



SCHOOL ENVIRONMENT IMPACT RESEARCH STUDY

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In 2007 the Provincial Executive had proposed in the Annual Action Plan a research study aimed at verifying the importance and value of using board employed staff in providing student services, namely the professional student service personnel. The resulting report, *Enhancing Services, Enhancing Success*, was used to help establish outside agency protocols around the province and assist in protecting important support service jobs.

The 2013–2014 Annual Action Plan included a research project that examines the relationship between school cleanliness/maintenance and student performance. The study was to clearly demonstrate the importance of adequate funding for the maintenance of current structures and could be used to demonstrate that improving the overall building condition is a cost effective way to achieve measurable improvements in student performance.

The next step in this process will be to develop lobby materials based on the report for use by local Bargaining Units and Districts.

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This research project was approved at AMPA 2013 as part of the Annual Action Plan for the 2013-2014 Federation year. The goal of the project was to collate and summarize recent research papers that examine the relationship between school cleanliness and maintenance and student performance.

There is a growing body of research that provides evidence of the link between the condition of a school building and the achievement of its students. The vast majority of this research comes from the United States, and is varying in its methodology and focus.

In *Healthy Schools are Clean, Dry, and Productive*, Dr. Michael Berry states that:

“a school’s interior climate, appearance, and cleanliness send either a positive or negative message to students, teachers, and staff. Emerging evidence suggests that environmental conditions that create a sense of ‘well-being’ and send a ‘caring message’ contribute directly to positive attitudes and elevated performance as measured by fewer health complaints, improved student attendance, teacher retention, and higher test scores.” (p. 1)

The studies that have been undertaken to date target a wide variety of items when considering the condition of a school building. Examples of the components considered include acoustics, presence of air conditioning, type of lighting, recency of painting, colour of paint used in classrooms, frequency of sweeping and mopping, condition of lockers, condition of classroom furniture, and presence of graffiti, just to name a few. There is also variance in the methods and instruments used to measure the condition of school buildings. A common method is to survey a school representative on the presence or condition of the components, examples of which are given above.

One such instrument, the Commonwealth Assessment of Physical Environment, or CAPE, was developed by researchers for just this purpose. The CAPE was first used in a 1993 study for the purpose of assessing the condition of 47 small rural high schools in Virginia so that comparisons could be made with student achievement

levels. Several subsequent studies conducted for the same purpose used either the original CAPE instrument, or a similar instrument derived from it. In this report, nine studies using CAPE or a derivative are included in the Literature Review section.

The CAPE instrument allows researchers to classify schools into one of three categories—substandard, standard, or above standard. The specific building items or attributes included in the CAPE are divided into two categories—cosmetic and structural. Cosmetic items are generally those which speak to the appearance of the school, such as condition and colour of paint and the frequency of mopping and sweeping. The structural category includes items such as presence of air conditioning and type of lighting. The CAPE allows researchers to assign a score to the overall condition of a school building, as well as individual scores for cosmetic condition and structural condition. Thus, researchers are then able to compare student achievement to the overall condition, as well as individually to one of the two categories of building condition.

The purpose of this project was to examine the relationship between student performance and school cleanliness and maintenance. Since items related to the cleanliness and maintenance of a school fall generally into the cosmetic category, studies which were conducted using the CAPE allow for this delineation and are then an effective tool in examining this relationship. However, a significant number of the studies do not use the CAPE but nonetheless provide research that is helpful in determining the relationship between the school facility and student achievement.

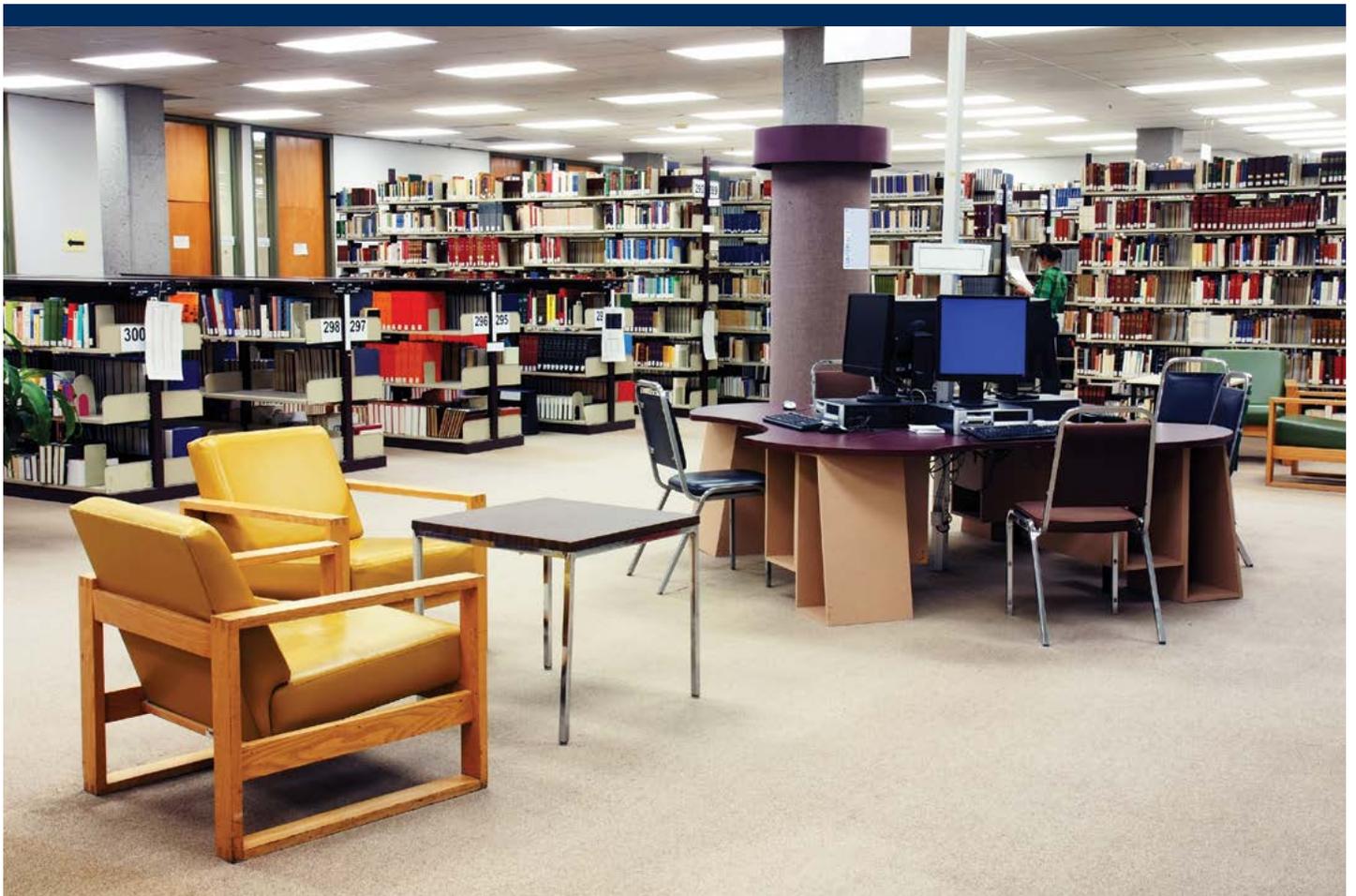
Some of the studies reviewed included examining components which are not relevant to the purpose here, such as the availability or condition of science laboratories and/or laboratory equipment, or design features of the building such as open concept classrooms. Others looked at teacher satisfaction and turnover rates as compared to school facility conditions as well as student achievement.

Another point of variance in the studies reviewed is the method used to measure student achievement, although the majority of the research uses scores from some type of standardized testing. While some studies reported raw scores from testing, some used percentage scores, others percentage pass rates, and still others reported percentage rankings. In addition, in many studies the scores were adjusted for the socioeconomic status of the population in order to control for this variable.

Given the parameters of this project, as described above, the main focus of this report is on studies which allow cosmetic condition, as a reflection of cleanliness and maintenance, to be compared with student achievement. In general, studies which did not permit that direct comparison are not included here.

Further, given that the Annual Action Plan referred to an ‘examination of recent studies’, the decision was made to focus on studies completed in the past 20 years, from 1993 to present—including Cash’s seminal 1993 research.

LITERATURE REVIEW



1. REVIEWS/SYNTHESSES OF RESEARCH

Earthman and Lemasters (1996)

The researchers conducted a review of relevant research and studies to examine the relationship between the built environment and student achievement and behaviour.

This investigation included a review of two surveys of previous research, one completed by Weinstein (1979) which included an examination of one hundred forty one previously published studies, and the other by McGuffey (1982) which involved a review of eighty eight published studies. While McGuffey had cautioned readers that the previous studies represented a very wide variety of methodologies examining a divergence of variables, the authors did state that based on the volume of studies reviewed “one must conclude that school facilities do indeed effect student achievement and behaviour.” (p. 8)

The studies reviewed by Earthman and Lemasters included Edwards (1992), Cash (1993), Earthman, Cash and Van Berkum (1995), and Hines (1996), the latter three of which are reviewed latter in this report.

