analysis looked at the geographic location the building is in as a potential factor in the condition of the building. Some research indicates that building condition might indeed be correlated with its location geographically. Student achievement incorporates many factors, and some of the variables must be controlled in order to get a more sensitive analysis leading toward answering the question about building condition affecting student achievement. Through the course of analyzing other studies of this nature, it has been determined that socio-economic status, median income of the area, and student density are highly significant variables in student achievement. Therefore, these three variables will be controlled in the study as factors in student achievement.
Figure 1. Theoretical Concept Map Underlying Research Design

**STRUCTURAL**
- Building Age
- Windows
- Flooring
- Heating
- Air Conditioning
- Roof Condition
- Ceiling Coverings
- Lighting
- Acoustics
- Roofs
- Framings
- Foundations
- Exterior Walls
- Doors
- Finishes
- Plumbing
- Electrical Power
- Ventilation

**GEOGRAPHIC LOCATION**
- Rural
- Urban
- Suburban

**BUILDING CONDITION**
- Above Standard, Standard, Below Standard

**COSMETIC**
- Interior Wall Paint
- Exterior Wall Paint
- Vandalism
- Vandalism Repaired
- Classroom Furniture
- Condition of Grounds

**STUDENT ACHIEVEMENT**
- Percent of students in 3rd, 4th and 5th grades attaining proficiency on the MEAP test in reading and mathematics

**SOCIO-ECONOMIC STATUS (SES)**

**STUDENT DENSITY**
- Median Income for the area in which the school is located
Limitations and Delimitations

The primary limitation to this study is the manner in which the condition of elementary school buildings are evaluated. In this study several building condition factors are evaluated by the principal of the building. This was done because principals are the most accessible personnel that have the most knowledge about the building and how it affects student achievement. However, it could be argued that the principals are not experts in building condition. In order to make the declaration that the condition of buildings has been expertly assessed, would require personnel trained in school facilities to conduct on-site reviews.

Picus et al. (2005) summarized in their introduction that capturing how much building condition affects student achievement is difficult because of the multitude of variables that are a part of educating children. As stated previously, in addition to building condition, three independent variables were selected based upon the literature’s assessment of their significance in affecting student outcomes. However, there are numerous other variables that could potentially affect student achievement. A variable that is very significant, yet is not controlled for in this study, is teacher quality. Teacher quality may be one of the most significant variables to affect student achievement, however, capturing the variance associated with it is arduous and potentially too subjective. Therefore, the many variables associated with student achievement could potentially affect the outcome of the analysis.

As with most studies, the greater the size of the sample, the more sensitive the statistical analysis will become, allowing for more accurate results to be obtained. This particular analysis had a total of 90 schools participating in the survey with 30 divided
among the strata of rural, urban and suburban. An increase of sample size would be potential benefit to the study. Along with that, only elementary schools were selected for participation in the study. A large number of facilities were excluded from the study such as middle schools and high schools, primarily because standardized testing options have changed in the last year, with high schools going from the M.E.A.P. examinations to the American College Test (A.C.T.) as an evaluation of student achievement. Middle School assessments have been changing somewhat over the past few years creating some issues in terms of alignment with curriculum, which may affect the outcome on the test.

The final delimitation for this study is in the area of subjects examined for student achievement. This analysis looked at the subjects of reading and mathematics as the focus of student achievement. These subjects are typically the subjects that most consider the most relevant to a sound education. However, there are other subjects that are tested on the M.E.A.P. examinations such as science. As science is very lab oriented subject, it could by hypothesized that better science facilities could yield better achievement results. In addition, correlations could prove that students who are proficient mathematics and reading students are more proficient at science and other subjects. Thus, it seems that reading and mathematics are the most prudent subjects to examine.

In summary, this particular analysis has several limitations and delimitations, which cause careful consideration of the results. The primary obstacle to this type of analysis, as previously stated, is the numerous and abstract characteristics that compose the education of students. Many of the variables that are incorporated into the education of students are quite difficult to measure, yet still play a major role. Therefore, as a study
of this nature is created, careful consideration must be given to previously mentioned issues.
CHAPTER II

LITERATURE REVIEW

The literature review analyzes the research that has been conducted on the variables that will be employed in this study. The variables that will be included are the independent variables of building condition, divided into structural and cosmetic conditions, geographic location of the school (rural, urban, suburban), the socio-economic status of the student, the median income of the area in which the school is located, and the student density of the building. The dependent variable for this analysis will be student achievement scores on the Michigan Educational Assessment Program for students in the third, fourth and fifth grades in the subjects of reading and math. The final component to the literature review is an analysis of the research regarding the variable of building condition and its effect on student achievement.

Building Condition

The primary independent variable is building condition. Building condition will be segregated into two categories labeled structural and cosmetic conditions. Items that are representative of structural conditions analyzed in the literature review are: (a) acoustics; (b) building age; (c) lighting; (d) heating; (c) air conditioning; and (d) ventilation. Cosmetic conditions being addressed in the literature review are wall coloring and lighting. This particular study will expand upon the number of items that comprise the components of building condition. However, this literature review will give a representation of the effect several building condition qualities have on student achievement.
Acoustics

One of the more important building features that allows for effective instruction and learning to occur with minimal interference is appropriate insulation against sound. Elementary buildings are alive with hundreds of children actively involved in the multiple programs that comprise an elementary education. According to Bowers and Burkett (1987), there are two kinds of sound that can be isolated in a school building, impact and airborne. In newer or renovated facilities carpeting has benefited controlling noise. Likewise, acoustical treatments now standard in strategic areas throughout the classroom diffuse sound created by those who are conversing. In order for one instructional setting not to be interrupted by another activity, acoustical considerations must be taken into account in facility planning.

In 1979, King and Marans conducted a study that hypothesized that noise factors have very little effect on academic achievement of general education students. They did note that some effect took place in the achievement of handicapped students. Other studies have analyzed the effect noise had on people of certain buildings. Cohen, Evans, Krant and Stokes (1980) addressed the impact aircraft noise had on elementary-aged children in Los Angeles in the areas of attention, feelings of personal control, and physiological processes related to health. The study summarized the impact on children by noting that some of the students had higher blood pressure, less cognitive task success, and greater feelings of helplessness. To support this contention, Evans, Kliewer, and Martin (1991) reviewed a series of studies that showed a significant increase in blood pressure associated with schools near noisy urban streets. These authors followed this premise by describing a 1986 research study conducted by Beglund and Lindvall that
found a relationship between educational facility and blood pressure among middle
school students. They drew attention to the fact that German and Russian students who
attended school near noisy urban streets and airports were found to have increased
systolic and diastolic blood pressure. The students in these studies tended to give up more
easily on tasks and demonstrated more distractibility from the task at hand. A second
study completed by Bronzaft and McCarthy (1975) studied the effect an elevated train
noise had on students’ standardized test scores in New York City. The conclusion
reached in this analysis was that extreme noise did indeed affect reading scores
negatively.

Cohen and Weinstein (1981) further investigated the non-auditory effects noise
has on behavior and health. Non-auditory effects are those reactions that the human body
may have as a result of excessive noise, but manifests itself as a health issue uncorrelated
to the ears. They concluded through a meta-analysis of several other studies that there is a
heightened sense of arousal when people are subjected to moderate and high intensity
noise. This led the authors to conclude that if students are subjected to at least a moderate
level of noise, it adversely affects attention on complex tasks. This contention is
supported further by Christie and Glickman (1980) stating, “It is likely that children’s
performance on many classroom tasks will vary as a function of classroom noise levels”
(p. 408). Further, a study by Chan (1980) demonstrated a positive correlation between
carpeted instructional areas and higher achievement. Hawkins and Lilley (1992) expand
the acoustical concerns by highlighting that instructional areas that incorporate ceilings,
walls, floors, and carpet would be barriers to excessive noise and thus, create more
effective areas for teaching and learning to occur. The logical conclusion is that student achievement would increase.

The overall conclusion that can be drawn from these studies is that acoustical issues do affect human beings in non-auditory ways. Indirectly, noise factors do impact health related issues such as attention, personal control, and even blood pressure levels. If any of these health related factors are adversely affected by acoustical tribulations, correlations can be made to poor productivity for students. Taken one step further, if the acoustics in a classroom are poorly constructed, it can indirectly and directly effect students’ ability to concentrate on the task at hand or cause health issues, thereby causing interference in the learning.

Building Age

The American Association of School Administrators published an article by Holt (1994) commenting on the condition of America’s schools which stated that, “...nearly 5 million students in the United States attended classes in 13,200 classrooms that were inadequate for meeting standards necessary to prepare students for today’s world” (p. 33). Many public school facilities are in disrepair, a situation affecting the morale, health, and academic achievement of students (Frazier, 1993). Schoolhouse in Red written by the American Association of School Administrators (1992), described the maintenance of schools across the nation:

On one hand, the administrators today are faced with more old buildings, which require additional maintenance; and on the other hand, they have smaller maintenance budgets to provide critical upkeep. The price tag for deferred maintenance has quadrupled in just eight years, from $25 billion to $100 billion.
A costly proposition in and of itself; deferred maintenance spawns other costs as it speeds up the deterioration of buildings and the need to replace equipment (p.11).

Chan (1982) summarized his literature review by constructing two postulates concerning the relationship of physical environment and student attitude. The two propositions were: "(a) Man is under the influence of his physical environment; and (b) Pupil attitudes toward school age are influenced by the condition and quality of the building in which he/she is housed" (p. 4). The main premise of Chan's (1982) examination was that pupils housed in modern school buildings have a significantly more positive attitude toward the school building than those students that are housed in older buildings. Newer buildings were found to better meet the student's emotional, physical, and physiological needs.

To assist in supporting the assertion that building age is responsible for the variance in student achievement, Ikpa (1992) found a significantly negative relationship between these two variables. Analysis of the data suggested that as the age of the school building increased, the achievement test scores decreased. Ikpa also discovered that buildings that had larger libraries tended to enhance student achievement. "Increased availability of library books may serve to stimulate students' interests in reading; therefore, enhance performance on achievement test scores" (Ikpa, 1992, p. 30).

McGuffey and Brown (1978) studied the impact of school building age on school achievement in Georgia. The purpose of this study was to examine the relationship of pupil achievement to facility age. The study also controlled for socio-economic status. They found their research supported other similar studies indicating that approximately
3% of the variance in achievement test scores can be explained by age of the facility after removing the variance caused by socio-economic factors.

Garrett (1980) cited a 1978 unpublished doctoral dissertation of Plumley which found a significant relationship existed between the academic achievement of all fourth grade students in Georgia public schools and the age of the facility in which their learning occurred. A positive variance of 5.3% in achievement on the Iowa Test of Basic Skills was accounted for by the environmental variable, modernized buildings.

Bowers and Burkett (1987) researched the academic achievement of 280 fourth and sixth grade students housed in separate school facilities in Tennessee. The two facilities were the oldest and the newest facilities in the selected school district. A significant correlation existed between students at the two elementary schools in regard to the relationship between the physical environment and student achievement. Scores in reading, listening, language, and arithmetic showed a significant difference, with the students in the modern building performing much better than the students in the older school. The students in the modern building also had a better record in the areas of health, attendance, and discipline.

The age of a school building provides a general overview as to the potential condition it represents. Typically a building that is older has more issues that are in need of repair, which reflects a building in poor condition. Thousands of classrooms across the nation are considered inadequate for meeting today’s educational standards. Most of these classrooms in poor condition are more than 50 years old. The research that has been conducted lends credence to the argument that building age is a factor as to how well students achieve academically. The studies that have been reviewed demonstrate that
students, who are in more modern buildings have a more positive attitude about going to school, which leads to increased achievement. In addition, other studies have concluded that there exists a negative correlation between student achievement and building age – as building age increases student achievement decreases. Overall, the literature regarding building age certainly indicates a strong association with student attitude and achievement.

Wall Color

When one enters a school building, the first item that is often seen is the color of the walls. A variety of different colors are often utilized on walls depending upon the philosophy of the school. Some schools attempt to coordinate the color of the walls with the colors of the school. Other school buildings attempt to utilize colors to impact student behavior and learning. Whatever approach a school takes in relationship to the color of the walls, it is important to note that color does impact students and most definitely influences the perception of anyone who enters the building.

Rice (1953) developed a study involving three Baltimore, Maryland schools of similar size, age, teacher-pupil ratio, socio-economic level and need of painting. One school was not painted, one was painted with green walls and white ceiling, and the third was painted according to a manufacturer’s suggestions with bright colors considered to be either warm or cool. The results of this study demonstrated a significant correlation between carefully planned color schemes and academic achievement of elementary students, especially at the kindergarten level. Students were rated on the Satisfactory Behavior and Performance Trait Instrument. Kindergarten students showed a 33.9% improvement in the experimental school, which followed the manufacturer’s suggestions,
and older students improved on average by 10.4% in all subject areas. Rice (1953) also found improved student achievement in buildings where the walls were freshly painted, regardless of the color. Although greater achievement was identified with the pastel colors, even freshly painted white walls were associated with higher student achievement than walls in need of paint.

Eilers (1991) supports the previously described argument by studying the productivity of workers. A change in the color scheme at the Sun-Maid Growers laboratory was followed by improvement in worker productivity and production efficiencies. This positive result was the impetus for changing the color scheme throughout the plant.

Other studies have demonstrated that color influences student attitudes, behaviors and learning (Stinofsky & Knirk, 1981). Stinofsky and Knirk (1981) suggested the most important reasons for using color effectively in a learning environment were that: (a) colors affect on a student’s attention span; and (b) color affected the student’s and teacher’s sense of time.

Papadatos (1973) raised the notion as to whether the proper use of color in schools can convert an atmosphere that is depressing and monotonous into one that is pleasing, exciting and stimulating. He suggested that such a change in schools would not only reduce absenteeism, as it has in the private sector, but would promote positive feelings about schools.

Poyser (1983) cited tests done by Bross and Jackson in 1981 which found that colors that were liked by students influenced their muscular tension and motor control. Hathaway (1988) referred to studies by Wohlforth in 1986 and Sydoriak in 1987 which
associated warm colors with slight elevations in blood pressure in children, while cooler colors caused slight drops in blood pressure. Apparently, warm colors may be used to purposely stimulate activity and conversely cool colors may be used to foster relaxation.

Over the past several years, educational research has concluded that the color of school building walls impacts the psychological state of mind for children. Studies demonstrate that as monotonous color schemes are being replaced by upbeat, pleasing and exciting colors, worker productivity increases and absenteeism decreases. This contention has also been studied in schools and student achievement, with the same results. In addition to the increase of academic achievement, positive health related results such as lower blood pressure for students was also attributed to color schemes in schools.

Heating, Ventilation and Air Conditioning

The category of HVAC is operationally defined as heating, ventilation, and air conditioning. More specifically, HVAC is the category that encompasses the components that control the quality of all air inside the school building. Ironically, many people would analyze the condition of the air in a building as simply the ability to control temperature. In fact, at present day, architects are terribly concerned about not only heating air appropriately but cooling it when necessary and maintaining the cleanliness of it as well. Ensuring indoor air quality that is positive is very important and in many cases for teachers, is of the utmost importance (Phillips, 1997).

A report produced by the Environmental Protection Agency in 2003 brought to the forefront the importance of maintaining appropriate air quality in schools in order to promote positive student achievement. The report made the declaration that data collected
for the report demonstrated that poor indoor air quality, “...may reduce a person’s ability to perform specific mental tasks requiring concentration, calculation, or memory” (Environmental Protection Agency [EPA], 1). Following this notion was the summary that,

Schools should be designed, built, and maintained in ways to minimize and control sources of pollution, provide adequate exhaust and outdoor air ventilation by natural and mechanical means, maintain proper temperature and humidity conditions, and be responsive to students and staff with particular sensitivities such as allergies or asthma. Failure to deal adequately with any of these issues may go unnoticed, but can and often does take its toll on health, comfort, and performance of teachers and students in school (EPA, 2003, p. 1).

This prior statement suggests that not only will HVAC issues impact students’ attention and behavior directly, but more importantly affects the students’ health issues on a long term basis. A report completed by the American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE) in 2003, concluded that upper-respiratory tract infections aided in part by poor air quality accounted for most short-term absences in schools, while allergy, asthma and symptoms of sick-building syndrome contribute to longer absences. Appropriate classroom design and operation can reduce symptom severity and incidence of complaints among children.

Heating

In order for school buildings to remain at a consistent temperature during colder seasons, it is critical that an appropriate heating system be installed in the building.
Temperatures that vary throughout the day can cause inefficiencies on the part of the students. Canter (1976) concluded that while human beings are both very sensitive to and tolerant of irregularities in heating; they work most efficiently at psychomotor tasks when at comfortable temperatures.

Most locations in the United States require school buildings to have appropriate heating systems to maintain a balanced indoor climate. This concept is even more important in schools in Michigan. Michigan’s climate can range from subfreezing temperatures to over ninety degrees at certain times of the year. For those periods that do not incorporate the few weeks in the summer when students are on vacation, an appropriate heating system is vital to maintaining a level of comfort that is conducive to a positive learning environment.

*Air Conditioning*

The antithesis to providing appropriate heating in school buildings is establishing an air conditioning system that cools classrooms in warm weather. It must be noted, however, that in many school buildings, air conditioning is not uniformly constructed because of cost constraints or geographic location. A study conducted by King and Marans (1979) determined that temperature, humidity and air movement have an impact on student performance. As temperature and humidity increased, achievement and task performance deteriorated, attention spans decreased, and students reported greater discomfort. Cooler classroom temperatures were associated with feelings of increased comfort, activity and productivity. To build on these findings, Bowers and Burkett (1987) conducted a five month study to determine the psychological effects of the thermal environment on performance of workers placed in duplicate wings of a government
building. One space was air conditioned and the other was not. The results showed an average work increase of 9.5% in the air conditioned building, an error reduction of .9% and an absenteeism decrease of 2.5%. 