Edwards had conducted a study of schools in Washington D.C. to examine the relationship between parental involvement, school building condition, and student achievement. She found that the level of student achievement was positively correlated to both the level of parental involvement and to the condition of the building; that is where more parents were involved, as indicated by membership in the PTA, the school buildings were in better condition, and the students performed better academically. Further, Edwards found that when a school moved from one category to another (from poor to fair, or from fair to excellent) that student achievement scores could be expected to increase by 5.455 percentage points. Similarly, she found that a move of two categories, from poor to excellent, would lead to an expected increase of 10.9 percentage points in scores.

All four of the studies reviewed had classified school buildings into three categories (substandard, standard, and above standard) based on a variety of factors such as thermal control, cleanliness of classrooms, presence of graffiti, and the frequency of cleaning. “The range of differences in each of these four studies be-

tween the test scores of students in substandard and above standard school buildings was between 1 and 11 percentage points, but nevertheless, in all cases there was a positive difference for students in the better buildings.” (p. 12)

Based on their review, Earthman and Lemasters concluded that “the preponderance of the research cited shows a very close relationship between the built environment and how well students and teachers perform in that environment.” (p. 11)

Lemasters (1997)

The author synthesized research that analyzed the relationships between school facility and student achievement as well as student behavior and building condition. A total of fifty-three studies conducted during the past fourteen years were reviewed. A matrix of the studies completed since 1980 is included.

Lemasters analyses studies that examined a variety of building condition variables: color, maintenance, age, classroom structure, climate conditions, density, noise, and lighting. She synthesizes the research to show how these independent variables impacted the dependent variables of academic achievement and student behavior. She grouped colour and light, as well as maintenance and age for this section of her doctoral dissertation.

Some of the research studies controlled for socioeconomic status, while others did not. The studies were not consistent in the instruments used to assess building condition nor were they consistent in the achievement and behavior assessment methods.

Seven studies that include facility maintenance and eight that include building age as independent variables are reviewed. Some included both age of building and maintenance—as a result there is a total of eleven research studies in the combined grouping.

Six studies correlated the dependent variable, student achievement, to facility maintenance and/or building age. In each the correlation is positive. In the schools that were rated as higher quality facilities, student achievement scores were higher. Students in newer buildings outperformed students in the older build-

ings. In some cases the relationship was statistically significant while in others it was not.

The eight studies that correlated student behavior with facility maintenance and building age had mixed results. Some showed a positive relationship while others revealed a negative relationship. Some of the research looked at discipline instances while others investigated student attitudes. A number of the studies compared student behavior to condition of the building, while others looked at differences when students were in a new building compared to an older one. In the latter, student behavior/attitude improved. In the former, discipline instances tended to increase in facilities that were in better condition. Some of the researchers have hypothesized that the increase in suspensions or expulsions in above standard buildings was due to higher expectations of student behavior.

In her summary of the findings contained in the research studies, Lemasters notes that “School facilities that are well-maintained have a positive impact on student achievement” (p. 196) and also that “School facilities that are maintained well positively impact student behavior” (p. 197).

Earthman (2002)

In 2002, Glen I. Earthman published *School Facility Conditions and Student Academic Achievement*, a review of research on the relationship between school facility conditions and student academic achievement.

Earthman found that studies had shown a strong positive relationship between the condition of a school building and the achievement of its students. He states that “researchers have repeatedly found a difference of between 5-17 percentile points difference between achievement of students in poor buildings and those students in standard buildings, when the socioeconomic status of students is controlled.” (p. 1)

Earthman cites a number of studies which point to this relationship. Berner (1993), in a study involving elementary schools in Washington D.C., found:

“a significant difference of 5 percentile points in the achievement scores of students in poor buildings compared with scores of students in excellent buildings. She also stated that based upon the parameter estimate that if a school were to improve its condi-

tions from poor to excellent, the achievement scores would increase by an average of 10.9 points.” (p. 7)

Cash (1993) had “found the achievement scores of students in substandard buildings to be from 2 to 5 percentile points below the scores of students in above standard buildings.” (p. 8) These results were confirmed in a subsequent study completed by Earthman et al (1996) which replicated Cash’s earlier study, and found differences of 5 percentile rank points on total achievement scores, as well as differences of 7 and 9 points on reading vocabulary and spelling subtests for students in substandard versus above standard buildings.

Hines (1996) in a similar study using essentially the same methodology as Cash found even greater differences than those of the earlier studies. His research showed differences of 14 percentile rank points on the total scores and 15 and 17 percentile rank points respectively on the reading and math subtests.

Earthman also cites later studies by Anderson (1999), Ayres (1999), and O’Neill (2000) which provide support for the above results, finding differences between students in substandard school and those in above standard schools to be between 5 and 17 percentile points.

Earthman concludes that “taken together, the research studies cited above, along with the studies dealing with age of buildings, presents a formidable body of research findings that demonstrate that the condition of the school building has a sizeable and measurable influence upon the achievement of students.” (p. 8)

Earthman also referred to a number of studies which focused on the relationship between the condition of the school building and the work and effectiveness of teachers. He concludes that the studies by Lowe (1990), Corcoran, Walker, and White (1988), and Dawson and Parker (1998) “have amply documented the fact that poor schools do reduce the effectiveness of the teachers and subsequently have a negative influence upon the ability of the students to learn.” (p. 10)

Bailey (2009)

Bailey’s doctoral dissertation is a synthesis of research studying the relationship between school building conditions and students’ academic achievement, behavior and attitude that were published between

1998 and 2008. A total of 54 research studies, including 35 dissertations, were reviewed. This work updates the earlier syntheses conducted by Weinstein (1979), McGuffey (1982), and Lemasters (1997). Lemasters' matrix was replicated by Bailey.

Findings show that building condition has a direct relationship to academic achievement, behavior and attitude in the research studies reviewed. Studies that looked at building condition and student attendance also showed a strong relationship. The research that used "a school building assessment instrument based upon research findings" (The Commonwealth Assessment of Physical Environment—CAPE) indicate that the building has "a significance influence upon the health and productivity of students and teachers." (p. 193).

The same was not true for those studies (4) that used a building assessment instrument based on technical or maintenance needs—these studies failed to find a relationship between academic achievement and building condition.

CAPE includes a scoring system that enables researchers to assign a score to each building so that school can be grouped into categories. This enables comparisons of the condition of the schools to the variables. During the 10 years of research examined,

there were eleven studies where either the original CAPE instrument, or a derivative of it, was utilized. Findings from these studies are consistent—there is a significant difference in academic achievement for students in satisfactory buildings as compared to those in unsatisfactory buildings. The differences range from two to seventeen percentile points.

Using mean scaled scores of tests, rather than number of students passing the test, provided more robust evidence of the relationship of building condition and student achievement. The relationship variable of student attitude to building condition showed only a weak influence.

Attendance rates for students in substandard schools was found to be lower (Duran-Narucki, 2008)—further studies of this relationship would be beneficial.

2. RESEARCH STUDIES USING THE COMMONWEALTH ASSESSMENT OF PHYSICAL ENVIRONMENT (CAPE)

Cash (1993)

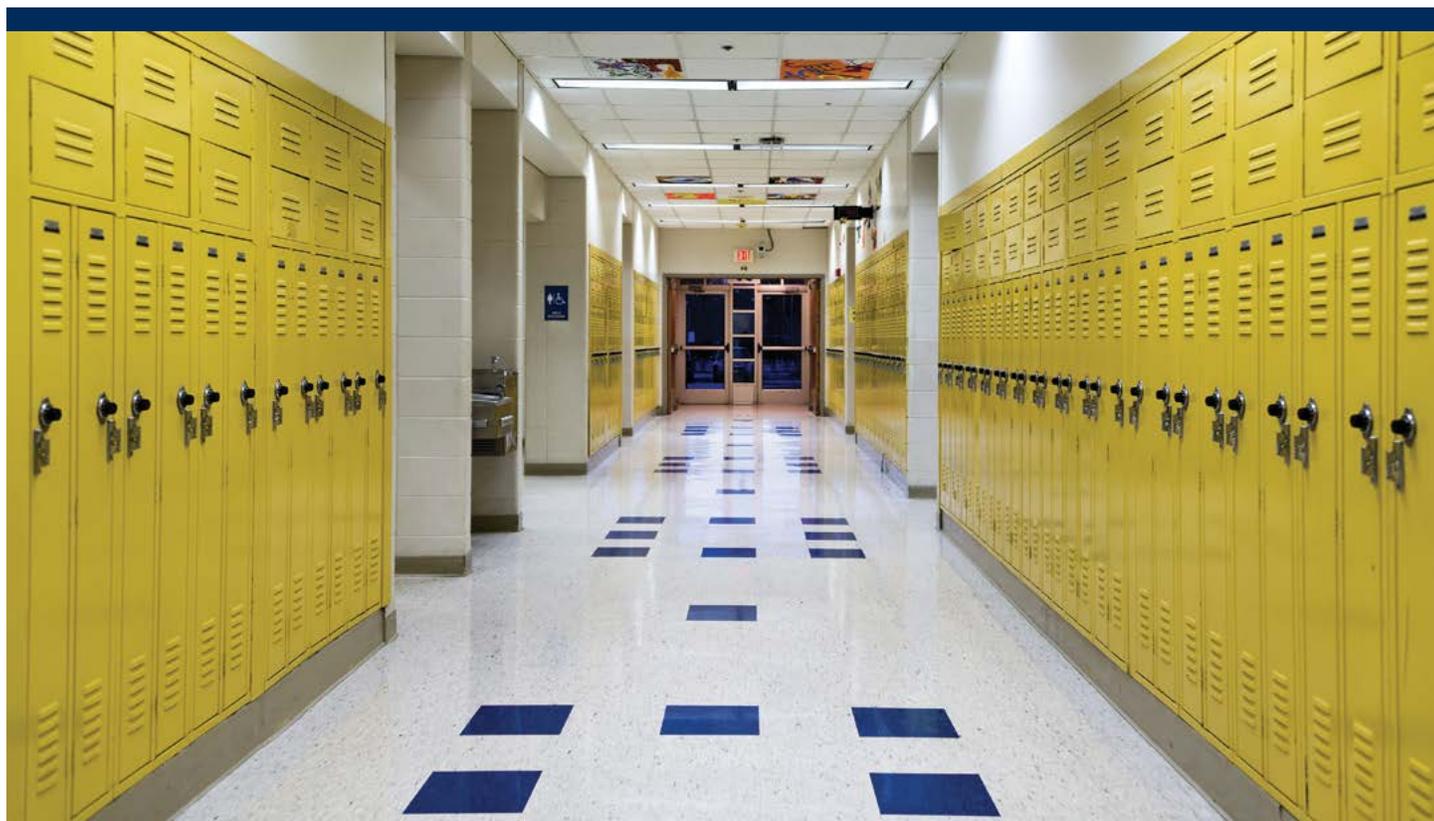
This doctoral research dissertation studies the relationship between school building condition, achievement, and student behavior in Virginia's 47 small rural high schools. The Commonwealth Assessment of Physical Environment (CAPE) was used to assess building condition. This is the first use of CAPE—a researcher-developed theoretical model. In this study, the instrument was completed by board office personnel rather than by the school principal. Forty three, of the forty seven schools that had been identified, participated in the study.

Student achievement was measured by scale scores using the seven subtest scores and the overall composite score of the Test of Academic Proficiency (TAP) for grade eleven students. Behaviour was measured by the number of student expulsions and suspensions, as well as incidents of violence/substance abuse as a ratio of the total student population. Achievement data was controlled for socioeconomic status by us-

ing the free and reduced lunch program enrolment percentages for each school.

The research identified a positive correlation between building condition and student achievement with cosmetic condition having a greater impact on both achievement and behavior than structural condition. Absence of graffiti/graffiti removal and the condition of lockers (along with ability to control classroom climate) showed a positive relationship to achievement scores.

The score percentile differences for student achievement comparing sub-standard and above-standard **overall** building condition shows an increase for every subtest as well as the composite score (+5 percentile ranks which is equivalent to a 10% increase). When achievement is compared to **cosmetic** building condition, the composite and all subtest scores except social studies increased by two to five percentile ranks. Social Studies was higher by 2 percentile ranks in the buildings with the lower cosmetic score. Structural building condition correlations were less



pronounced with no differences in mathematics and sources, a negative relationship in reading comprehension, basic composite, social studies, science and overall composite, and a positive relationship only in written expression where scores increased by one percentile rank.

Interestingly, student discipline incidents were higher in schools with better building condition as well as better cosmetic building condition. Cash suggests that this could result from a higher expectation of student behavior in schools which are in better condition.

Individual cosmetic items that show a positive correlation with academic scale scores were: no graffiti (+4 points), lockers mostly in good repair (+4 points), and classroom furniture is attractive and functionally sound (+7 points). Seven points is equivalent to eleven percentile ranks and would be in excess of a twenty percent increase for mean scores in the 50th percentile. (Thornton, 2006, p. 30)

In her conclusions, Cash states:

“When building condition was subdivided into structural and cosmetic conditions and student achievement was compared across the levels of the conditions, **higher student achievement mean scale scores were found in schools with higher quality cosmetic building condition ratings.** Student achievement mean scale scores were almost identical for both lower and upper scoring schools on structural ratings. Student achievement appeared to be more directly related to cosmetic factors.” (p. 77)

Earthman, Cash, and Van Berkum (1995)

This study examined all one hundred ninety-nine high schools in North Dakota to examine the relationship between the condition of the school building and the academic achievement and behaviour of students.

Building condition was evaluated using a survey based on the CAPE and completed by the school principal. The survey contained twenty-nine items, each categorized as cosmetic or structural. The cosmetic items were those related to the appearance of the school, such as recent painting, presence of graffiti, and frequency of sweeping and mopping. The structural items included such things as air conditioning, windows, lighting, and locker condition. The survey results were used to categorize each school as substandard, standard, or above standard.

Student achievement was measured using the Comprehensive Test of Basic Skills (CTBS) administered to all eleventh grade students. Scores were adjusted for socioeconomic status.

In eleven of the thirteen subtests of the CTBS, students in above standard buildings outscored those in substandard buildings, with differences ranging from 1 to 9 percentile ranks.

When only the items related to cosmetic condition were considered, the students in above standard buildings outscored those in substandard buildings in all but one of the subtests. In this case the differences ranged from 4 to 11 percentile ranks.

The researchers concluded that, while the results here were not as strong as those from similar studies, they do provide support for the conclusion reached by others that there is a positive relationship between the condition of a school building and the performance of the school's students on achievement tests. They state that “the condition of the school building is the result of efforts on the part of the school maintenance and operations staff” and that “the condition of the building rests ultimately upon the financial ability of the school system and the desire of the school board to have buildings in good shape.” (p. 1)

Hines (1996)

Hines studied eighty-eight urban high schools in Virginia to examine the relationship between the condition of school facilities, and student achievement and behaviour.

Building condition was determined by means of the CAPE instrument which consisted mainly of objective questions concerning building condition. Items on this instrument were divided into two groups, one consisting of items which provided a structural building condition rating (such as presence of windows, heat, air conditioning, and type of roofing), and one consisting of items which provided a cosmetic building condition rating (such as interior and exterior painting, floor sweeping and mopping, and graffiti issues). Scores were used to categorize each school as substandard, standard, or above standard.

Student achievement was assessed by obtaining scores from the Test of Academic Proficiency (TAP), a standardized test administered by the Virginia State

Assessment Program. Scores were adjusted for socioeconomic status.

When mean scale scores were compared for substandard and above standard schools on overall building condition, there were increases in scores on every subtest of the TAP, with differences in percentile ranks ranging between 9 and 17 points. The percentile ranks of above standard schools were 14 points higher than those of substandard schools for the complete composite test.

On a comparison of cosmetic building condition ratings with scale score means on the TAP, all but one of the subtests showed higher scores for the above standard schools than those of the substandard schools, with a difference on the complete composite test percentile ranks of 6 points.

For structural building condition ratings, the comparison between substandard and above standard showed a difference in percentile ranks of 9 points on the complete composite test.

Hines concluded that the data showed a very strong relationship between building condition and student achievement. He states that:

“improvements in building condition that can be acted upon with less financial impact need to be made. Painting, sweeping, and mopping need to be systematized. The school climate needs to be addressed through expedient removal of graffiti and the prompt removal of trash and garbage. The results in this study suggest improvements in student behavior as building conditions improve. A certain level of pride accompanies a better maintained building.” (p. 104-105)

Lanham (1999)

Lanham conducted a study of three hundred randomly selected elementary schools in Virginia to examine the relationship between student achievement and the physical condition of school buildings.

In order to determine building and classroom condition, Lanham developed a survey based on the CAPE instrument used previously by Cash (1993), Hines (1996) and Earthman, Cash, and Van Berkum (1995). The survey was distributed to school principals for completion. Included among the factors comprising the survey were the age of the building, time since painting was last completed, overall main-

tenance of the building, and frequency of sweeping and mopping.

Student achievement was measured by means of the Standards of Learning Assessments for Virginia which was administered to all third and fifth grade students.

Lanham found that the frequency of sweeping was one of five variables that were significant in explaining the differences in the third grade English tests, and determined that it accounted for a difference of 1.7 percent, concluding that “the frequency of floor sweeping may represent overall cleanliness of the learning environment.” (p. 126)

He also found that the frequency of mopping was one of three factors significant in explaining the differences in third grade math scores, accounting for 2.9 percent of the difference, concluding that the “results indicate students learned math better in self-contained classrooms that were cleaned frequently.” (p. 128)

Further, Lanham determined that overall building maintenance was one of five factors significant in explaining the difference in fifth grade technology scores where it accounted for a difference of 2.9 percent.