Maintaining an optimal temperature in classrooms is very important in assisting students' comfort level. As temperatures deviate more and more from a most favorable climate, students become less comfortable causing them to be less productive academically. This premise is supported by other supplementary research in the business world, where employees' work production increased when air conditioning was present in warm conditions.

*Ventilation*

While maintaining a balanced temperature is important in classrooms, ventilation may be an even more important variable that affects the quality of the air in the room. Quality of air affects student achievement because it affects the health of the students. Air in a classroom contains a number of micro-particles that can adversely affect the health of the students either in the short term or the long term. Dust mites, dander from animals, and fungi/mold can all become a part of the air that is breathed by the students. This contaminated air can become a health risk to the students that are susceptible to respiratory infections, and even to those that are considered healthy. As ASHRAE (2003) commented, "...upper-respiratory tract infections account for most short-term absences in schools, while allergy, asthma and symptoms of sick-building syndrome contribute to longer absences" (p. 71). This statement supports the contention that air quality indirectly affects student performance because of the health of the students, and certainly healthier students will perform better in school. Within the same report, Dr. Wyon stated,
“Improving classroom ventilation can thus be expected to reduce the incidence of such symptoms and therefore reduce absenteeism, increasing school performance” (p. 71).

A study completed by Tortolero et al. (2002) supported the assertions relating air quality to student achievement. This group of authors completed an extensive survey of 184 elementary schools in a district in southeast Texas. Using sophisticated environmental equipment, this team was able to carefully describe the condition of the air in the classrooms. The conclusion of the study was that in schools that had higher contaminants in the air often saw higher absenteeism amongst its teachers and staff. This in turn led to less efficient teaching and poorer retention on the part of the students. This particular report promoted certain standards and ventilation systems that would provide a quality air environment in which students would be healthier and therefore be in attendance on a more regular basis, thus providing more consistency for learning.

Ventilation is an unseen, yet critical component of a quality building facility. Due to the fact that hundreds of people labor in school buildings on a daily basis, and have limited and infrequent access to outside air, maintaining air quality that is uncontaminated is critical to ensuring a healthy environment. Disinfected air is a primary attribute for ensuring healthy students and staff. While a ventilation system may not affect every student, every day, a poorly functioning system can ultimately cause students to become ill which does impact student achievement. Thus, ventilation systems do have a significant potential to cause students to perform below expectations.
Lighting

One of the more critical physical characteristics of facility quality is classroom lighting. As cited by Dunn (1985), Bass (1973) insisted that the lighting of a school should be considered an active element of the total educational environment. Dunn (1985) continued to quote Bass stating, “In addition to ensuring efficient performance of visual tasks, a good lighting system contributes significantly to the aesthetic and psychological character of the learning space” (p. 865). Chan (1980) looked at student achievement in relationship to the presence or absence of fluorescent lighting. The study found little difference in achievement between schools with or without fluorescent lighting. Previous studies showed better perception and lower fatigue to be related to the intensity of the illumination (Tinker, 1939). Luckiesh and Moss (1940) demonstrated that student test scores are positively related to the quality of lighting in the classroom. According to Sleeman and Rockwell (1981), fluorescent fixtures were better than incandescent ones because of glare reduction and diffused light production. According to this study, better lighting was associated with greater productivity (Lexington, 1989; Ruch & Hershauer, 1974).

Horton’s (1972) research suggested that the ability of individuals in school to concentrate on instructions was strongly influenced by factors such as lighting. LaGiussa (1974) concluded that by altering their existing lighting system, schools could reduce costs while improving the learning environment through better vision, visual impact and comfort. According to Bowers and Burkett (1987), “…improper maintenance of fixtures leads to lower than average student performance, such as misinterpretation of the written word, whether on a handout or at the chalkboard” (p. 3).
Classroom lighting design plays a particularly critical role because of the direct relationship between good lighting and a student’s performance. The easier it is to see the printed or written word, the more quickly and accurately the word can be identified (Falk, 1972). Falk, the chairperson of the School and Lighting committee of the Illuminating Engineering Society, questioned the setting of a single standard for minimum brightness level in classroom lighting. Falk (1972), believed that one who can see and read more comfortably will read and write with more accuracy, and have less eye fatigue than one who is trying to complete the same task in poor lighting.

Some researchers have raised concerns about the validity of this argument. Illumination was addressed by Hawkins and Lilley (1992) in the Council of Educational Facility Planners International’s (CEFPI) Guide for School Facility Appraisal. In this report the authors admitted that not all lighting experts were in agreement on the direct effect illumination had on students’ performance in the classroom. However, the experts did concur that a certain minimum was need in order for students to experience successful classroom achievement.

In 1974, the New York Academy of Science Conference on the medical and biological effects of lighting concluded that light is a key to the general well-being of people that are confined in a building for a majority of the day (Hathaway & Fielder, 1986). In 1982, Rouner was to have found that “…illumination appears to be so important that even seasonal mood changes as strong as depression have been treated successfully merely by increasing the bright light in a person’s environment (Dunn, 1985, p. 868).
Phillips (1997) cites Hathway's 1994 analysis of a pilot study of four different lighting systems. Over a two year period, light had a measurable and significant effect on students. Under full spectrum fluorescent lamps with ultraviolet enhancement, students developed fewer dental cavities and had better attendance, achievement, and growth and development than students under other lights. King and Maran (1979) compiled a list of reports that demonstrated fluorescent lighting increased hyperactivity among children compared with use of full spectrum or incandescent lighting. The authors included one study that noted a positive correlation between the number of dental cavities students developed and fluorescent lighting. Another study cited by these authors further highlighted the fact that trace amounts of ultraviolet radiation in the classroom lighting significantly decreased the number of dental cavities.

While many studies have concluded that there is some correlation between the quality of lighting and student achievement, or at the least student health, which can indirectly affect the productivity of students, there still exists some ambiguity as to how much of an impact this characteristic has on the overall achievement of students. While light quantity and natural light are not conclusively important to student behavior and achievement, there is enough research to warrant the consideration of light when studying facility condition effects on students (Cash, 1993).

Geographic Location of the School Building

An independent variable that could significantly impact student achievement is the geographic region of the school building. For this study, geographic region is identified as rural, urban or suburban. To operationally define these terms rural is defined as pertaining to the area outside the larger and moderate-sized cities and surrounding
population concentrations. Generally a rural area is characterized by farms, ranches, small towns and unpopulated regions. Urban areas are typically characterized by cities or intensively developed areas. Lastly, a suburb is defined as a town or unincorporated developed area in close proximity to a city. Suburbs, largely residential, are often dependent on the city for employment and support services and generally characterized by low-density development relative to the city. Rural, urban and suburban generally define the potential areas in which schools can be located and this raises the potential for certain building quality to be associated with the geographic area of location.

The primary issue that is raised is whether or not student achievement differs based upon the geographic location of the school facility. A substantial amount of literature has concluded that rural students perform less well than urban students on standardized tests (Broomhall and Johnson, 1994; Broomhall, 1993; De Young, 1985). One hypothesis for this is that expenditures on education do matter, and expenditures are smaller in rural areas than in urban areas (Malkey, 1993; McDowell, et al, 1992; Reeder, 1989; De Young, 1985). Another hypothesis offered is that differences by location in attitudes of individuals, parents and peers about education exist and result in the observed differences in educational achievement by location (Broomhall and Johnson, 1994; Hanson and Ginsburg, 1988). The literature does appear to demonstrate a significant difference among student achievement in different geographic locations.

A study conducted by Borland and Howsen (1999) sought to determine if students from both highly rural and highly urban areas with similar associated explanatory variables perform similarly but less well on student achievement tests then students from other areas. The conclusion of this study showed that highly urban and highly rural
students do perform similarly on tests of educational achievement, but less well than
student from other areas, most notably students from moderately dense areas or suburban
areas.

Socio-Economic Status

One of the most important independent variables for this study is the socio-
conomic status of the students in the respective school. The term low socio-economic
status is often used synonymously with poverty. Poverty is defined by financial status,
determined by the government. In schools, impoverished children are usually identified
by whether or not they qualify for a free or reduced lunch. Students are provided
reductions in the amount he or she is required to pay, or if the amount of income is below
a certain threshold, he or she is provided a free lunch on a daily basis. The poverty rate of
a school is defined as the percentage of students that qualify for a free or reduced lunch
as show in Table 3.

Table 3

Scale for Free Meals (Michigan Department of Education, 2006)

<table>
<thead>
<tr>
<th>Total Family Size</th>
<th>Annual</th>
<th>Monthly</th>
<th>Twice per Every Two</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Month</td>
</tr>
<tr>
<td>1</td>
<td>$18,130</td>
<td>$1,511</td>
<td>$756</td>
</tr>
<tr>
<td>2</td>
<td>$24,420</td>
<td>$2,035</td>
<td>$1,018</td>
</tr>
<tr>
<td>3</td>
<td>$30,710</td>
<td>$2,560</td>
<td>$1,280</td>
</tr>
<tr>
<td>4</td>
<td>$37,000</td>
<td>$3,084</td>
<td>$1,542</td>
</tr>
<tr>
<td>5</td>
<td>$43,290</td>
<td>$3,608</td>
<td>$1,804</td>
</tr>
<tr>
<td>6</td>
<td>$49,580</td>
<td>$4,132</td>
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<tr>
<td>7</td>
<td>$55,870</td>
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<tr>
<td>8</td>
<td>$62,160</td>
<td>$5,180</td>
<td>$2,590</td>
</tr>
<tr>
<td>*</td>
<td>$6,290</td>
<td>$525</td>
<td>$263</td>
</tr>
</tbody>
</table>

*For each additional household member add:
School districts throughout the nation must deal with students that have very diverse backgrounds. One component of that diversity that is quite pronounced is the low socio-economic status of the students. As Haskell (2005) summarized Danzinger and Danzinger (1993), several studies attempt to correlate socio-economic status with student achievement, and while there are differing views on this question, there is no doubt that students in America of all economic backgrounds are doing much worse academically than American students several decades ago. Duncan and Brooks-Gunn (2000) noted that according to the United States Census Bureau in 1997, there were 13.4 million children classified as poor in the United States. Haskell (2005) is very emphatic when he states:

"Children’s academic success is highly correlated with their economic background. There are simply too many factors associated with low-income children that negatively affect their academic success to deny its impact. Some of the ways that it affects these children are through their home environment, the quality of childcare they receive, the economic pressure their family is under, pre-natal care, the mental and physical health of their parents, and sometimes even the environment in the neighborhood in which they live (p. 7)."

This analysis will follow the contention that Haskell (2005) purports – poverty does affect students in a variety of ways.

**Situational and Generational Low Socio-Economic Status**

According to Haskell (2005) there are two types of low socio-economic status categories that need to be clarified. The first is situational socio-economic status. Situational is characterized by a short term loss of income. Examples of this would be
losing a job because of an economic downturn or a sudden misfortune. The second type is generational low socio-economic status, which is sustained over a longer period and becomes a way of life for the family. Low-socio economic status must be disaggregated into different categories to present an accurate representation about how low socio-economic status affects students.

Haskell (2005) develops a complex description of generational low socio-economic status by reestablishing the connection between poverty and lower educational achievement. A cycle is established when someone comes from a family of low socio-economic status because they are less statistically likely to achieve academic success in school. Those who underachieve in school tend to earn less money as adults and this situation can become one of a generational proportion. Children of lower socio-economic families are more likely to become adults of low socio-economic families and in turn have children who are subject to lower socio-economic status. This is what is characterized as generational poverty.

*Socio-Economic Status and Homelife*

Families that have a low socio-economic status often cannot sustain their home financially and students in low-socio economic homes are less accountable for educational performance (Haskell, 2005). The learning environment of the students is inadequate compared to that of their peers, who do not reside in a low socio-economic homes. Rosebury-McKibbin (2001) states, “There is much evidence that the amount of parental language input to children of low socio-economic status is often less than the children of middle socio-economic status. Parents of low socio-economic status are less likely to respond to their children’s utterances” (p. 1). She also found that in one year,
children from professional families hear four million utterances, while children of welfare families hear roughly 250,000. Most of their peers live in homes where literature is valued and employed consistently, and the children have access to a number of other learning resources. Families that have a low socio-economic status often cannot afford these resources and the connection made between learning and home is not as strong. In addition, the quality of childcare that a child receives is a critical factor in determining a child’s home environment. The quality of daycare is closely associated with homecare. If parents cannot afford quality childcare, they must often settle for a lower quality situation for their children. This can also lead to an environment that is not plentiful in learning resources.

*The Importance of Timing in Becoming a Low Socio-Economic Status Student*

The timing for when a student becomes classified as a low socio-economic family can also be a primary factor in the overall academic achievement of the child. A student forced to encounter the effects of low socio-economic status at an early age can be greatly affected when it comes to achieving at school. Low socio-economic status can affect a student at any age, but it is during the early years that it seems to do the most harm (Haskell, 2005). While little is known about the importance of the timing of economic deprivation during early childhood, studies suggest that family income in the first five years of life is a powerful correlate of developmental outcomes in early and middle childhood (Duncan, Brooks-Gunn, Smith & Yeung, 1998, p. 412).

The earlier a child is exposed to low socio-economic status, the greater affect it will have on him or her in terms of academic achievement. A $10,000 income increment over the first five years of life for a child in a low socio-economic status family will
cause a 2.8% increase in the likelihood that the child will finish high school. In addition, family economic conditions in childhood are even more important for a student’s success versus his or her socio-economic status during adolescence (Haskell, 2005). A study by Feldman (2001) showed that some poor children, “...are in poor health and lack the pre-literacy, pre-math and social skills that more advantaged youngsters already have at the beginning of kindergarten” (p. 8). However, the positive point to her analysis was that the children who lacked these skills entering kindergarten were able to attain them due to the school and teacher. The downside to this is that students from the high socio-economic status group that came to school with these skills continued to progress maintaining the gap that had already been established. Mickelson (1990) hypothesized that children almost expect to end up in these situations, because of the perceived lack of jobs available for low socio-economic people.

*Length of Low Socio-Economic Status*

When a student becomes a low socio-economic status student, the length he or she is forced to remain in that condition impacts the extent to which it will affect his or her educational achievement. Orland (1990) states that, “The longer a child is in poverty, the more deleterious the effect on his or her educational growth. All student poverty is not equal. Students experiencing long-term poverty are much more likely to have educational difficulties than students whose duration in poverty is short” (p. 43).

Haskell (2005) cites Duncan et al.’s (1994) longitudinal analysis of family income and its impact on five year old reading scores. Duncan et al. discovered the duration of the low socio-economic status, the severity of the disadvantage and the stage at which it affects children are all factors in determining success. Chronic poverty has been found to

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consistently have a more powerful effect on a student’s outcome than transitory poverty. Duncan et al.’s investigation discovered that five-year olds in persistent poverty had mean intelligence quotients nine points lower than non-poverty children.

Depth of Poverty

The degree to which some families are in poverty certainly plays an important factor for student achievement as well. A student whose family recently qualified for a reduced lunch is more likely to succeed than a family that was significantly below the poverty threshold. The lowest scores are typically seen from students who are extremely poor, usually with an income that is 50% below the poverty threshold (Smith, Brooks-Gunn & Klebanov, 1997). In a study of completed schooling, the effects of income were much greater for youth who lived in families with incomes below $20,000 than for those with incomes above $20,000 (Duncan, Brooks-Gunn, Smith & Yeung, 1998 in Duncan, Brooks-Gunn, 2000). “When compared with children in families with incomes between 1.5 and 2.0 times the poverty line, children in families with income less than one-half of the poverty line were found to score between 6 and 13 points lower on the various standardized tests” (Duncan et al., 1998, p. 413). They found that children with incomes closer to the poverty line, but still below it, did worse academically than a group with higher income (Haskell, 2005).

Socio-Economic Status and Social Awareness

The age of the child that is impoverished plays a role in the consciousness of financial plight. Very young children are less likely to be cognizant of the surroundings than an adolescent. Young student are apt to take chances in the classroom compared older adolescent peers. Adolescents have had many more opportunities and experiences
than their younger counterparts, and they have a better understanding of how their family financial situation affects them at school. Younger children are less likely to be affected by poverty because they have not been conditioned to believe the perceptions that society subscribes to. Guo (1998) suggests, "...only from early adolescence (10 to 12 years old) on is a child likely to understand the full significance of the societal messages that he or she receives from an impoverished environment" (p. 263). Children beyond the age often begin and continue to receive the impact of their place in society. The research suggests that the younger a student is immersed in poverty, the chances of him or her reacting to the public perception of poverty is much less than an older student.

Low Socio-Economic Status, Health, and the Academic Affects

A child that is born to low socio-economic parents is likely to encounter more health problems than his or her peers that are in a higher socio-economic group. In addition, "Parents who are poor are likely to be less healthy, both emotionally and physically, than those who are not poor" (Duncan & Brooks-Gunn, 2002, p. 190). Parents with low income tend to suffer from more irritability and depression-like symptoms, which associated with low income, which can account for increased conflict between the child and the parents. This poor relationship can impact the attitudes of the child, which in turn, affects the academic performance of the child in school. Subsequently, "...a significant percentage of our young children, primarily poor children, are in poor health and lack the pre-literacy, pre-math and social skills that more advantaged youngsters already have at the beginning of kindergarten" (Feldman, 2001, p. 4).

When children are classified as a low socio-economic student, they often lack the appropriate health services, a condition which becomes a contributing factor to their lack
of academic success. Children born into poverty are not provided with the same health services as their higher income peers, and their potential for learning at school is impeded. Mcloyd (1998) states that, "...a connection between SES and health at birth is a common finding. For example, children who suffered low birth weight and who suffered various prenatal illnesses as infants experience greater school failure and more school-loss days" (p. 191). The resources that do help avoid complications at birth are not as available and this can lead to a number of problems including, "...premature birth, birth asphyxia, apnea, cerebral palsy, seizure disorders, visual and motor coordination problems, mental retardation, and learning disabilities" (Mcloyd, 1998, p. 191). Therefore, the more severe the illness the student has acquired, the more severe the learning disability.

A child's health status can be related to his or her family socio-economic status in a number of ways. Not always does a family socio-economic status determine the child's exposure to prenatal drugs, both illegal and legal, but any exposure to this type of activity can also adversely affect the child. "Drug exposed children for example, show impaired organizational and language skills during their early years of life" (Hawley & Disney, 1992, p. 6). Low socio-economic status is associated with increased prenatal complications and this can develop into longer-term problems. A child's physical status is not limited to their first few years. The physical status of a child through adolescence and into high school can affect their grades as well (Haskell, 2005).

The socio-economic status of a student drastically impacts the achievement he or she will experience due to several direct and indirect influences. A low socio-economic status often connotes the family does not have the income to provide appropriate services
for their children or they have not had an appropriate level of education to impart adequate learning skills to their children. When parental earnings do not reach a level to provide suitable health care, it is possible that the children will be impacted educationally by health related issues that could be prevented. The degree to which a family becomes impoverished is also critical as how the children will react educationally. If the family is impoverished for a limited time, due to a job loss for example, the children will be less affected than if the family is at a life-long poverty level. And when the students themselves begin to recognize their plight, society’s perception on low socio-economic students begins to impact students at school. Children at lower ages tend to not realize their lack of financial well-being nor its impact on them physically or mentally. The socio-economic status of students in school is a large variable as to how well a student will achieve. Therefore, it is critical for this study that the socio-economic status of the students be controlled to remove the variance attributable to student achievement.

Median Income

Another independent variable that must be controlled due to its highly correlated impact on student achievement is the median income of the area surrounding the school building. A factor not always considered when researching the adverse effect low-income families sometimes must endure is the neighborhood environment in which they live. The socio-economic mix of children’s neighborhoods also is related to completed years of schooling. Adolescents who grow up in neighborhoods of affluent families complete more years of school and have lower school dropout rates than adolescents from similar neighborhoods with proportionately fewer affluent families (Brooks-Gunn, Duncan, et. al., 1993 in McCloyd, 1998, p. 193). Neighborhoods with a majority of low-income
homes are often less organized than neighborhoods with higher income homes. This disorganization can lead to many unemployed adults in a neighborhood and to a rise in the crime rate. A child who lives in this type of environment is much more likely to think of his or her situation as acceptable rather than a child who encounters a more acceptable, safer environment. A child who is subject to more positive daily habits through the observation of his or her neighborhood is more inclined to have appropriate behaviors at school and will achieve at a higher rate.

Haskell (2005) gives a detailed description of the effect median income can have on children by relating the concept to parents and the amount of accountability they accept for their children. Parents who show interest in their children at home are teaching accountability through modeling. Parents who do not show involvement model a lack of commitment to their children, which in turn, has a “snowball effect” on the children. Children who reside with parents that have higher incomes encounter more accountability at home and the parents usually support the school and its efforts to provide an appropriate education. Middle-class parents choose to be involved in the progress of their children and sub-par performances by their children are usually dealt with not only in the classroom, but at home as well. Consequences may range from the removal of material rewards to implementation of stricter rules with regards to allowing the children to choose their own activities. A child who comes from a low socio-economic status, disadvantaged, disorganized environment is much less likely to witness accountability. A low socio-economic status student leaves school at the end of the day and moves from the school environment to a very difficult home environment. Therefore, the chances of
parents and children reviewing homework together reinforcing lessons learned in school at home reduce drastically.

Finally, Haskell (2005) correlates a parent’s educational success with the child’s success. Parents who head low-income households often did not score well in school and therefore do not push their children to do so either. A parent who succeeded in school and becomes a success after school often wishes for at least the same, if not more, out of their child. Children are more likely to receive poorer grades if they know the consequences are minimal or even acceptable. Very few students in our school systems, without accountability at home, will push themselves more than their parents.

Neighborhoods play a very important factor in a child’s success at school. In the United States, many neighborhoods are demographically determined in a *de facto* manner with families of the same financial status coalescing in the same area. Students that come from poorer backgrounds often live in neighborhoods that are disorganized, foster criminal activities, and have parents that had not valued experiences at school. These factors lend some insight as to why these students may or may not find success at school.

Building Capacity

Another critical independent variable that potentially has a large impact on student achievement is the size of the school in relationship to the number of students housed in the building. This concept can also be termed as student density. Student density is therefore operationalized as the number of students per square foot of the building. It would seem logical that the more space students have in which to maneuver and learn, the better the opportunity they will have to successfully achieve on standardized examinations. Moore and Lackney (1994) support this contention by
highlighting the fact that there is strong evidence that school building size impacts student achievement. Moore and Lackney further identify behavior influenced by school size as crime levels, student misconduct, and participation in extra curricular activities. They argue that these behaviors are mediating variables that in turn impact academic achievement. Previous research demonstrates a correlation between student achievement and building density that is strong enough to become a primary variable. As stated by Moore and Lackney (1993):

There is considerable evidence reported...that school size and classroom size directly lead to significant and substantial differences in learning achievement, and that location and the provision of secluded study areas within classrooms affect various beneficial mediating factors (like more student-teacher interaction, less interruptions, and greater student participation in learning) which there is good reason to believe will in turn lead to higher educational achievement (p. 104).

Student density will need to be controlled when analyzing building condition affecting student achievement due to the strength of this variable.

**Student Density**

Weinstein (1979) defined density as a mathematical measure of the number of people in a given space and crowding as the perceived judgment of excessive density. Saegart (1978) stated that physical density involves two separate components, the number of people in a given space and the amount of space per person. Studies regarding density become complicated due to the difference between social and spatial density. Social density studies vary the number of subjects while the size of the environment remains the
same. Spatial density studies vary the size of the environment while the number of subjects remains the same (Ginsburg, Pollman, Wauson & Hope, 1977). Saegart (1978) illustrated the complications of studying density by stating that the density in two studies might have equaled 12 square feet per person, but in one case there were 200 people in an assembly hall and in the other there were four people in half of a small laboratory room.

Hutt and Vaizey (1966) were some of the first researchers to study the effects of density on children. They investigated the behavior of normal and intellectually disabled children in varying social densities. They hypothesized that in accordance with the findings from animal studies, that increasing group density would change the nature and frequency of social encounters. They also theorized that the effects would differ according to the personality of the subject. They studied children with autism, traumatic brain injury, and typical children while at play. It was found that aggressive and destructive behavior increased for both typical and traumatic brain injured children under high density conditions. The data collected also showed that typical children participated in less social interaction while in the high density setting.

Loo (1978) completed several studies regarding density. In one study, Loo examined the behavior of preschool children identified as having behavior problems. She found that high anxiety students reacted to high density with emotional helplessness while low anxiety students responded by reducing mobility and increasing facing out positions. High hyperactive and distractible students became more active in high density conditions while low hyperactive and distractible students showed no significant difference in their activity level. Students who were labeled as hostile-aggressive did not react differently to density than typical children.
Ginsburg, et al. (1977) maintained that the one-way mirror used to observe the subjects altered the results of the Loo study, stating that mirror-image stimulation has been proven to affect behavior. The study they designed measured differences in the aggressive behavior of third through fifth grade male students videotaped from a distance when the spatial density of a play area was changed. They found that there was a functional relationship between the amount of space and aggressive behavior in children. The observational records from this study showed an increased frequency of aggression when the students were in the smaller playground. They also found a shift from the behavior pattern of flight from an aggressor in the large playground to fighting the aggressor as the dominant behavior when confronted in the smaller playground. Fights on the larger playground usually involved two participants while fights in the smaller playground involved more than two participants. Shapiro (1975) compared the behavior of children in classrooms that allowed less than 30 square feet per child to the behavior of children in classrooms with more than 50 square feet per child. More disruptive and aggressive behavior occurred in the high density classrooms. Smith and Connelly (1972) found that density did not effect aggression but that the amount of play equipment did. Loo (1978) stated that while the results of Smith and Connelly’s study are suggestive, they are not definitive due to the inconsistency of comparing indoor and outdoor behavior.

In a second study, Loo (1978) looked at the effects of spatial density on social behavior, motor levels, and types of activity. Personal space differences due to density and sex differences regarding density were also investigated. The students were more aggressive, engaged in more rough play, and made fewer social overtures and more
negative interactions in the high density condition. Boys reacted to the high density condition with more activity and aggressiveness than girls and the girls showed more avoidance behaviors than the boys. Students identified as having high personal space needs showed more negative and nonsocial interactions and less involved play than the low personal space needs students while in the high density condition. Rohe and Patterson (1974) found results similar to Loo's regarding gender differences. They found that males exhibited more aggressive and destructive behavior than females while in high density conditions and females showed more unoccupied behaviors.

When high density and physical interaction was investigated, Heller, Groff and Soloman (1977) found that each condition produced perceptions of crowding, but poorer task performance resulted only when high density and physical interaction were together. Stolkols, Ohligh, and Resnick (1979) stated the experience of crowding is heightened by excessive social stimulation. The perception of crowding is linked to restraints on behavior freedom and infringements on privacy imposed by the proximity of others. Increased demand for space may result from a scarcity of social and/or physical resources in the setting.

McGrew (1970) looked at spatial and social density when observing the free-play behavior of preschool students. Spatial density was changed by allowing the students to play in all or only part of the room. Social density was changed by varying the number of participants. Four conditions were observed: (a) low social and spatial conditions; (b) low social and high spatial conditions; (c) high social and low spatial conditions; and (d) high social and high spatial conditions. It was found that increased solitary play and close peer proximity occurred under the high spatial density conditions. Rohe and Patterson (1974)
suggested that when high density conditions cannot be avoided, that increasing resources will lessen the impact of crowding. Loo (1978) in a third study, examined the differences between social density versus spatial density. Participants in low social density (32.7 square feet per student) had fewer aggressive acts than participants in the high social density condition. Participants in the low spatial density condition (44.2 square feet per student) had more aggressive acts than participants in the high spatial density condition.

Aiello, Nocosia, and Thompson (1979) found age to be a moderating factor of density. They studied children who were 9, 13, and 16 years of age. They found that although the older children experienced comparable stress related arousal, they used more socially acceptable techniques to avoid each other in high density conditions. They also showed no increase in aggression. They suggested that crowding has more detrimental effects for young children and that coping mechanisms develop with age.

Murray (1975) hypothesized that children who lived in crowded conditions were more aggressive and insecure. The family size and house size of 250 children were studied in relationship to the children’s behavior. Murray found that crowded children were more aggressive, impulsive, and extroverted. Boys in crowded conditions were more neurotic than boys in conditions that were not crowded while girls in crowded conditions were less neurotic than girls from uncrowded conditions. Loo and Smetana (1978) found that the perception of overcrowding is mediated by whether those involved knew the people they were with. They cited studies that found that people felt more crowded if they were with unfamiliar people and that strangers were more likely to express dissatisfaction. Freedman (1975) stated that high density does not have generally negative effects on humans. Additionally, high density does affect people, but these
effects depend on other factors in the situation. He suggested that as density increases, the intensity of our moods and behavior increases. Freedman stated that the more friendly two people are, the closer they tend to stand. Given plenty of room, friends, spouses, parents, and children tend to stand much closer than strangers and acquaintances. In addition, a person usually stands closer to someone he likes than to someone he dislikes, even if he knows both equally well.

Wohlwill (1985) stated that most studies focused on the crowding of children do not look at the impact of child development. He believed that the influence of density on the development of a child is mediated by other variables. He postulated that density and the rate of social interaction should be studied rather than the effects of crowding. Wohlwill believed that variations in the environment are necessary for a child’s development and that the availability of a room for the child to “escape to” free of noise, congestion, and general activity is related to early cognitive growth. He stated that crowding is perceived differently in interior and exterior space. Wohlwill identified four correlates of density: (a) activity level and intensity of environmental stimulation; (b) competition for limited resources; (c) diversity in choice of peers; and (d) diversity of settings and facilities.

One reason overcrowding has not received much attention is that there have not been many studies tracking the effects of overcrowding on academic progress over time. A school is considered overcrowded when it is operating with an enrollment exceeding its capacity. How the school reacts to overcrowding determines the consequences of overcrowding on student achievement (Burnett, 1995). Overcrowding impacts the everyday logistics of running a school. Lunch periods must start earlier to accommodate
more and more students. Every available space is utilized for classrooms, which lessens use of electives and teaching strategies such as flexible grouping. Hallways are crowded between classes which can bring out increased conflict between students and necessitates additional time to travel from class to class. Lastly, administrators must concern themselves with maintaining order which lessens the amount of time and focus on school improvement issues (Burnett, 1995).

A person's perception of whether or not a space is crowded is dependent on variables such as: (a) past experiences; (b) personal space preferences, (c) familiarity with other individuals present; and (c) the type of activity occurring (Weinstein, 1979). Krantz and Risley (1972) found that when kindergartners were crowded around a teacher who was reading a story or conducting a demonstration, they were less attentive to the teacher or to the educational materials than when they were spread out in a semicircle. McCall (1997) stated that students in overcrowded schools scored significantly lower in both reading and mathematics than students in schools not filled to capacity. In addition, both students and teachers reported that overcrowding negatively affected classroom activities and instructional techniques.

Although many researchers have looked at the class size and achievement issue, room size has not been considered. This factor complicates the study of the effects of density on achievement (Weinstein, 1979). Guthrie (1979) believed the actual scale of the physical plant, the size of its population, and the size of the organization in which the pupils and staff participate should be studied. Weinstein (1979) stated that while the impact on achievement is unclear, there is evidence that high density results in dissatisfaction, nervousness, less social interaction, and increased aggression.
Studies regarding the effects of high and low density on children found that high density had significant impact on the behavior of children. The age of the subjects and the sex of the subjects along with the amount of resources available all altered responses to high density. The impact of density on achievement has not been researched thoroughly and additional data is needed (Swift, 2000).

Facility Quality and Student Achievement

Within every community in the United States there exists a building in which most of the children of that particular community attend school. However, it is obvious to that school buildings within the community or even more decisively, from town to town, differ greatly. Some buildings are older than others, and some have different colored walls. Yet, does the condition of the facility truly matter in terms of how students achieve? The research that has been completed is tenuous due to the fact that there truly are not enough studies to make appropriate generalizations and educating children encompasses a variety of factors, some of which are difficult to define.

When one analyzes the amount of time a child spends in school, one develops an appreciation that a significant amount of a child’s life is spent in a school building. If a child is in school seven hours per day and a typical school year is one-hundred eighty days, then the child is in school roughly 3,860 hours per year. Therefore, a child that completes a K-12 education spends approximately 2,090 full (24 hours) days in school, which constitutes a significant portion of their life.

Hypothetically, the students that are housed in newer and cleaner buildings would be provided a better environment in which to learn. However, the primary concern that is raised is what effect the physical environment has on human physiology that
would potentially affect student learning. There are multiple variables that affect the
education of children, however, one of the most often neglected is the physical building
that houses the children. Several authors have articulated the notion that the physical
environment should be included with any analysis related to learning encompassed in the
field of educational psychology (Good & Brophy, 1977; Knirk, 1979; Morris, 1978;
Woolfolk & Nicolich, 1980).

Interestingly enough, there has been a study completed by Taylor and Gousie
(1988) that disaggregates the concept of habitability comparable to Maslow’s hierarchy
of human needs. The three levels an individual needs in the built environment are: (a)
Health/Safety; (b) Functional; and (c) Psychological comfort. The authors of this study
define the analogy even further by stating:

Health/safety refers to basic physical survival needs and the prevention
of injury. Functional refers to adequate space and spatial relationships of
functionality related areas. Psychological comfort and aesthetic satisfaction
refer to needs such as privacy, sensory stimulation, sense of ownership and
involvement, and aesthetic appeal (p. 25)

While research has indicated that the lower needs have been met in most school facilities,
little has been accomplished in terms of the psychological comfort and aesthetic appeal.

Phillips (1993) found that Bexton, Heron, and Scott (1954) conducted an
experiment which supports the argument that the psychological needs of individuals must
be met in order for the individual to maximize learning. The participants of this study
were told to do nothing and then they were studied. The participants were provided
comfortable shelter and fed adequately. The individuals were not allowed to touch, see,
hear, or communicate with any other person. Initially, the subjects did nothing. He or she simply rested or slept. However, after a short period of time the subjects became quite agitated and could no longer sleep. There behavior became erratic, as if they were seeking an activity to accomplish or a problem to solve. Because this behavior became quite intense, the experiments lasted only a couple of days. When the individuals were released from the experiment, several of the participants reported feeling nauseous, fatigued, and intellectually disoriented. These symptoms occurred in spite of the fact the subjects were adequately fed and housed. The conclusion of the experiment was that normal, intelligent, adaptive behavior requires sensory input and an opportunity to seek out problems to solve.

Recognizing that it is important to account for the effect the physical environment has on a human being, there cannot be a separation between the learning process and the effect the physical environment has on a human being. Stinofsky and Knirk (1981) explained that educators must have knowledge related to environmental psychology in order to discuss and make recommendations for features in facilities that enhance learning opportunities. Poysner (1983) maintains that the informed educator can use the physical environment to teach, predict behavior, and manage tasks.

Handler (1960) made the following observation about the built environment that there has been, “…much folklore talk, and know how about the effect of buildings upon the occupant, but there was precious little scientifically grounded knowledge about the effects buildings should have on the people who occupy them” (p. 13). This remark regarding the physical environment was made as the Education Facility Laboratory of New York was attempting a research program encompassing numerous professional
disciplines to determine the effect of school buildings upon student achievement and behavior (Earthman, 1996). Eleven years later in 1971 after extensive research, Anderson noted that:

It is almost axiomatic that the physical environment of a school is important as a factor in each child’s learning; but solid proof or support of the proposition especially in terms of assessing the amount of difference the environment makes is almost nonexistent (Hathaway, p. 278).