Lanham states that “keeping buildings clean and well-maintained also emerged as factors that can be controlled at the school level and have a positive influence on student achievement.” (p. 131)

Al-Enezi (2002)

The author used the CAPE (Commonwealth Assessment of Physical Environment) to assess the building condition of 56 public high schools in Kuwait that offered Arts and Sciences majors. Half of the schools were boys only and the other half were girls' schools. Academic achievement was assessed using final examination scores from the Kuwaiti Ministry of Education. Pearson r was used to determine correlations between building conditions and achievement. There was no control for socioeconomic status. This is the first study of its kind to be conducted outside the United States.

Al-Enezi modified Cash's CAPE instrument (Cash, 1993) incorporating some of the changes introduced by Lemasters (1997) and Lanham (1999) as well as adding/changing elements to reflect the education environment in Kuwait.

The analysis shows a positive and significant relationship for building conditions and achievement in boys' schools, particularly for students taking the Sciences major where multiple regression showed that 77% of the variances could be explained by building condition. Girls' schools did not show a relationship between building condition and achievement in either of the two majors. The author speculates that societal factors could explain the difference—girls in Islamic countries do not have the same freedom as boys and thus would have more time for studying; the University of Kuwait has a quota system limiting the number of female students it accepts which, he posits, would make girls work harder at getting top grades in secondary school.

Across all schools and both majors, the amount of graffiti was the variable that impacted student achievement.

Lair (2003)

Lair studied twenty-nine randomly chosen schools in a high-achieving, high-poverty school district in Texas (the Ysleta Independent School District) to determine the impact of school facilities on academic achievement. In 1994, this district had decided to include school condition as a possible variable in its students' academic achievement and to take steps to improve school facilities through renovation. A modification of the Commonwealth Assessment of Physical Environment (CAPE) questionnaire was used to solicit information from school principals about the condition of the school—structure, maintenance, and housekeeping. In addition, the researcher conducted interviews and used observation to augment the questionnaire. Longitudinal student achievement was measured using the percentage of students, by school, passing all of the Texas Assessment of Academic Skills (TAAS) tests from 1994 to 2001 as well as the subtests reading, writing, and mathematics.



Socioeconomic status was determined by the percentage of students using free/reduced lunch programs—some 73.4 percent of the district's student population. The District also has a high percentage (88 %) of Hispanic students. However, the percentage pass rates for these two cohorts are considerably higher in Ysleta than in the rest of Texas and the percentage

gains in pass rates over the eight years shows that this school district has outperformed the State on this metric also.

44.83% of principals indicated that they did not have sufficient maintenance staff (p. 130). 27.59% reported that maintenance requests were not completed in a timely manner (p. 131).

Overall structural rating

resulted in one school below standard, 21 rated as standard and 7 as above standard. (p. 132). The vast majority (26 or 89.66%) of the schools reported that floors were swept or vacuumed daily; the remaining three schools (10.34%) reported this as a weekly activity. The schedule for mopping (waxing, stripping) was generally daily or weekly (26 schools), for others it was either a monthly (two schools) or an annual (one school) event. (p. 133). While graffiti was reported, the schools also reported that it was always removed within 24 hours. All of the principals reported that hallways are kept clean during the day and that their school smelled good. (p. 138). The majority (79.31%) indicated that they had sufficient housekeeping staff. The overall cosmetic condition of the school was rated as below standard by 62.07%, at standard by 34.48%, and above standard by 03.45% for one school. (p. 140)

“Over 93 percent of the principals responding to the survey indicate that the shareholders of their school believe the condition of the school affects the level of academic performance by their students.” The other “two principals were uncertain.” (p. 141)

Through a series of regression analyses, the researcher determined that building age positively (an inverse relationship) impacted student achievement—this

was true for disadvantaged, Black, and Hispanic students. Most other studies indicate that building age is negatively related to student achievement. The Ysleta school district's program to renovate its old facilities (rather than build new ones) commenced in 1994 and went hand-in-hand with a district-wide commitment to the importance of facility condition and maintenance as a potential factor in student success rates. Building age, therefore, may not be actual age but rather when the school was renovated. The researcher did not gather this data, but nonetheless notes:

“While the results of this study seem to contradict some previous findings concerning the impact of aging buildings, the documented gains in achievement by all ethnic and racial groups within Ysleta regardless of their socio-economic status cannot be ignored. An analysis of the data in this study indicates that the age of renovated buildings helps explain positive gains in student achievement.” (p. 182-3)

The change in the academic achievement of the Ysleta students from 1994 to 2001 is quite spectacular. In 1994 students who were identified as economically disadvantaged had TAAS reading sub-test pass rates of

34.5 percent (grades 3 through 8 and grade 10). The number passing the writing test was at 31 percent and for math it was 22 percent. Eight years later, “economically disadvantaged students are passing the TAAS test at a rate of 88.1 percent for reading, 89.2 percent for writing and 93.6 percent for mathematics.” (p. 81)

Crook (2006)

Crook's doctoral dissertation examined the percentage of high school students in Virginia passing the state's Standards of Learning (SOL) examinations in relationship to the school building condition. The researcher used the CAPE instrument to assess building condition for 142 high schools in the Commonwealth and selected seventy-two (half scored as substandard and half were standard based on bottom and top quartile rankings). Percentages of students passing the SOL examinations was assessed against overall condition of the school, the structural condition of the building, and the cosmetic condition of the building. SES was controlled for by percent of students using free or reduced lunch programs.



A significant relationship was found between student achievement and building condition for English writing and reading, but not for Geometry, Algebra 1 and Algebra 2 examinations. The cosmetic building comparator showed a higher percentage of students passing Algebra 2 and Geometry but the differences were not statistically significant.

Where students were in buildings that were identified by the school principal as standard, versus substandard, there was a significant difference for student achievement on all five examinations. The percentages of students passing SOLs in standard buildings was between 5.5% to 9.2% greater than for those in substandard buildings.

With the exception of the Algebra 1 passing percentages, all the examinations showed percentages of students passing the examinations was higher in schools where there was either no graffiti or it was removed within a week.

Schools that ranked as standard for cosmetic building condition showed 6.6 % more students passed the SOLs English reading subtest.

The author indicates that when socioeconomic status is controlled, then

“The percentages of students passing the Standards of Learning examinations between the standard and substandard building conditions differed by up to 17.2 percentage points.” (p. 119)

O’Sullivan (2006)

Using a modification of Al-Enezi’s (2002) version of the CAPE instrument, O’Sullivan studied the relationship between building condition and student achievement in Pennsylvania. A random sample identified four hundred and twenty-nine high schools, of these two hundred and five responded to the survey for a return rate of forty-eight percent. Socio-economic status (SES) was controlled for by using the percentage of students eligible for the free/reduced lunch program. Academic achievement “was measured by a three year scale score average of students’ performance on the writing, reading and mathematics sections of the Pennsylvania System of School Assessment (PSSA) exams.” (p. ii). The student cohorts used in this study were those taking the PSSA examinations in grade eleven.

A step-wise multiple regression analysis was used to determine relationship between student achievement and the three building conditions (overall, structural, and cosmetic). The results of these analyses show that the percentage of students receiving free/reduced lunch was a significant variance for all three of the PSSA sub-tests. SES accounted for a 21.4% variance on both the reading and mathematics test scores however this variance, while still significant, was smaller for writing (9.5%). Structural building condition was a significant variable for mathematics at 1.7% and cosmetic condition was a significant variable (2.0%) for reading. There were additional building facility variables correlating to achievement, but slightly below the significant level.

O’Sullivan concludes:

“As the overall building conditions, the cosmetic building conditions or the structural building conditions in the high schools improved, there was a corresponding increase in the academic achievement of students of up to 55.0 points on the PSSA reading exam and up to 20.0 points on the PSSA mathematics exam. It did not matter if the improvement in a school building’s condition was cosmetic or structural; any improvement in the survey rating score was associated with an increase in student academic achievement. This would indicate that a relationship exists between student academic achievement and school building conditions in Pennsylvania high schools.” (p. 117)

Thornton (2006)

In this doctoral dissertation, the author focused on two groups of students—those that were economically disadvantaged (determined by those eligible for free/reduced-price lunch or those who were homeless), and those who were minority students (using information reported by schools to the Department of Education). Thornton examined building condition, using a modification of the CAPE instrument, and its relationship to achievement and behavior for these two groups of students. The study replicates Cash (1993) in many respects and was conducted in Virginia but was not restricted to small rural high schools. The scaled scores from the Standards of Learning (SOLs) end of course tests taken by students in grades nine through eleven were used to determine student achievement.

The sample of high schools examined in this study is identical to the seventy-two that were studied by Crook (2006). Half of the schools were rated as sub-standard and the other half scored as standard for building condition. Crook's study had identified the percentages of students receiving free or reduced lunch for each of the seventy two schools. The percentage range was lower in schools rated as standard. Thornton selected twelve schools from each of the standard and substandard school lists to ensure similar percentage ranges of economically disadvantaged students in both groups. The twelve schools in standard condition with the highest percentage of students eligible for free and reduced price lunch (between 27.08% and 45.49% of students) were selected. For sub-standard schools, the twelve that best matched the percentages of the standard group were chosen. These sub-standard schools had between 31.93% and 45.93% of students in the free/reduced-price lunch program. The same methodology was utilized to identify twelve schools from each grouping with regards to the percentages of minority students (35% to 65% in the standard group and 27% to 61% in the sub-standard group).