Since Anderson’s 1971 conclusion, much more research has been conducted in this area, some of which is an antithesis to the contention that facility quality does indeed impact student achievement. The Coleman Report (1971) was a project that was designed to analyze a variety of factors that are crucial in predicting student achievement. The report found, “…that variations in facilities accounted for relatively little variation in achievement as measured by standardized test scores.” Thus, not all research conducted makes the generalization that the quality of the school facility impacts the quality of learning. However, the research conducted after the Coleman Report of 1971 certainly leans toward the premise that there is some variance between improved student achievement and facilities that are educationally appropriate and aesthetically pleasing.

Earthman (1998) articulated the concept that there is a desperate need to complete studies that attempt to correlate facility condition with student achievement. He states, “There have not been sufficient numbers of such studies…to present a strong relationship from which generalizations can be made” (p. 3). Much of the research concurs that analyzing this potential correlation is important because disparities in the quality of school buildings could leave some children at a disadvantage (Kozol, 1991). There are

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some discrepancies among empirical studies that a statistically significantly relationship exists between building condition and student outcomes (Picus, et al., 2005; Earthman, 1998; Earthman & Lemasters, 1996). However, there are multiple reasons for this discrepancy ranging from methodological issues to conflicting and ambiguous results. Earthman (1998) argues that a systematic analysis of this question on a scale large enough to generalize or predict has not yet been undertaken. Thus, it is imperative not to make assumptions or generalizations without a substantial number of studies, and to ensure the models for future studies are robust enough to sense statistical differences and consider a variety of confounding variables.

A provocative question that arises is the influence the built environment has on the performance of students. Through the past several decades much research has been conducted that sought to measure the possible relationship between student performance and school facilities. Those that have researched this potential relationship have investigated the possible influence various building characteristics such as wall color, building configuration, absence of windows, and air conditioning, have on the performance of students. According to Earthman (1998) most of the efforts of these researchers has proven valuable as most of the best features discovered in the research has been incorporated into new designs. While many improvements have been made in the types of schools built as a result of prior research, a main problem still exists. The majority of students in the United States still attend schools that are not defined as new. In fact, the vast majority of students are housed in buildings that are more than 50 years old.
Throughout the history of research into the topic of student achievement and facility condition, there are two researchers that have written the seminal works in this area. Carol Weinstein reported her analysis in the *Review of Educational Research* in 1979. Her review utilized over 140 published studies plus 21 references that were cited as papers presented at various professional organizations. Carroll McGuffey completed a second work in 1982 that cited 88 separate published studies. McGuffey, O’Fallon and Young (1982) listed and reviewed an additional nine studies. Thus, the reviews surveyed by Weinstein and McGuffey totaled 238 research studies plus 21 paper presentations. Out of these citations only six were cited by two or more authors meaning that 232 separate research studies were cited by these reviewers. Even with all these research articles that have been completed relating student achievement and building condition, the consistency of the findings has still been questioned. Even the researchers that support the premise that facility condition impacts student achievement recognize the complexities in capturing the exact variance.

**Michigan Educational Assessment Program**

The Michigan Educational Assessment Program (MEAP) examination is the instrument employed by the State of Michigan to assess all public school students in math, reading, writing, science and social studies in grades three through eight and eleven. The MEAP was developed by the State Board of Education and supported by then-Governor William Milliken and funded by the legislature. The first MEAP test was administered during the 1969-70 school year for the purpose of determining what students know and what students are able to do compared to all students in Michigan as
compared to standards set by Michigan's State Board of Education at key checkpoints during the students' academic career (Michigan Department of Education [MDE], 2007).

**MEAP Purpose**

The MEAP tests were developed to measure what Michigan educators believe all students should know and be able to achieve in the five core areas. The test results illustrate how well Michigan students and Michigan schools are doing on Michigan's Grade Level Content Expectations (GLCE) created by the State Board of Education. The MEAP test is the only common instrument utilized statewide for all students. In addition, the MEAP is the instrument approved by the United States Department of Education's requirement of assessing students as mandated by the No Child Left Behind legislation enacted in 2001. Students who achieve competency on the examination demonstrate significant achievement in valued knowledge and skills. Furthermore, the MEAP provides a common denominator to measure how well students are doing, and to assure that all Michigan students are measured on the same skills and knowledge, in the same way, at the same time.

**Validity and Reliability**

Many of the published tests that exist are norm-referenced, meaning that a student's performance is compared to other students' performance and not the expectations established by educators. In Michigan, most of the MEAP test questions are designed by Michigan educators. Therefore, the test is designed to measure the Grade Level Content Expectations developed by the Michigan Board of Education. Compared to the norm-referenced model, the MEAP examination is a criterion-referenced test, meaning that results are reported as performance against standards developed by
Michigan educators and approved by the State Board of Education. Student performance is assessed according to whether or not each student has met the achievement standard (MDE, 2007).

Two important concepts in measurement that need to be taken into consideration when analyzing a population are reliability and validity. For the MEAP test, reliability values are determined by using internal consistency formulas, which indicate how homogeneous items are in a test, or the degree to which students' responses to each item correlate with their total test (McMillan, 2004). Using Cronbach’s Alpha to measure internal consistency, all of the subject tests have a reliability higher than .800 with writing at grade eleven having a reliability of .610. McMillan (2004) states, “If the correlation coefficient is high, say .78 or .85, the reliability is said to be high or good. Correlation coefficients below .60 generally indicate inadequate or at least weak reliability” (p. 142). Thus, based upon the reliability data and the definition of reliability provided by McMillan (2004), the majority of subject area tests on the MEAP demonstrate a very high reliability.

Validity is defined by McMillan (2004) as, “...an overall evaluation of the extent to which theory and empirical evidence support interpretations that are implied in given uses of scores” (p. 136). Validity refers to the degree of appropriateness, meaningfulness, and usefulness of the specific inferences made from test scores. Because the current MEAP assessments are achievement tests used to assess what students have learned and should be able to achieve in specific content areas by the end of a certain grade, the most important type of validity of concern is content validity. To verify content validity, test
items must match the specified objectives given in the test blueprint or assessment framework. The Michigan Department of Education (2007) states:

Like all published achievement tests, the MEAP assessments have a blueprint that indicates the objectives to be tested in each content area. There is an infinite number of ways to write test items to measure each objective, and multiple forms are composed for each test. Not all objectives are tested in any given form of a test. Both “easy” and “difficult” items are used in every form to balance the difficulty level of the items, and to equate the different forms to one another. The sample of items chosen for a test represents the domain of all possible test items that fit the blueprint. For a student to do well on a test, he/she must have mastered the entire domain, not simply bits and pieces (p. 12).

Content advisory committees, which include teachers and curriculum coordinators, verify that each test question meets the objective it is supposed to measure, and that it fits the blueprint or framework. A Bias Review Committee then verifies that the items are not disadvantaging any particular group. The groups ensure that the MEAP tests have content validity. Finally, the Michigan Department of Education makes the declaration that, “The MEAP staff has always followed and will continue to follow, current psychometric practice in developing, administering, analyzing, and scoring the Michigan Educational Assessment Program tests.

Therefore, the MEAP tests being administered in the State of Michigan provide a very reliable and valid measurement of what all students have attained reflective of the standards and benchmarks developed by the State Board of Education. Selecting the
subject areas of reading and math from the MEAP test provide a sensible instrument to
demonstrate what students have learned. This is important in this study because there is a
great need to be able to assess students on a uniform standard. As there are multiple
variables that affect student learning, it is important to measure students on a uniform set
of standards with a reliable and valid measurement tool. The MEAP tests provide just
such an instrument.

Summary

Education in the United States is most decidedly focused on student achievement
as measured by standardized examinations. These examinations are then utilized to
ascertain whether students are meeting certain, uniform requirements as developed by a
particular state. Therefore, it is ever more important that all factors that are a part of
student learning be analyzed in order to provide the best education possible.

One variable that is important to verify its significance related to student
achievement is the condition of the school building in which the students attend. Far too
many buildings are encountering issues that cause them to be considered less than
satisfactory for learning. Because schools are encountering greater costs without financial
increases to match these expenditures, school districts are delaying maintenance and
postponing renovations and new construction. However, if the significance between
building condition and student achievement can be established, then an appropriate
allocation can be devoted to these areas to improve the facilities in which students learn.

The issue with measuring facility quality and student achievement is the fact that
there are numerous components that factor into building condition. It is critical to analyze
as many of these factors as possible. Other studies that have been completed look at
specific building condition items and the potential impact it may have on student performance. For example, a study may look at only building age as the guiding factor for facility quality, which may not be a precise indicator of the quality. Incorporating as many characteristics as possible provides a better description of the quality of the facilities. Based upon multiple independent studies, the primary characteristics of a building have been extracted and placed on the survey instrument for this study. In addition, the surveys that have been created in other studies typically have had limited scales in which to assess building features. Both of these examples demonstrate that many of the studies do not take into account the multiple factors that impact student facility quality. This study identified several structural and cosmetic conditions that describe the condition of the building in more detail, by creating a Likert scale, which gives more sensitivity to the rating adding more robustness to the study. In addition, the study controlled for the geographic region in which the school is located to determine whether or not the condition of the building is related to the location of the school. This is an important component because some of the literature hypothesizes that more resources are allocated to urban schools because they house more students. If theory is supporting the contention that urban schools are in better condition, and in actuality they are not, then it is noteworthy to mention.

As there are several variables that factor into student achievement, three have been selected as they appear to have substantial significance as demonstrated through the literature. In many of the studies reviewed, one area that is consistent in terms of a limitation is the number of variables that impact student achievement. In many of the studies assessing building condition and student achievement, confounding variables are
not controlled for, and occasionally are only mentioned as a limitation. This may in part be due to the model that is constructed, which does not allow for multiple independent variables to be included. The model for the current analysis will be a multiple regression, which will allow for the variances of multiple variables to be accounted for. The three independent variables controlled for in student achievement beyond the primary independent variable of building condition will be: (a) socio-economic status of the student; (b) the median income of the area in which the school is located; and (c) student density of the building. Through the course of the literature review it becomes quite lucid that all of the independent variables listed are highly significant as it relates to student achievement. In essence, this study utilizes other researchers’ basic framework of analyzing this phenomenon, but it incorporates multiple factors in assessing building condition and controls for variables that impact student achievement.

The overarching problem this study attempts to address is to determine the amount of influence building condition in elementary schools in Michigan has on student achievement on the M.E.A.P. examinations in reading and writing at the third, fourth and fifth grade levels. In order to assess this phenomenon, the study will be guided by the following four questions: (a) What is the status of quality of elementary school buildings in the State of Michigan?; (b) Does the quality of school facility vary by urban, rural, and suburban location?; (c) Is there a relationship between the facility quality of an elementary school and student achievement as demonstrated on the M.E.A.P. examination in reading and mathematics at the third, fourth, and fifth grade levels?; and (d) What are the three primary needs as identified by the respondents on the survey that are in need of repair in elementary school buildings in Michigan.
CHAPTER III
RESEARCH DESIGN

Sample, Population, and Participants

The sample for this study included elementary schools throughout Michigan. A simple random sampling procedure was employed in the desire to obtain a balanced sample disaggregated by the categories of rural, urban and suburban districts. Therefore, the aggregate for the sample will be ninety cases (N=90) with the strata divided among rural, urban, and suburban schools (n=30). The criteria for the sample will be that the school is a public elementary building with at least the grades of third, fourth and fifth being housed in it, and the building qualifies as rural, urban, or suburban. In addition, the researcher randomly selected 70 schools in each stratum with the anticipation of a 50% return rate. Schools will be identified for participation by using the 2007 Michigan Department of Education database, which identifies all schools in the state and the principal of each building.

Instrumentation

A survey instrument was employed to assess building condition among elementary schools in Michigan. After a review of several instruments, it was determined that the best instrument for this study was a hybrid of two instruments. Several studies have been completed utilizing the Commonwealth Assessment of Physical Environment (CAPE). The CAPE was developed by a researcher, Carol Cash (1993), who attempted to explain the impact of school building condition on student achievement and behavior in rural Virginia schools. Cash researched several instruments and selected the components that were best suited for her study. Hines (1996), a researcher following Cash, utilized the
same instrument in his study. He noted that Cash had the instrument field tested by personnel in the Virginia City Public Schools research department, who were experienced in facility assessment. These research personnel determined the field test scores were consistent with expected outcomes. Hines (1996) noted that Cash then tested for inter-rater reliability and obtained similar ratings. The CAPE identified several building characteristics that were reviewed and assessed by an individual that had intimate knowledge of the building. The characteristics were then categorized into one of three levels: (a) substandard, (b) standard, and (c) above standard. Scores were then aggregated into a composite score identified as one of the previous three categories.

The CAPE instrument had three responses available for the respondent to select from each question. The three responses in the CAPE were already predetermined as to whether they define a quality that is substandard, standard or above standard. The United States General Accounting Office (USGAO) study utilized a Likert scale, in which the building and the sub-categories are measured one through six with each whole number representing a descriptor: (a) 1=replace; (b) 2=poor; (c) 3=fair; (d) 4=adequate; (e) 5=good; and (f) 6=excellent. The USGAO instrument provides more definition for the quality of the building due to the detail of this Likert scale.

The instrument being utilized for this study is a hybrid of the two instruments previously described. The first question on the instrument, as can be seen in Appendix A, asks the respondent to report the number of students in his or her respective building in terms of full-time equivalency (F.T.E.).

Question number two asks the respondent to identify several components of student density for classes at the third, fourth, and fifth grade. The information being
sought at those grade levels is the number of teachers, the total number of classes, the 
average number of students, and the average square feet of the classroom.

Question three employs a Likert scale for the respondent to identify the overall 
facility condition. The question provides a detailed description for each possible 
numerical identifier: (a) 1=replace, (b) 2=poor, (c) 3=fair, (d) 4=adequate, (e) 5=good, 
and (f) 6=excellent.

Question four asks the respondent to measure the quality of the building in twenty 
different features that best characterize a school facility. These characteristics are derived 
from the CAPE instrument as well as the instrument utilized in the USGAO study. The 
Likert scale previously identified was employed again, and it utilizes the same descriptors 
as in question three. The building features that are incorporated on this instrument are 
disaggregated into two distinct categories: structural and cosmetic. Those features that are 
classified as structural are: (a) roofs; (b) framings, floors and foundations; (c) exterior 
walls; (d) windows; (e) doors; (f) finishes; (g) plumbing; (h) heating; (i) electrical power; 
(j) electrical lighting; (k) ceiling coverings; (l) acoustics for noise control; (m) 
ventilation; and (n) air conditioning. Cosmetic features include: (a) interior wall paint; (b) 
exterior wall paint; (c) classroom furniture; (d) condition of the grounds; (e) graffiti; and 
(f) the time it takes to remove graffiti.

Question five asks for the percentage of students that qualify for a free or reduced 
lunch, which is indicative of the socio-economic status of the student.

Question six asks the respondent to list the percentage of students attaining a level 
one or level two on the Michigan Educational Assessment Program (MEAP), which
correlates to exceeded expectations or met expectations respectively. Those scores are requested for third, fourth, and fifth grades in the subjects of reading and math.

Question number seven asks the respondent to identify the number of years since the building’s last major renovation. This time period will allow the researcher to determine the approximate modernity of the building.

To correlate with the CAPE, the instrument being employed in this study will advance the description of the Likert scale to a more detailed description. The CAPE compiled the data into three distinct categories for the analysis, above standard, standard and below standard. For this study, the building condition items are aggregated into two categories, adequate and below adequate. Below adequacy is defined as any score below a four on the Likert scale.

Data Analysis

For all tests conducted the level of statistical significance was set at $\alpha = .05$.

Research Question 1

In order for research question number one to be addressed, a comprehensive analysis must be completed to provide an overall depiction of the quality of elementary schools in Michigan. The results of this particular question are described through graphs and charts that define and illustrate the condition of schools.

For question number one, which measures student enrollment on the survey, the mean, standard deviation, range, minimum, maximum and kurtosis of the sample are displayed in chart form. The previous descriptive statistics are summarized for rural, urban and suburban schools. Following the chart of descriptive statistics is a bar chart that disaggregates the student populations into seven categories 0 through 600 and higher
by 100 (i.e. 0-100; 101-200). The previous breakdown is placed on the x-axis of the bar graph and the number of schools falling into these categories is placed on the y-axis.

Question number three on the survey instrument is an overall measure of the facility condition. It requests the respondent to measure his or her building’s condition based on a Likert scale of one to seven. Thus, descriptive statistics are calculated for mean, standard deviation, range, minimum, maximum and kurtosis of the sample. Question number four on the survey requires the respondent to assess a variety of features in his or her building using the Likert scale previously described. Following the chart displaying the descriptive statistics for question number four are two tables detailing the percentage of schools that reported inadequate building features. These statistics have been completed for the total sample as well as by geographic location. The final independent variables that descriptive statistics are presented for is the free and reduced lunch percentage, which defines the socio-economic status of the building, the median income of the area the building is located in, student density, which is calculated by dividing the average square footage of the room by the average number of students in the room. These descriptive statistics are calculated as an aggregate group and by geographic region. The dependent variable of M.E.A.P. test scores on the reading and mathematics tests in grades three, four and five have the mean and standard deviation listed for all geographic locations.

Research Question 2

Research question number two is a question designed to analyze if there was any statistical difference in building condition among elementary schools in Michigan based upon their geographic location of rural, urban, and suburban. A factorial analysis was employed on question number four of the survey in order to identify a smaller number of
variables that explain most of the variance observed in the rest of the characteristics. The methodology that was constructed to answer this question will utilize question number three on the survey as a composite score labeled as overall building condition. The items in question number four have been averaged over excluding vandalism repaired to give another score denoted as total building condition. Lastly, the variables created through the factor analysis were used as the dependent variable. An ANOVA was employed to measure the overall building score, total building score and the variables as a result of the factor analysis to determine if there is any significant statistical difference between rural, urban and suburban schools in these categories.

Research Question 3

The third research question examines the relationship between student achievement and the quality of the facility itself. For this particular analysis, a multiple regression technique was employed to examine the amount of variance that can be attributed to the condition of the building on student achievement scores. The independent variables for this formula were building condition, the socio-economic rate of the school, the median income of the area in which the school is located, and student density for the grades being analyzed. As for building condition, the mean of 19 building features were utilized in order to construct a new variable, building condition that is utilized as the primary independent variable of interest. Socio-economic status will be reported by the principal on the survey instrument. The median income of the area was gathered from the demographics section of the Wikipedia, which can be accessed from the internet. The data that is included in the Wikipedia is from the census in 2000. Lastly, student density will be calculated from the information collected on question number two.
from the survey. The average number of students will be divided by the average number of students in the classroom. This calculation will produce the square feet per student in the classroom.

The dependent variable for this regression analysis will be student test scores. As previously identified, the MEAP test scores for third, fourth, and fifth grades in the subjects of reading and math for those students attaining a level 1 or a level 2 on the respective test will be utilized. The level 1 and level 2 scores will be aggregated due to the fact the State of Michigan identifies students exceeding the state standards as level 1 and meeting the state standards as level 2. Therefore, there will be six regression analyses completed for the three grade levels identified and each subject.

Research Question 4

Question number four entails a qualitative analysis with the respondent identifying three primary building conditions that need to be improved for there to be an appropriate learning environment. When the respondent identifies the three areas of need, the list will be coded in order for a logical and coherent analysis to be provided. Thus, the coding will allow for the responses to be aggregated into larger categories making the reporting more efficient and more easily comprehended by the reader.
CHAPTER IV
RESULTS

In the following chapter, the results of the study are displayed in the order of the research questions. The first set of data provides a description detailing the condition of school buildings in Michigan. Descriptive statistics are presented that describe the building condition items as reported on the survey instrument. The description of building condition begins with an analysis of how many students actually occupy these buildings by displaying the descriptive statistics for student enrollment categorized by geographic location. Following the statistics for student enrollment is a chart denoting how many years have passed since the last time the respective building had major renovations. Next, in this section, table 6 described the descriptive statistics for all the building factors that were evaluated by the principal of the building. In order to better articulate a description of the condition of the schools responding, two tables (Table 7 and 8) follow the building condition descriptive statistics. These tables represent the percentage of schools that are reporting less than adequate features. A less than adequate feature is defined by the respondent evaluating the feature as a three or lower on the Likert scale. The percentages can then be compared with the federal report highlighted in tables 1 and 2. The final portion of this section contains descriptive statistics that describe the three other independent variables being controlled in the analysis. Student density is calculated by dividing the average classroom size as reported by the principal, by the average number of students in the class creating a square footage per student figure. The median income of the area in which the school is located is reported. The final
independent, controlling variable is socio-economic status of the students, which is denoted by the free and reduced lunch percentage of the school.

The second portion of this chapter provides an analysis to determine whether various building conditions statistically differ based upon geographic region. The first analysis is a one-way, fixed-effect, fully-factorial analysis of variance (ANOVA) based upon the mean score for overall building condition, which is an individual item rated on the survey. The same analysis was completed that averages all of the factors excluding overall building condition and vandalism repaired, which is known as total building condition. Finally, a factor analysis was utilized to determine if the building condition items evaluated represent one or two factors that can have the means of these new variables created compared to determine if any significant statistical difference exists.

The third section of this chapter provides multiple regression analyses to the dependent variable of student achievement denoted as the percentage of students successfully attaining a level 1 or level 2 on the M.E.A.P. examination in reading and mathematics for the third, fourth and fifth grades. The independent variables considered are socio-economic status, median income of the area in which the school is located, student density and building condition average. Building condition average is the average of the 19 item responses (excluding overall building condition and the amount of time to respond to vandalism). Therefore, six regression analyses have been completed to determine the amount of variance building condition average has on the dependent variable.

The final section of the results chapter presents the data from the section on the survey which asked the respondents to identify the three building conditions most in need
of repair. Pie charts are utilized to give a graphic illustration of the percentages of the number of responses in each category. In order to keep the entire study correlated with previous research, the categories come from the 1996 Government Accounting Office’s study that was reviewed in chapter one. There are four pie charts, one for each geographic location, and the final one is an aggregate of all the responses.

Building Condition of Michigan Elementary Schools

The following section provides an overall description of the condition of schools in Michigan. Table 4 is a compilation of the descriptive statistics for the student enrollment of the buildings in the survey. This chart analyzes the descriptive statistics for each individual geographic location as well as the aggregate. The graph that follows illustrates the number of schools divided into seven separate categories (Figure 2). As can be seen in this graph, the majority of schools completing the survey had enrollments between 301 and 500.

Table 4

*Descriptive Statistics for Student Enrollment by Geographic Location*

<table>
<thead>
<tr>
<th>Geographic Location</th>
<th>Range</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Kurtosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rural</td>
<td>607</td>
<td>114</td>
<td>721</td>
<td>367.87</td>
<td>138.165</td>
<td>1.366</td>
</tr>
<tr>
<td>Urban</td>
<td>570</td>
<td>50</td>
<td>620</td>
<td>326.23</td>
<td>128.245</td>
<td>-0.310</td>
</tr>
<tr>
<td>Suburban</td>
<td>563</td>
<td>241</td>
<td>804</td>
<td>437.10</td>
<td>123.499</td>
<td>1.239</td>
</tr>
<tr>
<td>Aggregate</td>
<td>754</td>
<td>50</td>
<td>804</td>
<td>377.07</td>
<td>136.614</td>
<td>0.612</td>
</tr>
</tbody>
</table>
While student enrollment is not a specific building feature, it is incorporated into the quality of the building for this study. The reason for this is that buildings with a higher enrollment will tend to deteriorate faster because the more students that utilize the facility will cause faster wear on it. In addition, buildings that are overcrowded do not provide appropriate learning environments for the students. An overcrowded building will be measured later in this section as student density. The geographic location with the highest mean for student enrollment was suburban (M=437.10) then rural (M=367.87) and finally urban (M=326.23). Surprisingly, the mean of urban schools was the lowest of the three. Because urban schools serve cities, it was expected that enrollments in these schools would be higher than its counterparts.

The manner in which the age of the facility was determined was to ask the respondent to note the number of years that had passed since the last major renovation or construction. Table 5 describes the range, minimum, maximum, mean, standard deviation
and kurtosis for the time that has passed since the building was significantly renovated. These descriptive statistics are categorized by geographic location as well as an aggregate analysis.

Table 5

*Descriptive Statistics Denoting Time Since Last Major Construction by Geographic Location*

<table>
<thead>
<tr>
<th>Geographic Location</th>
<th>Range</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Kurtosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rural</td>
<td>40</td>
<td>0</td>
<td>40</td>
<td>10.17</td>
<td>10.75</td>
<td>2.544</td>
</tr>
<tr>
<td>Urban</td>
<td>50</td>
<td>1</td>
<td>51</td>
<td>15.5</td>
<td>9.92</td>
<td>5.060</td>
</tr>
<tr>
<td>Suburban</td>
<td>20</td>
<td>0</td>
<td>20</td>
<td>7.73</td>
<td>4.78</td>
<td>0.213</td>
</tr>
<tr>
<td>Aggregate</td>
<td>51</td>
<td>0</td>
<td>51</td>
<td>11.13</td>
<td>9.37</td>
<td>4.394</td>
</tr>
</tbody>
</table>

This category attempts to describe how much time has passed since buildings have been renovated or constructed. If a researcher simply takes the age of the building, then the age could potentially neglect significant remodeling, which could bring the school up to a high quality standard. For this study, the mean years since the last major construction was completed had suburban schools (M=7.73, SD=4.78) with the lowest, rural schools second (M=10.17, SD=9.92), and urban schools with the highest number of years (M=15.5, SD=9.92). Interestingly, urban schools are significantly higher than its counterparts by slightly more than five years to rural schools and slightly less than eight years to suburban schools. In summary, based upon this data set, urban schools tend to have less construction or renovation completed to keep them current and up to date.

For this study, the primary research hypothesis is the quality of building condition affecting how well students achieve on the M.E.A.P. examinations in reading and mathematics. Therefore, an overview has been completed to illustrate the condition of
Michigan schools as reported by the sample on the survey. Table 6 denotes the descriptive statistics for the aggregate building conditions. The range, minimum, maximum, mean, standard deviation and kurtosis of the sample are present. In order to accurately interpret the table, the Likert scale used on the survey instrument had building condition scores of four or higher as adequate. Therefore, scores of four or higher in this chart demonstrate building conditions that are at least adequate. To highlight one point on this table, vandalism repaired shows how quickly vandalism to a particular building is corrected. Therefore, a score of four through six would technically denote a less than adequate response ranging from monthly to yearly.

Table 6

Descriptive Statistics for Building Features

<table>
<thead>
<tr>
<th>Building Condition</th>
<th>Range</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>Std Deviation</th>
<th>Kurtosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall Building Condition</td>
<td>4</td>
<td>2</td>
<td>6</td>
<td>4.63</td>
<td>0.930</td>
<td>0.71</td>
</tr>
<tr>
<td>Roof</td>
<td>5</td>
<td>1</td>
<td>6</td>
<td>4.40</td>
<td>1.068</td>
<td>0.08</td>
</tr>
<tr>
<td>Framing, Floors and Foundations</td>
<td>5</td>
<td>1</td>
<td>6</td>
<td>4.67</td>
<td>0.994</td>
<td>1.67</td>
</tr>
<tr>
<td>Exterior Wall Condition</td>
<td>4</td>
<td>2</td>
<td>6</td>
<td>4.83</td>
<td>0.939</td>
<td>0.55</td>
</tr>
<tr>
<td>Windows</td>
<td>4</td>
<td>2</td>
<td>6</td>
<td>4.71</td>
<td>1.134</td>
<td>0.18</td>
</tr>
<tr>
<td>Doors</td>
<td>4</td>
<td>2</td>
<td>6</td>
<td>4.58</td>
<td>1.005</td>
<td>-0.37</td>
</tr>
<tr>
<td>Finishes</td>
<td>4</td>
<td>2</td>
<td>6</td>
<td>4.61</td>
<td>0.932</td>
<td>0.60</td>
</tr>
<tr>
<td>Plumbing</td>
<td>4</td>
<td>2</td>
<td>6</td>
<td>4.41</td>
<td>1.004</td>
<td>0.13</td>
</tr>
<tr>
<td>Heating</td>
<td>5</td>
<td>1</td>
<td>6</td>
<td>4.67</td>
<td>1.060</td>
<td>1.65</td>
</tr>
<tr>
<td>Electrical Power</td>
<td>4</td>
<td>2</td>
<td>6</td>
<td>4.76</td>
<td>0.903</td>
<td>0.28</td>
</tr>
<tr>
<td>Electrical Lighting</td>
<td>3</td>
<td>3</td>
<td>6</td>
<td>4.79</td>
<td>0.880</td>
<td>-0.48</td>
</tr>
<tr>
<td>Ceiling Coverings</td>
<td>5</td>
<td>1</td>
<td>6</td>
<td>4.59</td>
<td>0.982</td>
<td>1.14</td>
</tr>
<tr>
<td>Acoustics</td>
<td>5</td>
<td>1</td>
<td>6</td>
<td>4.38</td>
<td>1.012</td>
<td>0.90</td>
</tr>
<tr>
<td>Ventilation</td>
<td>4</td>
<td>2</td>
<td>6</td>
<td>4.34</td>
<td>1.072</td>
<td>-0.44</td>
</tr>
<tr>
<td>Air Conditioning</td>
<td>5</td>
<td>1</td>
<td>6</td>
<td>4.03</td>
<td>1.403</td>
<td>-0.29</td>
</tr>
<tr>
<td>Interior Wall Paint</td>
<td>4</td>
<td>2</td>
<td>6</td>
<td>4.67</td>
<td>0.874</td>
<td>0.25</td>
</tr>
<tr>
<td>Exterior Wall Paint</td>
<td>5</td>
<td>1</td>
<td>6</td>
<td>4.57</td>
<td>0.984</td>
<td>1.93</td>
</tr>
<tr>
<td>Furniture</td>
<td>5</td>
<td>1</td>
<td>6</td>
<td>4.40</td>
<td>1.089</td>
<td>0.14</td>
</tr>
<tr>
<td>Grounds</td>
<td>5</td>
<td>1</td>
<td>6</td>
<td>4.51</td>
<td>0.939</td>
<td>1.41</td>
</tr>
<tr>
<td>Vandalism</td>
<td>3</td>
<td>3</td>
<td>6</td>
<td>4.69</td>
<td>0.697</td>
<td>0.09</td>
</tr>
<tr>
<td>Vandalism Repaired</td>
<td>5</td>
<td>1</td>
<td>6</td>
<td>1.89</td>
<td>1.472</td>
<td>0.29</td>
</tr>
</tbody>
</table>

It should be noted on this chart that, as an aggregate, all building conditions are deemed to be in at least an adequate state with scores of four or higher. Vandalism repaired shows an aggregate mean of 1.89, which highlights a very quick response to
repair the violation. Based upon this set of data, the responses provided by the principals on the survey indicate that schools in Michigan, overall, are in adequate condition.

Another manner in which to summarize the condition of Michigan schools as represented by this particular data set is to note the percentage of schools reporting less than adequate facility conditions as recorded on the survey instrument. This method of reporting coincides with the USGAO study (1996) cited in tables 1 and 2 of this current analysis. One side note, the percent reported for the category of vandalism acts describes whether it occurs from a range of often to daily. This information is detailed in table 7.

Table 7

<table>
<thead>
<tr>
<th>Feature</th>
<th>Percent Less Than Adequate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall Condition</td>
<td>8.8%</td>
</tr>
<tr>
<td>Roofs</td>
<td>20.0%</td>
</tr>
<tr>
<td>Framing Floors and Foundations</td>
<td>11.1%</td>
</tr>
<tr>
<td>Exterior Walls</td>
<td>7.8%</td>
</tr>
<tr>
<td>Windows</td>
<td>14.4%</td>
</tr>
<tr>
<td>Doors</td>
<td>15.6%</td>
</tr>
<tr>
<td>Finishes</td>
<td>10.0%</td>
</tr>
<tr>
<td>Plumbing</td>
<td>17.8%</td>
</tr>
<tr>
<td>Heating</td>
<td>8.8%</td>
</tr>
<tr>
<td>Electrical Power</td>
<td>10.1%</td>
</tr>
<tr>
<td>Electrical Lighting</td>
<td>10.0%</td>
</tr>
<tr>
<td>Ceiling Coverings</td>
<td>12.2%</td>
</tr>
<tr>
<td>Acoustics</td>
<td>16.7%</td>
</tr>
<tr>
<td>Ventilation</td>
<td>20.0%</td>
</tr>
<tr>
<td>Air Conditioning</td>
<td>27.1%</td>
</tr>
<tr>
<td>Interior Wall Paint</td>
<td>10.0%</td>
</tr>
<tr>
<td>Exterior Wall Paint</td>
<td>23.0%</td>
</tr>
<tr>
<td>Furniture</td>
<td>20.0%</td>
</tr>
<tr>
<td>Grounds</td>
<td>12.2%</td>
</tr>
<tr>
<td>Vandalism</td>
<td>15.6%</td>
</tr>
</tbody>
</table>

When the building condition data is modified to show the percentage of schools that reported inadequate building features, an interesting phenomenon develops. In table
6, it was concluded that the aggregate mean for the entire sample yielded no building
conditions that were below a level of adequate. However, when the sample is analyzed
specifically for responses that are less than adequate, the data reveals a slightly different
conclusion. For instance, overall building condition for mean scores in table 6 yielded a
score of 4.63, which is considered above the adequate level. However, in table 7, the
number of schools reporting overall building condition as inadequate is 8.8%. Another
example of this would be ventilation, whereby in the mean scores, it was reported at 4.34,
again higher than adequate. Yet when one analyzes table 7, schools that reported
inadequate ventilation was 20%. The primary reason for this discrepancy lies in the
arithmetic of calculating means. It is possible that when principals rated their building
conditions, they did so quite highly, and for those that rated the condition as inadequate,
they did so slightly lower than the adequate mark of four. This in turn would explain why
the means were above the adequate mark, yet there were still many schools that labeled
the building condition as below adequate.