The mean scale scores of minority students and economically disadvantaged students in the selected schools were used to determine achievement for each of the ten tests that comprise the SOL for high schools.

Achievement comparison for economically disadvantaged students is as follows: Algebra I—higher in standard (0.01 level of significance); Algebra II—higher in sub-standard schools but the difference was not significant; Geometry—higher in sub-standard buildings and significant; Earth Science—higher for the standard group and significant; Biology—higher in standard schools and significant; Chemistry—higher in sub-standard schools and the difference is significant; World History I—higher in standard buildings and significant; World History II—higher in standard buildings and significant; U.S. History—higher in sub-standard buildings and significant; Reading—higher in sub-standard and significant.

Achievement comparison for minority students yielded the following results: Algebra I—higher in standard and significant (0.01 level of significance); Algebra II—higher in sub-standard schools but the

difference was not significant; Geometry—higher in standard buildings but not significant; Earth Science—higher for the standard group and significant; Biology—higher in standard schools and significant; Chemistry—higher in standard schools and the difference is significant; World History I—higher in standard buildings and significant; World History II—higher in sub-standard buildings and significant; U.S. History—higher in standard buildings and significant; Reading—higher in standard schools and significant.

The author provides some useful insight regarding the sub-tests:

“There were four common subtests where significant differences were found for both economically disadvantaged students and minority students in buildings rated standard. These included Algebra I, Earth Science, Biology, and World History I. These subtests are all similar in the fact that all students are required to take these tests. Algebra II, Geometry, Chemistry, and World History II are usually taken by only those students trying to complete an advanced study diploma. Reading and U.S. History are eleventh grade tests and students do not have to pass U.S. History in order to graduate. The Reading test may be affected by students earning a modified standard diploma that do not have to take the test.” (p. 96)

Thornton summarizes the results of his research and concludes “that the condition of the school building influence on the achievement of economically disadvantaged students when they are housed in inferior buildings is inconclusive.” (p. 92); however, he found that “the results of the analysis indicated a positive relationship between building conditions and the achievement of minority students in the majority of the achievement measures.” (p. 93).

In his recommendations for future research, Thornton notes that overall building condition was used in this study and that it might be useful to conduct a similar study separating structural and cosmetic building conditions. He also suggests replicating this study using only the sub-tests that all students take—this would eliminate Algebra II, World History II, and Chemistry.

Bullock (2007)

Bullock's doctoral dissertation was conducted in Virginia middle schools that taught Grade 8 during the 2005-2006 school year. The total sample size was 191 schools. One hundred and eleven (58%) of the initial sample, responded and were used in this study.

It assessed academic achievement using the percentage of students passing Standards of Learning (SOL) examinations and the Commonwealth Assessment of Physical Environment (CAPE) instrument to assess facility condition. To control for socioeconomic status the percentage of students who used the free or reduced lunch program was measured.

As with earlier studies of Virginia schools (Cash, 1993; Hines, 1996; Lanham, 1999; and Crook, 2006), the author examined the relationship between student achievement on SOLs and (a) overall building condition, (b) cosmetic building condition, and (c) structural building condition.

Overall building condition showed a positive and significant relationship to the percentage pass rate of students taking SOLs in English (+3.89%), mathematics (+2.2%), and science (+3.86%). Structural

building condition had a greater impact: English (+5.29%), Mathematics (+5.86%), and science (+5.16%). Cosmetic building condition accounted for pass rate increases of: English (+4.77%), Mathematics (+6.47%), and science (+5.13%). (p. 42-47)

Floors swept daily or weekly accounted for pass rate differences of: English (+2.26%), Mathematics (+2.51%), and science (+1.69%). Floors mopped daily or weekly compared to those done annually also showed a relationship: English (+1.05%), Mathematics (+6.49%), and science (+0.08%).

There was an inverted relationship for furniture condition and SOLs pass rate—that is the students in the substandard schools (2) outperformed those in the standard schools (27). The sample size for substandard schools versus standard schools could be a contributing factor in this result.

Bullock also examined the pass rate differences between students by sex correlated to the three measures of building condition and noted the variances.

3. RESEARCH STUDIES THAT USED THE TOTAL LEARNING ENVIRONMENT ASSESSMENT (TLEA)

McGowen (2007)

This doctoral dissertation examines how the quality of school facilities impact student achievement, attendance, behavior, completion rates and teacher turnover. Selected high schools in Texas were studied. Selection parameters included the size of school (between 1,000 and 2,000 students enrolled) and that the number of economically disadvantaged students should not exceed 40%. The initial sample size was 101 schools. With a response rate of 30%, the researcher does posit that the small sample size may be partly responsible for the lack of significant correlations between variables in the study.

McGowen used the Total Learning Environment Assessment (TLEA), as completed by the principal, to

determine school facility condition. The TLEA was developed for a prior study of Texas public schools (O'Neill, 2000) and includes 15 potentially relevant questions (out of a total of 86) that are intended to assess the exterior (3 questions are pertinent) and interior (12 questions are pertinent however, excluding those about lighting and windows, colour schemes, temperature control, ventilation, and acoustics, results in 6 relevant questions) cosmetic condition.

The relevant questions from the Environment for Education sections are:

- Proper maintenance (exterior) of school facility is a priority and vandalism or graffiti are repaired/ removed quickly
- Site and building are well landscaped



- Exterior walls, or windows and trim were painted less than 5 years ago or are in excellent condition
- Classroom furniture is functionally sound and facially attractive
- Proper maintenance (interior) of school facility is a priority and vandalism or graffiti are repaired/removed quickly
- Custodial daily routines are effective in keeping facility clean and attractive
- The condition of your facility is excellent both cosmetically and structurally
- There are visible indications of roof leaks in the school facility
- Interior walls, including classroom spaces, were painted less than 8 years ago or are in excellent condition

Student achievement was measured by the number of students passing TAKS (Texas Assessment of Knowledge and Skills) rather than mean or scaled test scores.

There was a negative correlation between TAKS scores and Environment for Education even though the facility adequacy trends were similar to those in other studies. There was no significant correlation between attendance and the TLEA subsection scores. There was a significant correlation for student behavior (discipline). Completion rates showed a statistically significant correlation with interior environment.

Vandiver (2011)

Vandiver examined the relationship between the school facilities and the learning environment in a northeast Texas high school (Grades 9 to 12). The school had moved to a new facility in 2004. The study used a mixed method research design. Principals, assistant principals or designates evaluated the school facility condition while teachers evaluated school climate and culture. Questionnaires were used to collect the

information: (a) a demographic instrument to collect data about teacher qualifications, age, years of teaching, etc.; (b) the Total Learning Environment Assessment High School Version (TLEA) assessed the school building; and (c) the Organizational Climate Description Questionnaire for Secondary Schools (OCDQRS) collected data from teachers, principals and assistant principals. The researcher also interviewed the sixteen teachers using open-ended questions.

Student academic achievement was measured using pass rates for the Texas Assessment of Knowledge and Skills (TAKS). TAKS has four subtests—English language arts; mathematics, science, and social science. Baseline data for the school year (2003-4) prior to renovation was compared to the average scores across grades 9, 10 and 11 for the post renovation years (2005-6 through 2008-9). The comparison of before and after scores showed percentage pass rates improved by between 2.8% (English) and 22% (mathematics). All subtests and the results of all tests combined showed increases. The increases in mathematics, social studies (5.6%), and all tests (17%) were statistically significant, while the result for science (6.8%) was marginally significant and for English was not statistically significant.

“These results also indicate that while only 48.0% of students passed all of the tests before the new facility, 65.0% of the students since the new facility passed all four tests.” (p. 96)

4. RESEARCH STUDIES THAT USED INSTRUMENTS OTHER THAN CAPE OR TLEA

Stevenson (2001)

The author was commissioned by the Education Oversight Committee of South Carolina to study the relationship between school condition and student achievement. Stevenson developed a questionnaire that was sent to by all public school principals (elementary, middle, and high schools) in the state. The response rate was fifty seven percent (626 questionnaires completed and returned). Principals were asked to indicate whether the school facility was positively or negatively impacting student achievement. The majority indicated that the relationship for their school positively correlated to achievement, while twenty percent assessed the relationship as negative. Physical condition of the school was a factor for both the positive and the negative responses.

Academic achievement was measured using the average SAT score for each high school and the PACT results (grades three through eight) for elementary and middle schools. State information was used to determine the age of the school, the size of the school, and attendance of both teachers and students. This data were used to ascertain whether there were linkages between student achievement and school age, school size, and teacher and student attendance. The questionnaires completed by the principals regarding school condition and adequacy were also compared to facility age, achievement, school size, and attendance.

Stevenson's analysis of the state information (test scores, age of facility, size of school, and teacher/student attendance) for the 168 public high schools in South Carolina revealed a significant and positive correlation between SAT scores and each of the four variables. However, when controlled for socio-economic status of students (number of students in the free/reduced lunch program) only student attendance retained a significant positive correlation. Almost 60% of the variance in SAT scores was attributable to socio-economic status while an additional 3% is related to student attendance.