While the overall percentage of schools reporting less than adequate building
conditions is important as a broad description of the condition of Michigan schools, it is
evident that the disparity of building condition widens depending upon the geographic
location of the school. Table 8 displays the percentages of schools reporting less than
adequate building conditions based upon the geographic location. As with table 7, table 8
reports the category of vandalism occurrences.
Table 8

Percentage of Schools Reporting Less Than Adequate Building Conditions by Geographic Location

<table>
<thead>
<tr>
<th>Feature</th>
<th>Rural</th>
<th>Urban</th>
<th>Suburban</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall Condition</td>
<td>3.3%</td>
<td>20.0%</td>
<td>6.7%</td>
</tr>
<tr>
<td>Roofs</td>
<td>20.0%</td>
<td>30.0%</td>
<td>13.3%</td>
</tr>
<tr>
<td>Framing, Floors and Foundations</td>
<td>10.0%</td>
<td>16.7%</td>
<td>7.0%</td>
</tr>
<tr>
<td>Exterior Walls</td>
<td>16.7%</td>
<td>16.7%</td>
<td>3.3%</td>
</tr>
<tr>
<td>Windows</td>
<td>10.0%</td>
<td>26.7%</td>
<td>6.7%</td>
</tr>
<tr>
<td>Doors</td>
<td>13.3%</td>
<td>26.7%</td>
<td>3.3%</td>
</tr>
<tr>
<td>Finishes</td>
<td>6.7%</td>
<td>16.7%</td>
<td>3.3%</td>
</tr>
<tr>
<td>Plumbing</td>
<td>10.0%</td>
<td>30.0%</td>
<td>6.7%</td>
</tr>
<tr>
<td>Heating</td>
<td>10.0%</td>
<td>13.3%</td>
<td>6.7%</td>
</tr>
<tr>
<td>Electrical Power</td>
<td>13.3%</td>
<td>13.3%</td>
<td>10.0%</td>
</tr>
<tr>
<td>Electrical Lighting</td>
<td>10.0%</td>
<td>13.3%</td>
<td>3.3%</td>
</tr>
<tr>
<td>Ceiling Coverings</td>
<td>13.3%</td>
<td>20.0%</td>
<td>3.3%</td>
</tr>
<tr>
<td>Acoustics</td>
<td>10.0%</td>
<td>26.7%</td>
<td>13.3%</td>
</tr>
<tr>
<td>Ventilation</td>
<td>13.3%</td>
<td>40.0%</td>
<td>10.0%</td>
</tr>
<tr>
<td>Air Conditioning</td>
<td>17.6%</td>
<td>45.8%</td>
<td>20.8%</td>
</tr>
<tr>
<td>Interior Wall Paint</td>
<td>6.7%</td>
<td>20.0%</td>
<td>6.7%</td>
</tr>
<tr>
<td>Exterior Wall Paint</td>
<td>6.9%</td>
<td>21.4%</td>
<td>6.7%</td>
</tr>
<tr>
<td>Furniture</td>
<td>13.3%</td>
<td>36.7%</td>
<td>6.7%</td>
</tr>
<tr>
<td>Grounds</td>
<td>3.3%</td>
<td>26.7%</td>
<td>6.7%</td>
</tr>
<tr>
<td>Vandalism</td>
<td>0%</td>
<td>10.0%</td>
<td>3.3%</td>
</tr>
</tbody>
</table>

In chapter one of this study, using an initial report by the United States General Accounting Office (USGAO), a variety of building conditions and the number of schools that reported unsatisfactory conditions were described. The USGAO analysis was completed for every state in the nation. In Michigan, 51.8% of all buildings were reported as having at least one inadequate feature. In this study, 60% of the schools surveyed reported at least one building feature as being inadequate. This is slightly higher than the USGAO study. The percentage of buildings reporting inadequate features in the USGAO study can be seen in tables 1 and 2. Data was also collected that described schools...
reporting inadequate building features by geographic location. The breakdown was rural 40%, urban 90% and suburban 50%.

These results are in direct proportion to the overall condition of the building. The percentage of schools reporting less than adequate overall building conditions are urban schools 20%, suburban schools 6.7% and rural schools 3.3%. Thus, urban schools report a 10% or greater incidence in less than adequate building features overall. So, while inadequate building features for this study are within 9% of the USGAO study, urban schools in Michigan are in poorer condition than their rural and suburban counterparts. Thus, if there is any significance to the quality of building condition affecting student achievement, then urban schools could be a predictor of low student achievement.

Descriptive Statistics for the Independent Variables of Student Density, Median Income and Socio-Economic Status

Student density is critical to this analysis as it represents a controlling variable, possibly impacting the dependent variable of student achievement on the math and reading M.E.A.P. examinations. Student density was calculated by dividing the average square footage of the classrooms by the average number of students in the class. The descriptive statistics for student density are displayed in Table 9.

Table 9

<table>
<thead>
<tr>
<th>Geographic Location</th>
<th>Range</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Kurtosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rural</td>
<td>6.65</td>
<td>1.25</td>
<td>7.89</td>
<td>2.74</td>
<td>1.21</td>
<td>10.806</td>
</tr>
<tr>
<td>Urban</td>
<td>6.03</td>
<td>1.29</td>
<td>7.32</td>
<td>3.03</td>
<td>1.37</td>
<td>1.759</td>
</tr>
<tr>
<td>Suburban</td>
<td>2.80</td>
<td>0.93</td>
<td>3.73</td>
<td>2.08</td>
<td>0.68</td>
<td>0.501</td>
</tr>
<tr>
<td>Aggregate</td>
<td>6.96</td>
<td>0.93</td>
<td>7.89</td>
<td>2.62</td>
<td>1.19</td>
<td>5.681</td>
</tr>
</tbody>
</table>

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Worthy of note in this section is the mean square footage per student. In this era of school facilities in Michigan, the perception that is prevalent is that urban schools are the most overcrowded because of higher populations in urban areas resulting in very dense conditions. The results of this study tend to lend a different conclusion. For Michigan schools, the urban category, actually had the largest mean for student density (M=3.03, SD=1.37) among the geographic regions. Suburban schools, which most people typically associate with higher quality, surprisingly showed the lowest square footage per student mean (M=2.08, SD=.68) and had a lower minimum and maximum student density as well. Urban schools have seen an increase in the number of students leaving the area and attending school in suburban areas. Thus, urban schools are seeing an increase in the square footage per student while other areas are seeing a decrease.

Another controlling variable utilized in this study is the median income of the area the school is located in. The median income of the area in which the school is located has the potential of affecting student achievement as described in the literature review. The descriptive statistics for this sample can be seen in Table 10 disaggregated by geographic region.

Table 10

*Descriptive Statistics for Median Income by Geographic Location*

<table>
<thead>
<tr>
<th>Geographic Location</th>
<th>Range</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Kurtosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rural</td>
<td>$33,597.00</td>
<td>$22,829.00</td>
<td>$56,426.00</td>
<td>$36,345.43</td>
<td>$8,852.66</td>
<td>.134</td>
</tr>
<tr>
<td>Urban</td>
<td>$34,064.00</td>
<td>$17,471.00</td>
<td>$51,535.00</td>
<td>$32,865.60</td>
<td>$8,544.16</td>
<td>.509</td>
</tr>
<tr>
<td>Suburban</td>
<td>$57,367.00</td>
<td>$29,899.00</td>
<td>$87,266.00</td>
<td>$49,551.23</td>
<td>$15,646.81</td>
<td>1.230</td>
</tr>
<tr>
<td>Aggregate</td>
<td>$69,795.00</td>
<td>$17,471.00</td>
<td>$87,266.00</td>
<td>$39,567.42</td>
<td>$13,466.06</td>
<td>3.234</td>
</tr>
</tbody>
</table>

83
The results for this component of the analysis truly reflect what one would hypothesize. When looking at income levels in the different geographic regions, most people would assume the urban setting would yield the poorest mean (M=$32,865.60, SD=$8,544.16) for median income with rural slightly higher (M=36,345.43, SD=$8,852.66) and suburban the highest (M=$49,551.23, SD=$15,646.81). Cities are typically home to larger concentrations of poor people, while those that have white collar, higher paying professional careers move to the suburban areas.

The final independent variable for this study is the socio-economic status of the student. Socio-economic status is defined by the percentage of students that qualify for free or reduced lunch at school. This figure indicates the extent to which a school services impoverished students. The descriptive statistics for this variable can be seen in Table 11.

Table 11

Descriptive Statistics for Socio-Economic Status by Geographic Location

<table>
<thead>
<tr>
<th>Geographic Location</th>
<th>Range</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Kurtosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rural</td>
<td>86</td>
<td>5</td>
<td>91</td>
<td>45.83</td>
<td>22.24</td>
<td>-0.160</td>
</tr>
<tr>
<td>Urban</td>
<td>96</td>
<td>2</td>
<td>98</td>
<td>74.40</td>
<td>27.93</td>
<td>1.655</td>
</tr>
<tr>
<td>Suburban</td>
<td>71</td>
<td>4</td>
<td>75</td>
<td>32.20</td>
<td>21.33</td>
<td>-0.703</td>
</tr>
<tr>
<td>Aggregate</td>
<td>96</td>
<td>2</td>
<td>98</td>
<td>50.81</td>
<td>29.44</td>
<td>-1.228</td>
</tr>
</tbody>
</table>

As highlighted in the literature review, socio-economic status is a very significant variable in how successful students will be in school. Socio-economic status is the percentage of students who qualify for free or reduced lunch. This percentage becomes a quality measure as to the level of poverty in the school. If one were to transfer the results from the median income section to the socio-economic section, it would be logical to presume the same results. The mean socio-economic percentage for urban schools...
(M=74.40, SD=27.93) is significantly higher than rural schools (M=45.83, SD=22.24) and suburban schools (M=32.20, SD=21.33). If socio-economic status is as strong as the literature suggests in factoring how a student learns in school, then it could become a very strong predictor of student achievement.

Descriptive Statistics for the Dependent Variable of M.E.A.P. Mathematics and Reading Scores in the Third, Fourth and Fifth Grades

The dependent variable for this study, student achievement, is operationally defined by student scores in the third, fourth and fifth grades on the M.E.A.P. mathematics and reading examinations. The descriptive statistics can be seen for these grades and tests in Table 12.

Table 12

<table>
<thead>
<tr>
<th></th>
<th>Third Grade Reading</th>
<th>Third Grade Math</th>
<th>Fourth Grade Reading</th>
<th>Fourth Grade Math</th>
<th>Fifth Grade Reading</th>
<th>Fifth Grade Math</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>Std. Deviation</td>
<td>Mean</td>
<td>Std. Deviation</td>
<td>Mean</td>
<td>Std. Deviation</td>
</tr>
<tr>
<td>Rural</td>
<td>87.09</td>
<td>6.62</td>
<td>91.65</td>
<td>5.69</td>
<td>87.00</td>
<td>7.77</td>
</tr>
<tr>
<td>Urban</td>
<td>77.53</td>
<td>12.07</td>
<td>75.03</td>
<td>13.62</td>
<td>67.50</td>
<td>17.70</td>
</tr>
<tr>
<td>Suburban</td>
<td>91.53</td>
<td>7.18</td>
<td>90.13</td>
<td>6.94</td>
<td>91.87</td>
<td>5.99</td>
</tr>
<tr>
<td>Total</td>
<td>85.44</td>
<td>10.61</td>
<td>82.55</td>
<td>10.43</td>
<td>80.96</td>
<td>12.41</td>
</tr>
</tbody>
</table>

To support the contention that urban schools are in poorer condition and could negatively impact student achievement, student achievement scores must be analyzed. Table 12 demonstrates in both subjects, at all three grade levels, that urban scores are much lower than rural or suburban scores. In fact, urban school scores come no closer than 9.56% on any of the tests. At this juncture, two items seem to be relatively clear: (a) urban principals report more inadequate building features resulting in buildings that are in poor condition; and (b) urban schools have much lower student achievement on the
respective M.E.A.P. tests than rural or suburban schools. These results run contrary to studies completed that were cited in the literature review. Several researchers (Broomhall and Johnson, 1994; Broomhall, 1993; De Young, 1985) concluded that rural students perform less well than urban students on standardized tests. One possible hypothesis for this result is the influence of the socio-economic status on student success, which will be reviewed in the Discussion chapter.

Building Condition as a Function of Geographic Location

The research hypothesis for this section states that there is a statistically significant difference in building condition among the three geographic areas of rural, urban and suburban. In order to determine the accuracy of this hypothesis, one-way, fixed-effect, fully-factorial analysis of variance (ANOVA) was employed to evaluate several definitions of building conditions as a function of geographic location. The first analysis that was completed was to determine if building condition differed across geographic location based upon the overall building condition responses from the survey. For this analysis, Levene’s Test (Table 13) demonstrated that the assumption of equal variances within groups was tenable ($F_{2,87} = .358, p = .700$).

Table 13

| Levene's Test of Equality of Error Variances for Overall Building Condition |
|-----------------------------|---|---|---|
| $F$                        | $df1$ | $df2$ | $p$ |
| 0.358                      | 2     | 87    | 0.700 |

The full results for the one-way analysis of variance can be seen in table 14 labeled as overall building condition defined by geographic location. These results indicate that there is a significant difference among overall building condition as a
function of the geographic location ($F_2 = 7.57, p=.001, \eta^2=.940$). Therefore, the research hypothesis is accepted in this case. The overall building condition score on the survey instrument demonstrates a difference in building quality among the three geographic locations with suburban being the highest ($M=4.93, SD=.94$), rural the second highest ($M=4.83, SD=.75$) and lastly urban ($M=4.13, SD=.90$). This information can be seen in Table 15.

Table 14

*Analysis of Variance for Various Building Condition Variables as a Function of Geographic Location*

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>$F$</th>
<th>$\eta$</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall Building Condition x Geographic Location</td>
<td>2</td>
<td>7.57*</td>
<td>.940</td>
<td>.001</td>
</tr>
<tr>
<td>Error</td>
<td>87</td>
<td>(.753)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Building Condition x Geographic Location</td>
<td>2</td>
<td>15.042**</td>
<td>.999</td>
<td>.000</td>
</tr>
<tr>
<td>Error</td>
<td>61</td>
<td>(.359)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Structural Building Factor x Geographic Location</td>
<td>2</td>
<td>12.597**</td>
<td>.995</td>
<td>.000</td>
</tr>
<tr>
<td>Error</td>
<td>62</td>
<td>(.501)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Visual Building Factor x Geographic Location</td>
<td>2</td>
<td>4.323**</td>
<td>.976</td>
<td>.000</td>
</tr>
<tr>
<td>Error</td>
<td>62</td>
<td>(.501)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note: Values enclosed in parentheses represent mean square scores*

$p<.05. \quad **p<.01.$

Table 15

*Mean Scores for Overall Building Condition as a Function of Geographic Location*

<table>
<thead>
<tr>
<th>Geographic Location</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rural</td>
<td>4.83</td>
<td>.75</td>
</tr>
<tr>
<td>Urban</td>
<td>4.13</td>
<td>.90</td>
</tr>
<tr>
<td>Suburban</td>
<td>4.93</td>
<td>.94</td>
</tr>
<tr>
<td>Total</td>
<td>4.63</td>
<td>.93</td>
</tr>
</tbody>
</table>
Due to the fact that the analysis of variance revealed a statistically significant difference among the overall building condition scores, a *post hoc* comparison was employed using Tukey’s HSD test. This test revealed significant differences between the rural (M=4.83, SD=.75) and urban means (M=4.13, SD=.90) and between the urban (M=4.13, SD=.90) and suburban means (M=4.93, SD=.94).

The second method of defining building condition was to average the individual item scores excluding overall building condition and vandalism repaired, which created the variable of total building condition. Levene’s Test (Table 16) demonstrated that the assumption of equal variances was tenable (F\(_{2,61}\) = .167, p = .847).

Table 16

*Levene’s Test of Equality of Error Variances for Total Building Condition*

<table>
<thead>
<tr>
<th>F</th>
<th>df1</th>
<th>df2</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>.167</td>
<td>2</td>
<td>61</td>
<td>.847</td>
</tr>
</tbody>
</table>

The results for the analysis of variance comparing the means of total building condition by geographic location can be seen in Table 14. The results from this examination show that there is a significant difference among mean total building condition scores depending upon the geographic location (F\(_{2}=15.042, p<.001, \eta^2=.999\)). The mean scores for the variable of total building condition defined by geographic location can be seen in table 17.
Table 17

*Mean Scores for Total Building Condition as a Function of Geographic Location*

<table>
<thead>
<tr>
<th>Geographic Location</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rural</td>
<td>4.92</td>
<td>.56</td>
</tr>
<tr>
<td>Urban</td>
<td>4.02</td>
<td>.52</td>
</tr>
<tr>
<td>Suburban</td>
<td>4.84</td>
<td>.69</td>
</tr>
<tr>
<td>Total</td>
<td>4.55</td>
<td>.72</td>
</tr>
</tbody>
</table>

Due to the fact a statistically significant difference is evident in the results from the preceding paragraph, Tukey’s HSD test was utilized to determine where the difference exists. This examination noted the difference was between the rural mean (M=4.92, SD=.56) and the urban mean (M=4.02, SD=.52) and between the urban mean and suburban mean (M=4.84, SD=.69).

The third analysis of variance required a factor analysis of the items prior to examination. The factor analysis was conducted using principal components extraction and varimax rotation. Using .5 as the cut off point, the results in Table 18 seem to suggest that there are two factors, structural and visual. The two factors accounted for 71% of the variance.
Table 18

Results of Factor Analysis After Rotation

<table>
<thead>
<tr>
<th>Building Item</th>
<th>Structural (Factor 1)</th>
<th>Visual (Factor 2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roof Condition</td>
<td>.599</td>
<td></td>
</tr>
<tr>
<td>Electrical Lighting</td>
<td>.615</td>
<td></td>
</tr>
<tr>
<td>Ceiling Coverings</td>
<td>.788</td>
<td></td>
</tr>
<tr>
<td>Acoustics for Noise Control</td>
<td>.716</td>
<td></td>
</tr>
<tr>
<td>Interior Wall Paint</td>
<td>.806</td>
<td></td>
</tr>
<tr>
<td>Exterior Wall Paint</td>
<td>.587</td>
<td></td>
</tr>
<tr>
<td>Window Condition</td>
<td>.693</td>
<td></td>
</tr>
<tr>
<td>Door Condition</td>
<td>.653</td>
<td></td>
</tr>
<tr>
<td>Plumbing Condition</td>
<td>.592</td>
<td></td>
</tr>
<tr>
<td>Heating</td>
<td>.807</td>
<td></td>
</tr>
<tr>
<td>Electrical Power</td>
<td>.710</td>
<td></td>
</tr>
<tr>
<td>Ventilation</td>
<td>.774</td>
<td></td>
</tr>
<tr>
<td>Air Conditioning</td>
<td>.717</td>
<td></td>
</tr>
<tr>
<td>Classroom Furniture Condition</td>
<td>.714</td>
<td></td>
</tr>
<tr>
<td>Condition of Grounds</td>
<td>.602</td>
<td></td>
</tr>
</tbody>
</table>

Taking into account that two variables have been created through this factor analysis, structural and visual, an analysis of variance was employed for structural building conditions using these items as a representation of building condition along geographic definitions. Levene’s Test (Table 19) demonstrated that the assumption for equal variances is tenable ($F_{2,62}=.152, p=.860$).

Table 19

Levene’s Test of Equality of Error Variances for Structural Building Conditions

<table>
<thead>
<tr>
<th>$F$</th>
<th>df1</th>
<th>df2</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>.152</td>
<td>2</td>
<td>62</td>
<td>.860</td>
</tr>
</tbody>
</table>

The analysis of variance (Table 14) indicates that there is a statistically significant difference among mean scores for the variable structural building conditions across geographic region ($F_2=12.597, p<.001, \eta^2=.995$). To understand the difference, Tukey’s HSD test was used to determine where the difference lies. Table 20 shows the means for
the variable of structural building conditions, which highlights that the urban mean 
(M=3.90, SD=.63) differs from the rural mean (M=4.83, SD=.70) and the suburban mean 
(M=4.81, SD=.83).

Table 20

<table>
<thead>
<tr>
<th>Geographic Location</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rural</td>
<td>4.83</td>
<td>.70</td>
</tr>
<tr>
<td>Urban</td>
<td>3.90</td>
<td>.63</td>
</tr>
<tr>
<td>Suburban</td>
<td>4.81</td>
<td>.78</td>
</tr>
<tr>
<td>Total</td>
<td>4.48</td>
<td>.83</td>
</tr>
</tbody>
</table>

The final analysis of variance was conducted in the same manner as the 
previous examination, except the dependent variable changed from structural to visual. 
Levene’s Test (Table 21) demonstrates that the assumption for equal variances is tenable 
(F2, 84=.346 p=.708).

Table 21

<table>
<thead>
<tr>
<th></th>
<th>F</th>
<th>df1</th>
<th>df2</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>.346</td>
<td>2</td>
<td>84</td>
<td>.708</td>
</tr>
</tbody>
</table>

Table 14 contains the results for this final analysis of variance located in the 
category of visual building factor as a function of geographic location. The analysis 
revealed that a significant difference exists among the means (F2=4.323, p<.001, 
η²=.976). Tukey’s HSD test was employed to evaluate where the difference exists. As 
with the previous three examinations, the urban mean score (M=4.12, SD=.60) differs
between the rural mean (M=4.80, SD=.74) and between the suburban mean (M=4.79, SD=.68), which can be found in Table 22.

Table 22

Mean Scores for Structural Building Conditions as a Function of Geographic Location

<table>
<thead>
<tr>
<th>Geographic Location</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rural</td>
<td>4.80</td>
<td>.74</td>
</tr>
<tr>
<td>Urban</td>
<td>4.12</td>
<td>.60</td>
</tr>
<tr>
<td>Suburban</td>
<td>4.79</td>
<td>.68</td>
</tr>
<tr>
<td>Total</td>
<td>4.58</td>
<td>.74</td>
</tr>
</tbody>
</table>

To illustrate these four analysis of variances, Figures 3 through 6 include four line graphs that demonstrate urban mean scores are significantly lower than the rural or suburban mean scores for the four different methods of constructing building condition.

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Figure 3. ANOVA Results for Overall Building Condition as a Function of Geographic Location.

Estimated Marginal Means of Overall Building Condition

<table>
<thead>
<tr>
<th>Geographic Location</th>
<th>Estimated Marginal Means</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rural</td>
<td>4.2</td>
</tr>
<tr>
<td>Urban</td>
<td>4.6</td>
</tr>
<tr>
<td>Suburban</td>
<td>4.8</td>
</tr>
</tbody>
</table>

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Figure 4. ANOVA Results for Total Building Condition as a Function of Geographic Location.
Figure 5. ANOVA Results for Structural Conditions as a Function of Geographic Location.

Estimated Marginal Means of Structural

- Rural
- Urban
- Suburban

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While urban principals report more inadequate building features, statistical analysis investigated whether or not this has occurred simply by chance or is related to building condition. To answer this question, an analysis of variance (ANOVA) was conducted on four separate dependent variables reflecting building condition. The first ANOVA was completed using question number four on the survey, which asked the respondent to assess the overall building condition. The second method was to average across 19 individual items the respondent assessed. The last method required a factor analysis to be employed, which suggested that two factors are present that accounted for 71% of the variance. These two factors are designated as "structural" and "visual." Each ANOVA was completed using the previously mentioned building condition categories as
the dependent variable and the geographic location as the independent variable. All four ANOVAs showed a statistically significant difference among building condition scores depending upon the geographic location. Because a statistically significant difference was detected, post hoc tests were completed to determine where the difference lies. For all four ANOVAs, the post hoc tests revealed that urban building condition scores were significantly poorer than rural or suburban building condition scores. Therefore, it can be concluded that urban elementary schools in Michigan are in poorer condition than rural or suburban schools. If building condition impacts student achievement significantly, then those that manage educational programs need to be cognizant of these results.

Student Achievement Related to Building Condition

In this section the hypothesis of building condition affecting student achievement is analyzed through a multiple regression. As has been detailed previously in this study, the independent variable for this analysis is student achievement scores on the M.E.A.P. examination in the third through fifth grades. Therefore, six separate multiple regressions have been completed with building condition, socio-economic status, median income of the area and student density as the independent variables. Building condition is the average of nineteen of the items rated by the principal of the building. The items of overall condition and vandalism repaired were left out of this calculation because overall building condition on the survey is an educated guess of what the other building conditions will average to. Vandalism repaired is rated by a scale that is the opposite of the other building condition characteristics and would skew the mean of these characteristics. The objective of this section is to predict the student achievement score based upon the four independent variables presented. The analysis will then establish the
percentage of variance for which building condition is accountable regarding student
achievement on the M.E.A.P. examination.

**Third Grade Reading**

Regression analysis revealed that the model significantly predicted reading scores
on the M.E.A.P., $F_{4,85}=28.628, p<.001$. $R^2$ for the model was .574, and adjusted $R^2=.554$.
Table 23 displays the unstandardized regression coefficients (B), standardized regression
coefficients ($\beta$), observed $t$ value and significance level ($p$).

Table 23

**Multiple Regression Analysis of Socio-Economic Status, Median Income, Student Density
and Building Condition Average on Third Grade Reading M.E.A.P. Scores**

<table>
<thead>
<tr>
<th>Independent Variable</th>
<th>B</th>
<th>Beta</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Socio-Economic Status</td>
<td>-.258</td>
<td>-.717</td>
<td>-7.113</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Median Income</td>
<td>.000</td>
<td>.096</td>
<td>1.069</td>
<td>.288</td>
</tr>
<tr>
<td>Student Density</td>
<td>1.543</td>
<td>.172</td>
<td>2.253</td>
<td>.027</td>
</tr>
<tr>
<td>Building Condition Average</td>
<td>.720</td>
<td>.049</td>
<td>.628</td>
<td>.531</td>
</tr>
</tbody>
</table>

*Note: $R^2=.574$, $F_{4,85}=28.628$, $p<.001$*

In terms of individual relationships between the independent variables and third
grade reading scores, socio economic status ($t=-7.113, p<.001$) and student density
($t=2.253, p=.027$) each significantly predicted third grade reading scores. Looking at the
$p$-values for this analysis, it can be seen that socio-economic status and student density
have the greatest chance of increasing the predictive power of the independent variable.
Socio-economic status has a 99% chance of adding predictive power to a study. In order
to determine how much of an impact building condition had on third grade reading
scores, the effect size ($R^2$) must be evaluated. For this regression analysis, $R^2=.574$.
Therefore, 57.4% of the variance for third grade reading scores on the M.E.A.P. can be
attributed to the four independent variables.
When the regression analysis is completed again without building condition as an independent variable, $R^2=.571$. This indicates that the addition of building condition as an independent variable explains only .3\% more variation in third grade reading scores on the M.E.A.P.

**Third Grade Math**

Regression analysis again yielded results that the four independent variables significantly predicted student achievement on the M.E.A.P. math test for third grade students in Michigan ($F_{4,85}=24.103, p<.001$). $R^2$ for the model was .531 and adjusted $R^2$ was .509. The unstandardized regression coefficients, standardized regression coefficients, observed $t$ value and level of significance are displayed in table 24.

Table 24

*Multiple Regression Analysis of Socio-Economic Status, Median Income, Student Density and Building Condition Average on Third Grade Math M.E.A.P. Scores*

<table>
<thead>
<tr>
<th>Independent Variable</th>
<th>$B$</th>
<th>Beta</th>
<th>$t$</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Socio-Economic Status</td>
<td>-.276</td>
<td>-.655</td>
<td>-6.195</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Median Income</td>
<td>.000</td>
<td>.071</td>
<td>.756</td>
<td>.452</td>
</tr>
<tr>
<td>Student Density</td>
<td>.962</td>
<td>.092</td>
<td>1.145</td>
<td>.256</td>
</tr>
<tr>
<td>Building Condition Average</td>
<td>1.981</td>
<td>.115</td>
<td>1.408</td>
<td>.163</td>
</tr>
</tbody>
</table>

*Note: $R^2=.531, F_{4,85}=24.103, p<.001$*

The individual relationship between the independent variables demonstrated that socio-economic status was the only variable that significantly predicted student achievement on the third grade M.E.A.P. math examination ($r=-6.195, p<.001$). These four variables together represented about 53\% of the shared variability. For this particular analysis building condition average does not appear to be significant for third grade student achievement scores on the M.E.A.P. examinations.

99
Fourth Grade Reading

Regression analysis demonstrated significant results for this particular data set \( (F_{4,85}=29.679, p<.001) \). \( R^2 \) for the model was .583 and adjusted \( R^2 \) was .563. The unstandardized regression coefficients, standardized regression coefficients, observed \( t \) value and level of significance are displayed in table 25.

Table 25

*Multiple Regression Analysis of Socio-Economic Status, Median Income, Student Density and Building Condition Average on Fourth Grade Reading M.E.A.P. Scores*

<table>
<thead>
<tr>
<th>Independent Variable</th>
<th>B</th>
<th>Beta</th>
<th>( t )</th>
<th>( p )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Socio-Economic Status</td>
<td>-.303</td>
<td>-.685</td>
<td>-6.866</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Median Income</td>
<td>.000</td>
<td>.058</td>
<td>.657</td>
<td>.513</td>
</tr>
<tr>
<td>Student Density</td>
<td>1.720</td>
<td>.156</td>
<td>2.067</td>
<td>.042</td>
</tr>
<tr>
<td>Building Condition Average</td>
<td>2.894</td>
<td>.161</td>
<td>2.078</td>
<td>.041</td>
</tr>
</tbody>
</table>

*Note: \( R^2 = .583, F_{4,85} = 29.679, p<.001 \)*

In terms of the individual relationships between the independent variables and student achievement on the fourth grade reading M.E.A.P. examination, socio-economic status \( (t=-6.866, p<.001) \), student density \( (t=-2.067, p=.042) \) and building condition average \( (t=-2.078, p=.041) \) each significantly predicted student achievement on the test. These results demonstrate that building condition has a 95.9% chance of adding predictive power. Together, those three independent variables contributed 58.1% in shared variability. Most germane to this current study, however, is the finding that building condition contributed only 1% in shared variability with the dependent variable.
Fourth Grade Math

Regression analysis revealed significant results for the four independent variables predicting student achievement on the fourth grade math M.E.A.P. examination \((F_{4,85}=36.10, p<.001)\). \(R^2\) for the model was .630 and adjusted \(R^2\) was .612. The unstandardized regression coefficients, standardized regression coefficients, observed \(t\) value and level of significance are displayed in table 26.

Table 26

*Multiple Regression Analysis of Socio-Economic Status, Median Income, Student Density and Building Condition Average on Fourth Grade Math M.E.A.P. Scores*

<table>
<thead>
<tr>
<th>Independent Variable</th>
<th>(B)</th>
<th>Beta</th>
<th>(t)</th>
<th>(p)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Socio-Economic Status</td>
<td>-.362</td>
<td>-.667</td>
<td>-7.098</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Median Income</td>
<td>.000</td>
<td>-.005</td>
<td>-.056</td>
<td>.956</td>
</tr>
<tr>
<td>Student Density</td>
<td>-.548</td>
<td>-.041</td>
<td>-.569</td>
<td>.571</td>
</tr>
<tr>
<td>Building Condition Average</td>
<td>4.812</td>
<td>.218</td>
<td>2.989</td>
<td>.004</td>
</tr>
</tbody>
</table>

*Note: \(R^2=.630, F_{4, 85}=36.109, p<.001\)*

The individual relationship showed that socio-economic status \((t=-7.098, p<.001)\) and building condition \((t=2.989, p=.004)\) significantly predicted student achievement on the fourth grade M.E.A.P. math examination. Building condition, therefore, had a 96% chance of adding predictive power to the study. These two variables, combined, accounted for 63% of the shared variability while building condition accounted for 3.9% in shared variability with the dependent variable.

Fifth Grade Reading

The regression analysis showed significance between the four independent variables and fifth grade student achievement on the M.E.A.P. reading examination \((F_{4, 85}=33.090, p<.001)\). \(R^2\) for the model was .615 and adjusted \(R^2\) was .596. The
unstandardized regression coefficients, standardized regression coefficients, observed $t$ value and level of significance are displayed in table 27

Table 27

*Multiple Regression Analysis of Socio-Economic Status, Median Income, Student Density and Building Condition Average on Fifth Grade Reading M.E.A.P. Scores*

<table>
<thead>
<tr>
<th>Independent Variable</th>
<th>B</th>
<th>Beta</th>
<th>$t$</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Socio-Economic Status</td>
<td>-.348</td>
<td>-.701</td>
<td>-7.197</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Median Income</td>
<td>.000</td>
<td>-.026</td>
<td>-.300</td>
<td>.765</td>
</tr>
<tr>
<td>Student Density</td>
<td>.673</td>
<td>.055</td>
<td>.741</td>
<td>.461</td>
</tr>
<tr>
<td>Building Condition Average</td>
<td>4.372</td>
<td>.216</td>
<td>2.858</td>
<td>.005</td>
</tr>
</tbody>
</table>

*Note: $R^2=.615$, $F_{4, 83}=33.090$, $p<.001$*

Individually, socio-economic status ($t=-7.197, p<.001$) and building condition average ($t=2.858, p=.005$) significantly predicted student achievement on the fifth grade M.E.A.P. examination in reading. These results show that building achievement has a 95% chance of adding predictive power to the analysis. The two significant variables then account for 61.3% of shared variability. Building condition average, therefore, accounted for 4.2% in shared variability with the dependent variable.

*Fifth Grade Math*

The final dependent variable for this section, fifth grade math, also yielded significant results with the four dependent variables on the regression analysis ($F_{4, 83}=33.090, p<.001$). $R^2$ for the model was .688 and adjusted $R^2$ was .673. The unstandardized regression coefficients, standardized regression coefficients, observed $t$ value and level of significance are displayed in table 28.
Table 28

Multiple Regression Analysis of Socio-Economic Status, Median Income, Student Density and Building Condition Average on Fifth Grade Math M.E.A.P. Scores

<table>
<thead>
<tr>
<th>Independent Variable</th>
<th>B</th>
<th>Beta</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Socio-Economic Status</td>
<td>-.500</td>
<td>-.727</td>
<td>-8.302</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Median Income</td>
<td>.000</td>
<td>-.075</td>
<td>-.963</td>
<td>.339</td>
</tr>
<tr>
<td>Student Density</td>
<td>-1.199</td>
<td>-.070</td>
<td>-1.059</td>
<td>.293</td>
</tr>
<tr>
<td>Building Condition Average</td>
<td>6.292</td>
<td>.225</td>
<td>3.300</td>
<td>.001</td>
</tr>
</tbody>
</table>

*Note: R^2=.668, F_{4,83}=45.813, p<.001*

In terms of the individual relationships between the independent variables and student achievement of the fifth grade math M.E.A.P. examination, socio-economic status ($t=-8.302, p<.001$) and building condition average ($t=3.300, p=.001$) each significantly predicted student achievement on the examination. These results show that building condition average has a 99% chance of increasing the predictive power of the study. The two significant independent variables accounted for 68% of the shared variance and specifically, building condition contributed 3.8% in shared variability.

Six separate multiple regression analyses were employed with the math and reading scores from the M.E.A.P. examination in the third, fourth and fifth grades being used as the dependent variable. All six of the regressions were significant. The four independent variables that were selected accounted for 53% to 69% of the variance in predicting student achievement. These four independent variables account for roughly one-half to two-thirds of the variance.

For third grade reading scores building condition is not significant. Student density and socio-economic status are the two independent variables that register significance. As one can quickly notice by analyzing all of the regression results, socio-economic status is highly significant as a predictor of student achievement. One possible
conclusion that can be drawn from the result is that third graders are unaware of their surroundings that affect the way they learn. The literature review in this study provided evidence that demonstrated younger children are not as cognizant of their world around them, therefore, external surroundings have less effect academically. That is why younger children that may have negative societal factors still perform well. Third grade students may not respond to the non-significant independent variables which could impact his or her ability to learn.