Similar results were found at the middle school level (English and math exams), with SES accounting for the greatest variance and student attendance remain-

ing significant after controlling for socio-economic status. For the middle schools, SES accounted for between 25% and 29% and student attendance from 3% to 6% of the variance in student achievement depending upon the subject and the grade level.

Results for elementary schools show the same relationships as those for middle and high schools. Math and English PACT scores for grades 3 through 5 controlled for socio-economic status reveal that between 53% and 66.8% of the differences relate to SES while attendance accounts for between 1% and 2%. SES had a greater impact on English scores than on those for mathematics and student attendance shows a slightly greater impact for math than it does for English.

The principals' rating of school facility condition was found to have a significant relationship to student achievement in English for grade 7 and 8, and for mathematics in the sixth and seventh grades.

The researcher notes that:

“The impact of the effect of the overall socio-economic status of a high school's student body as measured by free and reduced lunch was so staggering that the other factors (age of building, teacher attendance, and school size) lost significance when SES was included in the calculations.” (p. 21)

Student attendance continues to be a significant factor even when socio-economic status is considered and this is true for all grade levels from elementary through high school. The principals' rating of school condition is the third most significant factor in test scores for students at some grade levels.

Tennessee Advisory Commission on Intergovernmental Relations (2003)

The researchers review various U. S. studies (Washington, DC.; Milwaukee, Wisconsin; Saginaw, Michigan; Virginia; Syracuse, New York; North Dakota; Tennessee; Baltimore, Maryland) on school facilities that have been undertaken to determine where relationships to education outcomes were found. Most of the emphasis is on the build environment, the age of facilities,

and the maintenance costs coming from the local tax base rather than from State or Federal funding.

Time in learning is identified as an important variable in academic achievement that is negatively impacted by maintenance—air quality has the potential to be a significant and detrimental factor in student as well as teacher health and attendance. The results include the following:

“One study showed that children aged nine to eleven were more likely than adults to identify untidy classrooms, dirty bathrooms, and school walls painted one color as physical attributes that made their school not welcoming.” (p. 4)

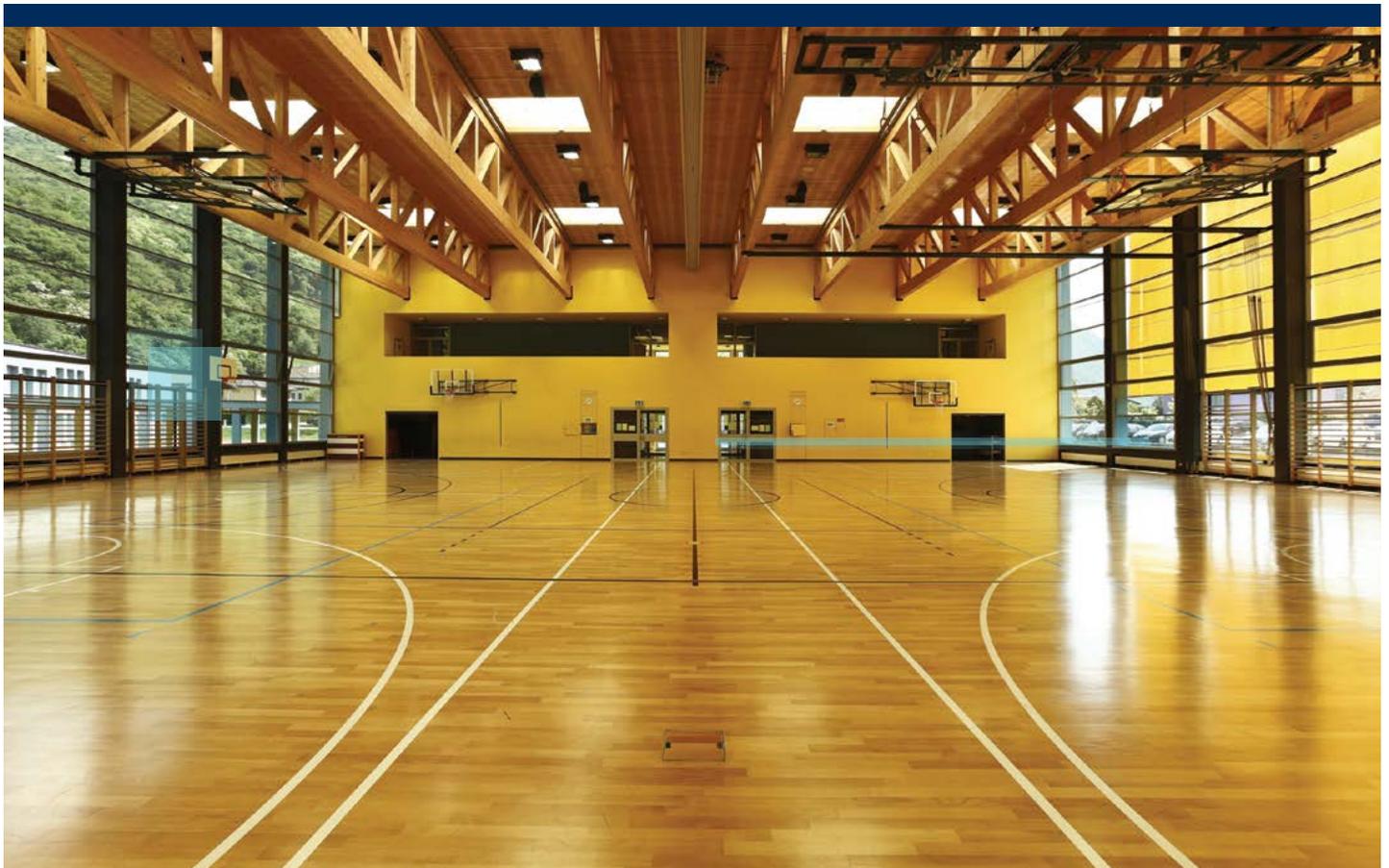
“2000 teens from across the nation were asked their opinions about various aspects of their schools... 33% placed building maintenance and construction as the number one item needing improvement.” (p. 5)

“it is simply a fact that the school environment itself has a largely untapped potential as an active contributor to the learning process.” (p. 5)

Branham (2004)

This article reports on a study of 226 schools in the Houston Independent School District on a school by school basis in order to obtain information for each school and control for variations that exist across and within school districts. Each school is considered as a discreet unit within the school district. All of the schools had open enrolment, with a variety of student populations. It found that student population varied widely by school and that there was variety in the quality of school buildings but does not measure the age or quality of the building, nor the magnitude of disrepair.

A statistically significant co-relation between inadequate janitorial services and student attendance, especially at the secondary school level, was identified (p. 1121). The author contends that student attendance is a major factor in student achievement, therefore lower attendance impacts student achievement.



“The data clearly support the conclusion that schools with inadequate custodial service have higher drop-out rates.” (p. 1122)

The study also correlates the amount of square feet that a custodian has to clean and maintain to attendance and drop-out rates.

Buckley, Schneider, and Shang (2004)

This study examined the relationship between the extent to which schools in the Los Angeles Unified School District comply with health and safety regulations and academic performance of students.

In 2003 the school district completed an assessment of the health and safety compliance of its schools based on fourteen measures of compliance which included items such as chemical safety, pest management, restroom facilities, indoor air quality, and maintenance and repair. Schools were assigned an Overall Compliance Rating (OCR) based on these measures. The OCR was used as a measure of the quality of the facility.

Student achievement was measured using California’s Academic Performance Index (API), which measures academic performance and academic growth of schools using results of standardized tests as well as the California High School Exit Examination.

The researchers measured the relationship between the OCR and the API. They found a positive relationship and determined that effect of compliance on academic achievement is approximately the same as that of a reduction in enrolment, i.e. an effort to create smaller schools.

Earthman (2004)

Earthman was asked by the American Civil Liberties Union of Maryland to review the 31 criteria for school facilities established by the Maryland Task Force to Study Public School Facilities, and to prioritize those criteria on the links between conditions in school buildings and student achievement.

Earthman finds that:

“there is sufficient research to state without equivocation that the building in which students spend a good deal of their time learning does in fact influ-

ence how well they learn. Numerous studies have indicated that students in poor buildings perform less well than students in functional or acceptable buildings.” (p. 18)

He goes on to state that “each researcher found a significant difference in the achievement scores of students in poor buildings and in good buildings”, and that “most researchers found differences ranging from 5 to 10 percentile ranks” which he categorizes as “statistically significant.” (p. 18)

Edwards (2006)

For her doctoral dissertation, Edwards conducted qualitative research to determine how summer school middle and high school students in an urban district (Columbus, Ohio) perceived the impact of school facility conditions on their educational achievement, motivation, behavior, safety, value to society, and the quality of teaching. She used surveys, interviews and observation to collect data from thirty-nine randomly selected poor and minority students (fourteen in middle school and twenty-five in high school) during the six week summer school session. The sample included students at every middle and high school grade level and represented 27 different schools within the district.