The fourth and fifth grade regression analysis yielded significant results in both math and reading with the independent variables of socio-economic status and building condition containing most of the variance in the analysis. While building condition is the main variable of importance for this study, it is important to note the amount of variance attributed to this variable. For this analysis, building condition accounted for 1% to 4.2% of the variance, depending upon the subject. Therefore, even though building condition is statistically significant in concert with the other independent variables, it accounts for very little of the variance toward student achievement. These results coincide with the study of Picus et al., (2005), which concludes that, “...clearly...there is essentially no relationship between building condition...and student achievement...” (p. 88). Other studies concluded that building condition affects how students achieve academically, but for this study, it reported out a minimal influence, which only serves to increase the ambiguity about how statistically significant building condition is in affecting student achievement.
Improvements Needed to Elementary Schools as Reported by the Principals

This final section is intended to give an overall analysis of which conditions the principals, that completed the survey, think are important to correct. While principals are not necessarily experts in building condition, they do have first hand knowledge of instructional practices for their students. It is not unreasonable to assume that principals can identify specific building conditions that are in less than adequate condition and that could potentially affect student achievement. This next analysis is a compilation of the principals’ assessment of which building conditions are in the greatest need of repair. The summaries are completed as pie graphs denoting the percentages for each category. All of the characteristics are representative of the 1996 Government Accounting Office’s report, previously referenced in tables 1 and 2 of this study.
Figure 7 is a pie chart that disaggregates the responses for rural schools by the previously indicated characteristics. Rural school principals identified heating, ventilation and air conditioning (HVAC) as the primary need for improvements. 19% believe their building is in need of some type of HVAC repair. The largest percentage for rural schools came in the area of other, which constituted any condition that could not be coded into one of the other characteristics. An example of other was too few computers or not enough parking spaces. The area reported in the least need of repair was framing, floors and foundations.

Figure 7. Rural Building Conditions in Need of Repair.
Figure 8 represents the items in need of repair as reported by urban principals. This segment of principals noted that the greatest need to repair building conditions that were less than adequate fell in the category of framing, floors and foundations. Excluding the other category, playground, roofs and plumbing saw the least percentage (7%) of principals stating this was an area of need for repair.

*Figure 8. Urban Building Conditions in Need of Repair.*
Suburban principals highlighted that interior finishes were their greatest concern. 38% (Figure 9) reported that interior finishes needed addressing in his or her building to bring it to a point of adequacy. Playgrounds tended to be the area the principals found the least amount of concern in this study as only 2% indicated this as an area of concern.

Figure 9. Suburban Building Conditions in Need of Repair.
Below, is a pie graph representing the aggregate of the rural, urban and suburban principal responses. Figure 10 shows that interior finishes was the area that many principals found needed improving in order to bring it to an adequate condition. Several areas were of the least concern, individually representing 7% of the analysis.

*Figure 10. Total Building Conditions in need of Repair.*

Many of the conditions that are highlighted in these charts that principals believe are need of repair constitute basic improvements. There are a variety of building conditions that need to be repaired, but would be considered cosmetic in nature such as interior finishes. Therefore, these features are not necessarily critical to the building’s function, but may be aesthetically pleasing when corrected. Items that are critical to the day to day functioning of the building like framings, floors and foundations or HVAC,
seem to be in need of more repairs in urban schools. This data supports the earlier assessment that urban schools are in poor condition, because not only are they rated in poorer condition, principals of these schools also highlight foundational areas that need improvement.
CHAPTER V
DISCUSSION, IMPLICATIONS, AND RECOMMENDATIONS

Introduction

The purpose of this study was to define the condition of elementary schools in Michigan, assess whether the geographic location of the school was a factor in building condition and to determine whether or not these conditions impact student achievement on the Michigan Educational Assessment Program (M.E.A.P.) examinations in reading and mathematics for the third, fourth and fifth grade levels. While several studies have been completed, researchers acknowledge that not enough studies have been done to make strong generalizations (Picus et al., 2005; Earthman, 1998). While researchers believe the notion that building quality impacts student achievement, Picus et al., (2005) qualifies the statement by theorizing that statistically significant relationships have been difficult to obtain. This study investigated how the condition of Michigan schools affected student achievement across the state.

Overview of Significant Findings

School Facility Quality in Michigan

In 1996, the USGAO completed a study that detailed the inadequacy of school facilities across the nation. Michigan was part of that study. That analysis concluded that over one-half of all Michigan schools reported at least one inadequate building feature. Eleven years later, the results changed slightly for the worse with 60% of schools reporting at least one inadequate building feature for this study. Based upon this statistic, little improvement has been made in facility quality throughout schools in Michigan.
The descriptive statistics that were reported in table 6 of the results chapter showed the means for all of the characteristics rated. The means for all of these characteristics were above four, which constituted an adequate feature. When the individual building is analyzed for reporting inadequate features, the description of the condition of the building changes. All categories of building condition characteristics reported schools with inadequate features. The lowest category was exterior walls at 7.8% and the highest was air conditioning (for those schools that have this feature) at 27.1%. The concern for school facility quality increases when the building characteristics are disaggregated by geographic location. In many cases, urban schools are at least 20 percentage points higher for reporting inadequate building conditions. Many of the building conditions reported as inadequate are structural components that are necessary for buildings to function at a basic level. Because urban schools reported more inadequate building conditions, the subject is worth examining further.

School Facility Quality as a Result of Geographic Location

Urban schools reported substantially poorer conditioned facilities than its suburban and rural counterparts. This difference is verified statistically. Four different variations of the variable building condition were created in order to verify the association between geographic location and building condition. The survey had a single question which asked the respondent to identify the overall condition of the building. The means for these scores were then analyzed by geographic location using an ANOVA, which yielded significant results. Post hoc tests confirmed a statistically significant difference with urban means being lower than either rural or suburban means. ANOVAs were completed for the three remaining building condition variables with the same
results. Those variables were total building condition, which was an average of all the building characteristics and a factor analysis, which identified two factors, structural and visual. These factors were found to have the same conclusion: undeniably, urban school facilities are in poorer condition than rural or suburban schools.

To further describe the condition of urban schools, a few other descriptors need to be addressed. The student enrollment mean for urban schools is lower than suburban or rural enrollment means. This runs contrary to the notion that schools located in cities are more populated than the other geographic areas. This could imply that there are more schools in urban areas, which lowers the number of students attending them or students are leaving urban areas to attend school in rural or suburban communities. However, what is of interest is that when one analyzes the means for student density, it becomes evident that urban schools have the highest square footage per student. This statistic supports the earlier notion that either there are more school buildings in urban areas to accommodate the students or students are leaving urban areas, yet, overall, they are in poorer condition.

One possible explanation for this phenomenon is the age of the building. Building age, as assessed by the literature review, was determined to be an important factor of building condition. For this study, building condition was defined as the number of years that had passed since the last time the building was significantly renovated, or was newly constructed. Urban schools went 5.33 years longer than rural schools and 7.77 years longer than suburban schools since the last major update to the building. The conclusion that is made from this information is that urban schools are not renovated as quickly as its counterparts, which causes more deterioration in building quality. Therefore, in
connection with the preceding paragraph, which demonstrated there are not as many students in urban schools as rural or suburban, the buildings have most likely been in existence longer, and have not been improved upon as quickly as rural or suburban schools leaving them in poorer condition.

**Building Condition Affecting Student Achievement**

The main purpose of this study was to determine if student achievement was affected by the condition of the facility. After completing the regression analyses, building condition was significant in 4 out of 6 tests. In the four significant tests, the variance attributable to building condition ranged from 1% to 4.2%. This demonstrates the fact that building condition did not affect student achievement to a large degree. However, the variable socio-economic status, which reported the percentage of students that qualify for a free or reduced lunch, was very influential in predicting student achievement. All six regression analyses demonstrated that socio-economic status was significant and it yielded at least 50% of the variance in all six tests.

**Areas in Need of Repair According to Principals**

The last portion of this study was designed to highlight the building conditions that are in need of repair as listed by the principal of the building. This information was presented in pie chart form in chapter 4. Collectively, among the three geographic regions, interior finishes and HVAC were the issues highlighted the most by the respondents. HVAC was reported to be an area that needs improvement in all three of the geographic regions. This coordinates with the data collected highlighting significant inadequacies for the category of HVAC. Interior finishes was an area noted by the respondents, collectively, as well as by geographic location as an area of need as well.
However, the data collected for inadequacies does not completely correlate with the need for repair. More respondents stated the need for repair of this feature than those that reported it as inadequate. This is likely because for principals interior features could be adequate or functional, but it can be an area to improve upon to make the building more aesthetically pleasing for students and staff. Overall, the principals believe that the areas in the greatest need of repair lie in the structural areas, which are construed as basic building features.

Current Findings Compared withExisting Research

The overall conclusion to this study is that in Michigan, schools with inadequate conditions are comparable to those reported in the 1996 study completed by the USGAO with urban schools being in poorer condition than the rural or suburban schools. Although, based upon the conclusions of this study, it was determined that building condition has very little effect on how students perform academically. These conclusions are in contrast to studies completed by Phillips (1997), Cash (1993) and Hines (1996), which determined that higher quality facilities positively affected student achievement. A recent study completed by Picus et al., (2005) concluded just the opposite. These researchers stated that, “...these analyses clearly indicate that there is essentially no relationship between building condition ...and student achievement ...meaning higher quality buildings are unrelated to higher levels of student academic achievement" (p. 89). The conclusion by Picus et al., (2005) correlates with the conclusions of this study in that building condition minimally affects student achievement. The conflict that is present is summarized by Earthman and Lemasters (1996), “...even with this large number of studies, it is difficult to determine any definite line of consistent findings” (p. 3).
While statistically it may be difficult to obtain a significant relationship between building condition and student achievement, the studies cited in this paper and the data collected demonstrate a cause for concern about the quality of elementary schools in Michigan. As the 1996 USGAO study showed, 60% of America’s schools reported at least one inadequate building feature. The report stated that Michigan schools had 51.8% of its schools reporting at least one inadequate building feature. For the current analysis, the data supported the national average with 60% of Michigan schools reporting at least one inadequate building feature, slightly above the USGAO’s assessment of 51.8%. While a direct correlation between facility quality and student achievement may be difficult to detect, the surveys showed that those involved with schools sense the concern for having well-built school facilities and understand their role in the education of children. Even though direct relationships may be difficult to obtain, indirect correlations seem to potentially exist.

The reality of an indirect relationship between facility condition and student achievement is confirmed by the responses of principals in this study regarding conditions that need improvement in his or her building. For example, heating, ventilation, and air conditioning (HVAC) is a feature described in the literature review that undeniably can cause indirect influence on student achievement. If air quality is poor and a carrier of microbiological organisms, students can become ill, lose concentration, or miss school altogether, which obviously impacts the students’ ability to achieve academically.

It is reasonable to assume that an indirect correlation exists between building condition and student achievement. As the example in the preceding paragraph
demonstrates, the condition of the building will to some extent affect how students learn. Even though this analysis did not yield significant quantitative evidence to support the hypothesis, it is reasonable to speculate that an appropriate learning environment would facilitate better achievement. For example, a room that is significantly smaller than a regular sized room, which has more students assigned to it than should be in there, will result in a potentially uncomfortable environment; and if the students are uncomfortable, the chance is greater that it will affect their achievement overall. Another quality example of this is poor ventilation, which was reviewed in the literature review. If the air in the classrooms is not purified effectively, then the potential for students to become ill increases. When students are ill the chances for absenteeism increases, which causes students to lose instructional time causing them to potentially not achieve academically as they otherwise would have. Therefore, indirect correlations can still potentially exists between facility quality and student achievement.

Implications for Current Theory

This study had a practical application at the outset, and that was to determine if facility quality impacts student achievement in Michigan elementary schools enough so policymakers can support the call for funding the construction of schools through this research. The results of this study conclude that higher quality schools do not affect student learning, which adds to the conflict that already exists among the literature. This study had similar conclusions to the Picus, et al., (2005) analysis and the statistical models were fairly similar. Because some of the literature is reporting a relationship and others are not, policymakers, including school officials, must be very careful about promoting ideas using this research as support. These findings are critically important in
Michigan as more schools are becoming older with more structural and cosmetic deficiencies. The call for improved funding for school construction in Michigan is great. However, in light of recent studies on this subject, educational resources may have greater potential of affecting student learning in other areas.

Recommendations for Further Study

Correlating building condition with student achievement is a complex phenomenon that will require additional investigation to make solid generalizations. The literature leaves ambiguity regarding the contention that higher quality buildings are related to higher levels of student academic achievement. Another substantial issue is the number of variables that impact how students learn. One important variable worth noting is teacher quality. Obviously, the pedagogical methods that an instructor employs on a daily basis impacts how students learn. The difficulty with this component is that measuring teacher quality is fairly subjective. Educators, parents, and students know what good teaching looks like, and they know the difference between a good and bad teacher, but providing an objective measurement for this characteristic is difficult. One study that could potentially lend some insight into developing a method to assess teacher quality is an instrument completed by DeAngelis, Presley, and White (2005), which provides a composite measure that indexes teacher quality.

A second suggestion for further study is to increase the size of the sample. This could be done in several ways. One way to increase the sample is to open the research to schools outside the state of Michigan. This would give a larger number of schools to assess and this would provide a better representation of building conditions from which to make generalizations. A second way to increase the sample size is to
include secondary schools as well as elementary schools. This study utilized only elementary schools in the state of Michigan and it may be too small of sample to truly answer the question about high quality buildings affecting student achievement.

A third consideration for further study is the manner in which the quality of the facility is assessed. For this study, the building principal was the main source for evaluating the condition of the building. A principal has general knowledge of the condition of his or her building and has knowledge about how the condition of the building impacts student learning. However, he or she is not an expert in architecture and, therefore, the analysis he or she gives may be subjective. It would be beneficial if an expert in building condition were to evaluate the facilities to ensure the facility is evaluated in an objective a manner.

A fourth phenomenon is to investigate thoroughly the impact socio-economic status has on student achievement. The literature review analyzed socio-economic status and how it affects student learning. The research reviewed for this study affirmed that low socio-economic students are less successful academically (Haskell, 2005). This analysis supported this contention because with each of the regression analyses that were conducted, the independent variable of socio-economic status was a highly significant predictor of student achievement. When the socio-economic status is analyzed for the variance associated with student achievement, this study demonstrated a strong relationship. It is apparent through analyzing the literature and the results for this study that socio-economic status is a strong predictor of how students will achieve academically and should be examined further.
The final recommendation for further study is to analyze urban schools more closely as it relates to building condition and student achievement. It was determined in this study that urban facility quality is substantially lower than either rural or suburban. It would be worthy to note how students achieve in urban facilities comparing adequate facilities to inadequate facilities. This may help to reduce the "statistical noise" surrounding the confounding variables, especially socio-economic status. Socio-economic status was found to have tremendous influence in student achievement therefore, if most of the sample had roughly the same socio-economic status, a higher statistical significance may be detected correlating building condition and student achievement.
Appendix A

Survey Instrument
Survey Instrument

1. What is the total number of FTE students in the building?
   _____________________ FTE students

2. Based upon your third, fourth and fifth grade classes, please answer the following questions:
   How many teachers are in those grades? _____________________
   How many total classes are at those grades? _____________________
   What is the average number of students in those classes? _____________________
   What is the average size in square feet of those classrooms? _____________________

3. What is the overall condition of the building? Refer to the rating scale shown below. Overall condition includes both physical condition and the ability of the buildings to meet the functional requirements of the instructional programs.

   Excellent: new or easily restorable to "like new condition; only minimal routine maintenance required.
   Good: only routine maintenance or minor repair required.
   Adequate: some preventive maintenance and/or corrective repair required.
   Fair: fails to meet code and functional requirement in some cases; failure(s) are inconvenient; extensive corrective maintenance and repair required
   Poor: consistent substandard performance; failure(s) are disruptive and costly; fails most code and functional requirements; requires constant attention, renovation, or replacement. Major corrective repair or overhaul required.
   Replace: Non-operational or significantly substandard performance. Replacement required.

   Replace  Poor  Fair  Adequate  Good  Excellent
   1--------2--------3--------4--------5--------6

4. Overall, what is the physical condition of each of the building features listed below:

   Excellent: new or easily restorable to "like new condition; only minimal routine maintenance required.
   Good: only routine maintenance or minor repair required.
   Adequate: some preventive maintenance and/or corrective repair required.
**Fair:** fails to meet code and functional requirement in some cases; failure(s) are inconvenient; extensive corrective maintenance and repair required

**Poor:** consistent substandard performance; failure(s) are disruptive and costly; fails most code and functional requirements; requires constant attention, renovation, or replacement. Major corrective repair or overhaul required.

**Replace:** Non-operational or significantly substandard performance. Replacement required.

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### B. Framing, floors, foundations

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### F. Finishes

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H. Heating

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K. Ceiling coverings

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L. Acoustics for noise control

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M. Ventilation

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N. Air conditioning

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O. Interior wall paint

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Q. Classroom furniture

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R. Grounds

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S. Vandalism

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T. Vandalism Repaired

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5. What is the Socio-Economic rate of the building (Free/Reduced Lunch percent)?

____________________________ %

6. What is the percentage of students passing the MEAP in the following grades and subjects?

- 3rd Grade Reading: ______
- 3rd Grade Math: ______
- 4th Grade Reading: ______
- 4th Grade Math: ______
- 5th Grade Reading: ______
- 5th Grade Math: ______

7. How many years since the building’s last major renovation? ________________

8. Please list the three characteristics you feel are in the greatest need of repair in order to provide the best learning environment for your students.

1. __________________________________________
2. __________________________________________
3. __________________________________________
Appendix B

Human Subjects Institutional Review Board

Letter of Approval
Date: April 17, 2007

To: Sue Poppink, Principal Investigator
    Brett Geier, Student Investigator for dissertation

From: Amy Naugle, Ph.D., Chair

Re: HSIRB Project Number: 07-04-16

This letter will serve as confirmation that your research project entitled “Facility Quality of Elementary Schools in the State of Michigan and Its Association on Student Achievement in Math and Reading on the Michigan Educational Assessment Program” has been approved under the exempt category of review by the Human Subjects Institutional Review Board. The conditions and duration of this approval are specified in the Policies of Western Michigan University. You may now begin to implement the research as described in the application.

Please note that you may only conduct this research exactly in the form it was approved. You must seek specific board approval for any changes in this project. You must also seek reapproval if the project extends beyond the termination date noted below. In addition if there are any unanticipated adverse reactions or unanticipated events associated with the conduct of this research, you should immediately suspend the project and contact the Chair of the HSIRB for consultation.

The Board wishes you success in the pursuit of your research goals.

Approval Termination: April 17, 2008
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