The student survey consisted of fourteen questions using a five level Likert scale ranging from ‘strongly agree’ to ‘strongly disagree’. Seventy-four percent strongly agreed that it was important for the school to be neat, clean and in good physical condition. A majority believed students would learn more and have better academic achievement if their school was in good condition—51.2% agreed and a further 7.6% strongly agreed compared to 25.6% who disagreed. When asked if they personally could learn better in a school which is neat, clean and in good physical condition, 43.5% agreed whereas 17.9% selected each of the strongly agree, undecided, and disagree options.

Rating whether the student’s own home school was in good physical condition resulted in 33.3% disagreeing, 15.3% strongly disagreeing, 12.8% undecided, 25.6% agreeing, and 12.8% strongly agreeing. When the participants were asked whether it was important for the school s/he attended to be in good condition, 43.5% strongly agreed while 33.3% agreed, 10.2% were undecided, and 12.8% disagreed.

Overall building condition correlated positively for the individual's motivation level with 61.5% strongly agreeing/agreeing (12.8% and 48.7% respectively) and 23.0% undecided. Sixty-six point five percent agreed/agreed strongly that students would be more motivated academically in schools that were in good condition—20.5% were undecided.

When asked if the condition of the school reflects the school district's concern for the students' education, close to one third were undecided while 53.7% either agreed or agreed strongly. Correlating safety and school condition revealed that 79.4% agreed/agreed strongly that students would feel safer in a facility that is in good physical condition. On an individual level, the student indicated that s/he would feel his/her personal safety would be better guaranteed in a facility that is in good physical condition with 23.0% strongly agreeing and 46.1% agreeing—a further 20.5% were undecided.

There was a lack of consensus regarding whether the condition of the school impacted their personal behavior and conduct while in school—30.7% disagreed, 23.0% agreed, and a further 23.0% were undecided. The results were similar when asked if most students would behave properly in a school in good condition and which is visually appealing—25.6% agreed, 30.7% disagreed, and 33.3% were undecided.

Participants were asked about the relationship between quality of teachers/principals and ability to teach relative to school building condition. Sixty-one point four percent strongly agreed or agreed (30.7% for each response) that teachers could teach better in a school that was in good condition and 23.0% disagreed/disagreed strongly. When asked if schools that are neat, clean and in good physical condition have better teachers and principals 43.5% disagreed, 23.0% agreed strongly, 15.3% agreed, and 15.3% were undecided.

In addition to the survey, Edwards conducted in-depth interviews with fifteen of the thirty-nine students. The interviewees related the condition of the building to wanting to be there, and noted that the school facility "should be clean and kept neat." (p. 110) The condition of the school was also a concern to the students, particularly the cosmetic condition, although students mentioned physical condition in relationship to their own safety.

This research revealed that the participants believe that unkempt schools impacted the students' mood, achievement, motivation, and behaviour.



Campbell (2008)

This article reports on a study in which students at randomly selected post-secondary educational institutions in the United States were surveyed to determine if (i) there is a correlation between the level of cleanliness of the learning environment and student learning, and (ii) if there is a link between personal health and cleanliness. A survey that consisted of twenty questions was sent to students by email. Over one thousand four hundred students responded. Campbell also conducted a literature review as part of the research.

Students were asked to consider five levels of cleanliness: Level 1—Orderly Spotlessness, Level 2—Ordinary Tidiness, Level 3—Casual Inattention, Level 4—Moderate Dinginess, and Level 5—Unkempt Neglect.

Some of Campbell's key findings include that 88.1% of students reported that a lack of cleanliness becomes a distraction to learning at Level 3 or 4, and that 83.6% reported that they consider Level 1 or Level 2 cleanliness sufficient to create a good learning environment. Further, when asked to indicate what level of correlation they believe exists between building cleanliness and the student's ability to learn (using a six point scale where 1 represented High Correlation, and 6 represented No Correlation), 87.7% reported that correlation was 3 or higher. In addition, 78.1% reported that cleanliness had an impact on their health, indicating that a lack of cleanliness affects allergies, spreads germs, increases bug and rodent infestation, and promotes higher stress levels.

Campbell concludes that there exists "ample evidence that there is a positive correlation between school building conditions and academic achievement." (p. 34). Further he states that "Poor building conditions, including inadequate custodial service have shown a correlation to low student attendance" and that "Student attendance is a significant variable in predicting academic scores on standardized tests." (p. 34)

Based on his findings Campbell makes a number of recommendations, including "Building conditions including custodial service should be considered an important factor in student academic achievement" (p. 34), as well as "Institutions of higher education need to develop levels of cleanliness that create an environment that contributes to student learning." (p. 35)

Dura'n-Narucki (2008)

The researcher examined ninety-five public elementary schools in Manhattan. Data were obtained from the New York City Board of Education's website. Facility condition information is based on inspections by independent architects and engineers conducted in the late nineties. Academic achievement, attendance, socioeconomic status, ethnicity, and teacher turnover were ascertained from the school report cards for 2000.

"This study found that the conditions of school buildings predicted both attendance and academic achievement after controlling for other possible predictors like SES, ethnicity, school size, and teacher quality. School attendance mediated the relationship between school building condition and academic achievement. The mediation was complete in the case of English Language Arts and partial for Mathematics. Overall, the models showed that in rundown school buildings students attend fewer days in percentage and had a poorer performance in Mathematics and English Language Arts standardized tests." (p. 283)

Sheets (2009)

Sheets' doctoral dissertation examined the condition of the 72 rural public high schools in Texas relative to student attendance, academic achievement, and teacher turnover. School condition was determined using data from the 2006 Texas Comptroller's Facility Survey.

Socioeconomic status was the biggest factor in student achievement variances (accounting for 29% of the variance in average TAKS scores) but there was also a measurable effect on student achievement, as well as teacher turnover, relative to the condition of facilities. The percentage of portables to total square feet per student and the percent of deferred maintenance accounted for approximately 5% and 4% respectively of the average TAKS scores negative variance. Age of building showed an inverse relationship to TAKS scores, where older buildings resulted in a 5% increase in average scores.

There was no significant correlation found between student attendance and any of the variables in this study.

5. OTHER RESOURCES CONSULTED

Berry (2002)

In *Healthy Schools are Clean, Dry, and Productive*, Dr. Michael Berry examined the effect of the indoor school environment on the attitudes and performance of its students and staff.

Berry states that:

“A school’s interior climate, appearance, and cleanliness send either a positive or negative message to students, teachers, and staff. Emerging evidence suggests that environmental conditions that create a sense of ‘well-being’ and send a ‘caring message’ contribute directly to positive attitudes and elevated performance as measured by fewer health complaints, improved student attendance, teacher retention, and higher test scores.” (p. 1)

Further, Berry goes on to say that “schools are high activity environments that need constant attention in the form of cleaning, maintenance, and repair.” (p. 1)

Berry indicates that maintaining the condition of the school is a necessary and cost effective way of improving student performance, stating that:

“there is growing evidence that when a school building is in disrepair, teaching and student achievement suffers; the school environment works against the educational process. Public school systems too often elect to postpone repairs and delay construction of new facilities to divert money during periods of financial austerity. Making cuts in roof repair, maintenance, and cleaning is mistakenly considered less devastating than slashing academic programs.” (p. 1)

Berry points to the case of the Charles Young School in Washington D.C. as an example of the effect a poor indoor environment can have on student achievement. Prior to renovations which began in 1997, the school had several structural issues which negatively contributed to the overall quality of the environment, including a roof, windows, and HVAC system



which were in disrepair. Among other consequences, these contributed to the staff's inability to maintain a clean and healthy school. Post renovation, the school was restored to a healthy environment, and the effect of the attitudes and performance of the students and staff was remarkable. Results on national tests showed that prior to the restoration, only 51% of the school's students were at or above basic levels in math scores, and only 59% in reading scores, whereas after the renovations, 76% of the school's students scored at or above basic levels in math, and 75% in reading.

Berry states that:

“since the restoration, the school radiates a sense of well-being. It is widely reported by teachers and staff that many students are reluctant to leave in the afternoons because they like the school environment that many call a ‘safe haven.’ Teachers and staff throughout the school district want to there. Many of the best teachers at the school have elected to delay their retirement. The restored school is the pride of the community. Parents often visit the school, and some even take classes in reading. Attendance, prior to the restoration, has risen from 89% to 93%. Many parents in the community had previously moved their children to private and special schools; however, since the restoration, many of these students have returned. Students from other schools throughout the district are seeking admission to Charles Young Elementary. The District of Columbia is using Charles Young Elementary as the model for restoring 9 other schools in DC.” (p. 7-8)

Berry concluded that “cleaning is the most effective means of achieving a sustainable high level of environmental quality in a school.” (p. 9)

Berry (2002)

In his report “Healthy School Environment and Enhanced Educational Performance - The Case of Charles Young Elementary School, Washington, DC” Dr. Michael Berry lists “the school is clean and sanitary” under Essential Environmental Considerations of Schools. (p. 2)

He ties the cleaning and maintenance of school facilities to student illness:

“The cleanliness of schools is also an important aspect of school environments. Clean schools not only lower the threat of the spread of illness, but also convey a caring message to the students and teachers. Cleaning and maintenance of schools is

vitaly important and is often underemphasized and underperformed.” (p. 3)

He further points out that:

“Making cuts in routine cleaning and maintenance, repairs, and restoration is commonly considered less devastating than cutting academic programs. This limited thinking is very short-sighted, and, in the long run, ends up adding to the cost of education.” (p. 5)

Environmental Protection Agency (2003)

In “Indoor Air Quality and Student Performance” the Agency provides evidence to support the connection between indoor air quality and attendance of teachers and students:

“Evidence continues to emerge showing that poor indoor air quality (IAQ) can cause illness requiring absence from school, and can cause acute health symptoms that decrease performance while at school. In addition, recent data suggest that poor IAQ may directly reduce a person's ability to perform specific mental tasks requiring concentration, calculation, or memory.” (p. 1)

Failure to adequately perform housekeeping and maintenance is cited as a common example of factor contributing to poor indoor air quality. (p. 1)

“Children's overall performance decreases due to sickness or absence from school. Building associated health effects can increase student or teacher absences from school and degrade the performance of children or teachers while in school. Respiratory health effects, such as respiratory infections and asthma, are the illnesses most closely associated with increased absenteeism. In fact, asthma-related illness is one of the leading causes of school absenteeism, accounting for over 14 million missed school days per year.” (p. 2)

“Overall, the evidence suggests that good housekeeping designed to control surface dust plus care and maintenance of the HVAC system, including provisions for good filtration performance, are important aspects of school operating protocols designed to improve student health and performance.” (p. 4)

Lawrence (2003)

This policy brief for the United States' Rural School and Community Trust focusses on consequences of deferred maintenance for school facilities in rural

areas. She discusses the decline in maintenance, the vicious cycle of deferred maintenance, the increase in square footage per custodian, and the impact that results when facilities are inadequately maintained.

These impacts include morale, learning, health & safety, and student achievement. She notes:

“There is a growing body of research that strongly suggests a correlation between the condition of the school facility and student academic performance. Studies in urban, suburban and rural communities have demonstrated what intuitively one might suspect: the condition of the facility students attend affects their academic achievement.” (p. 11)

The brief concludes with recommendations in the areas of maintenance policy, practice, and funding.

National Education Association (2004)



In their publication “Take a Deep Breath and Thank Your Custodian” the NEA reminds readers that:

“In addition to illness, and decreased performance and concentration, students exposed to poor IAQ miss approximately 14 million days of school each year due to asthma, and score 11 percent lower on standardized tests than those students attending schools in good condition.” (p. 2)

Ontario Healthy Communities Coalition (2005)

This videotape follows a project to improve indoor air quality undertaken at Blake Street Public School and E.A.S.T. in the City of Toronto. It identifies the problems (poor maintenance of ducts and filters, thirty year-old carpets, cleaning chemicals, levels of carbon

dioxide) and ties these to various health issues for students and staff (headaches, skin irritation, asthma, inability to concentrate).

A community IAQ workgroup was set up, the parent council was leveraged, trustees, experts and various health professionals were consulted, questionnaires were sent to school employees and to parents, and the ‘Tools for Schools’ checklist was used to conduct health and safety walk-through of each school, and dialogue with the TDSB Facilities Department was initiated in order to determine the extent of the problem.

Simple solutions were then identified and enacted. Throughout the project, all stakeholders were kept informed and engaged. Health & Safety officers from CUPE 4400, Toronto district ETFO, and Toronto district OSSTF assisted the workgroup.

Finally, the group makes recommendations for others who may wish to undertake similar projects.

Cash & Twiford (2009)

In this article, the authors review previous research on the relationship between academic achievement and school facilities—including cleanliness and painting. They propose ten actions to “invest minimally and reap rewards in student performance.” (p. 6). Six of these actions are within the purview of maintenance and custodial staff.

The authors note that:

“What some school leaders do not realize is that there is a direct and quantifiable connection between the condition of the school and the student achievement.” (p. 1)

Mass Insight Education—School Turnaround Group (September 2010)

The document is a set of metrics for use in school turnaround. These include two that could be correlated in order to measure the impact of maintenance on student behaviour:

Metric 2—attendance/dropout/retention/suspensions

Metric 6—safety and cleanliness of school facilities.

CONCLUSION



While methodology and target populations vary in the research conducted in this area, the majority of studies strongly support a positive correlation between school building condition and student achievement.

As Berry indicates in *Healthy Schools are Clean, Dry, and Productive*, “there is growing evidence that when a school building is in disrepair, teaching and student achievement suffers; the school environment works against the educational process.” (p. 1)

This is reflected not only in differences in student achievement levels, but also in the attitudes of both students and staff in a school. In a study conducted by Campbell (2008) in which a survey was sent to students at randomly selected post-secondary education institutions in the United States, over fourteen hundred students responded. Among the findings were that 88% of the students responding reported that a lack of cleanliness becomes a distraction, and that 84% reported that they desire a high level of cleanliness to create a good learning environment.

Campbell’s research also found that 78% of the students responding reported that cleanliness had an impact on their health, indicating that a lack of cleanliness affects allergies, spreads germs, increases bug and rodent infestation, and promotes higher stress levels.

Edwards (2006) asked a sample of summer school middle and high school students about their perceptions of the relationship between the condition of their home school and its impact on their achievement, motivation, and behavior. A majority of the students agreed/strongly agreed (61.4%) that they personally could learn better in a facility that is neat, clean and in good physical condition and 66.5% agreed/agreed strongly that students would be more motivated in such schools.

The idea that school building condition and cleanliness can affect students’ health and therefore performance is supported by the research as well. In *Indoor Air Quality and Student Performance*, a document produced by the U.S. Environmental Protection Agency, failure to adequately perform housekeeping and maintenance is cited as a common example of factors contributing to poor indoor air quality (p. 1). This document states that:

“Evidence continues to emerge showing that poor indoor air quality (IAQ) can cause illness requiring absence from school, and can cause acute health symptoms that decrease performance while at school. In addition, recent data suggest that poor IAQ may directly reduce a person’s ability to perform specific mental tasks requiring concentration, calculation, or memory.” (p. 1)

The report goes on to state that:

“Children’s overall performance decreases due to sickness or absence from school. Building associated health effects can increase student or teacher absences from school and degrade the performance of children or teachers while in school. Respiratory health effects, such as respiratory infections and asthma, are the illnesses most closely associated with increased absenteeism. In fact, asthma-related illness is one of the leading causes of school absenteeism, accounting for over 14 million missed school days per year.” (p. 2)

The link between cleanliness and achievement is reflected in other literature as well. In a document produced by the National Education Association titled *Take a Deep Breath and Thank Your Custodian* it is stated that “In addition to illness, and decreased performance and concentration, students exposed to poor IAQ miss approximately 14 million days of school each year due to asthma, and score 11 percent lower on standardized tests than those students attending schools in good condition.” (p. 2) In his report *Healthy School Environment and Enhanced Educational Performance - The Case of Charles Young Elementary School, Washington, DC* Dr. Michael Berry lists “the school is clean and sanitary” under Essential Environmental Considerations of Schools (p. 2). Dr. Berry states that:

“The cleanliness of schools is also an important aspect of school environments. Clean schools not only lower the threat of the spread of illness, but also convey a caring message to the students and teachers. Cleaning and maintenance of schools is vitally important and is often underemphasized and underperformed.” (p. 3)

While the exact impact on test scores varies from one study to the next, what is consistent in the research is the strong positive correlation between cleanliness and maintenance, as reflected by the condition of the school building, and student achievement. As indicated by Hines “Upon reviewing the analyzed data, that relationship must be acknowledged”, and the “overall improvement denotes a very strong relationship.” (Hines 1996, p. 86) Hines found positive differences of between 9 and 17 points in his study. Earthman, Cash, and Van Berkum (1995) found cosmetic building condition alone accounted for between 1 and 9 percentile ranks on the Comprehensive Test of Basic Skills subtests. Cash (1993) also equated cosmetic condition with score improvements of up to 5 percentile ranks. Crook (2006) found, after controlling for socio-economic status, that:

“The percentages of students passing the Standards of Learning examinations between the standard and substandard building conditions differed by up to 17.2 percentage points.” (p. 119)

Bullock (2009) found that cosmetic building condition accounted for pass rate increases of between 4.77% and 6.47% for middle school students.

The result of this must be to recognize the importance of cleanliness and maintenance on student achievement as well as on the overall wellness of the school and the people which occupy it. As Campbell indicates, “Building conditions including custodial service should be considered an important factor in student academic achievement.” (p. 34) This is echoed by Dr. Berry who states, “Making cuts in routine cleaning and maintenance, repairs, and restoration is commonly considered less devastating than cutting academic programs. This limited thinking is very short-sighted, and, in the long run, ends up adding to the cost of education.” (Healthy School Environment and Enhanced Educational Performance—The Case of Charles Young Elementary School, Washington, DC, p. 5)

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