EVALUATION OF INSTRUMENTS THAT MEASURE SCHOOL BUILDING CONDITION

GLEN I. EARTHMAN
Virginia Tech, U.S.A.

ABSTRACT

This manuscript contains a discussion of the evaluation of survey instruments used in research studies to assess the influence the school building has upon student and teacher performance. Under the assumption that the school building influences student and teacher performance, it is necessary to determine the actual physical condition of the school buildings. To determine the condition of the school building, a variety of instruments have been developed and used. Roberts (2017) has recognized these instruments as being in two categories. The first category are the instruments developed by researchers specifically to determine the condition of the school building. The second category of instruments are the maintenance type instruments that are mainly used to determine building needs for the upkeep of the building. The second category measures needed repairs and improvements need to keep the building in good condition. This instrument may or may not contain the measures of those building elements or features that directly relate to student learning.

Cash (1993) developed the Commonwealth Assessment of the Physical Environment (CAPE) for one of the early studies on the influence of the school building. She also validated the study by using principals not involved with the study to assess the instrument. To date this has been the only validation of an instrument designed to measure the condition of a school building. A listing of the various instruments that have been used in research studies is contained in the Appendix.

INTRODUCTION

For almost half of a century, educational researchers have been investigating the possible relationship between the physical environment, as represented by the school buildings and classrooms, and the health, attitudes, and performance of students and teachers. In this period of time, the findings of successive research efforts have demonstrated that there is a positive relationship between the two variables. These findings indicate that if a school building is in satisfactory condition the students will perform academically much better than if they are in a building that is in unsatisfactory condition.

Some of the earliest studies were those that used the age of the building as a variable to indicate the influence of the structure has upon student performance (Blincoe, 2008; Chan, 1979; Chan, 1980; Garrett, 1981; McGuffey & Brown, 1978; Phillips, 1997; Plumley, 1978). These researchers found that students in older buildings performed less well than students in new buildings. The age of a building, however, was not the reason for poor student performance, but rather those building components and features that the older buildings lack, but which new building possess, was the reason for the significant difference in student achievement scores. The building components vital for positive student learning were absent in the older school buildings

The next research efforts went beyond using the age of the building as an independent measure and instead used an assessment of the condition of the building as the variable that might influence student achievement. In these studies, the building condition was represented by an assessment of various building components and features that previous research had indicated had

a relationship to the health and performance of the users of the space (Cash, 1993; Crook, 2006; Earthman, Cash, & Van Berkum, 1995; Hines, 1996). For instance, the thermal environment is an especially important aspect of a good physical environment. This building component has been used in many studies to assess its effect upon the health and performance of the occupants of the space. Therefore, this would be an important item to assess in determining the condition of the building. There are other building components that have been used in research studies to determine the effect upon the users of the space. These items have been condensed into school building assessment instruments that are used to determine the total condition of the school building for research purposes to find any possible effect.

The field of study under consideration in this discussion encompasses the research conducted to investigate the possible influence the condition of the school building has on student and teacher performance and attitudes. The second consideration is an examination of assessment instruments used for maintenance purposes, yet in some cases have been used in research studies. These two types of instruments have served the needs of researchers and school authorities to ascertain if the condition of the building has any influence upon those individuals within the school buildings and also the school buildings are in serviceable condition.

This is a rather narrow scope of investigations, but an especially important one because the research results impact upon human behavior. The results of the many investigations into this subject have indicated a positive influence that the physical environment, as represented by the school building, has upon the individuals who work and study in that environment. The end result of such research investigations is to use data to inform school authorities of the need for improvement of the physical environment of students and teachers to increase performance.

Naturally, one the of requirements of this type of research is the use of instruments in gathering data on the condition of the school building. In effect, the condition of the school building is essential if a determination is to be made of possible influence. In addition, there is a need to identify needed repairs in the school building for maintenance purposes.

In reporting to the Supreme Court of British Columbia in a deposition, Roberts (2013) delineated two types of school building evaluative instruments. The first is the maintenance or engineering type of instrument. This instrument is designed to identify those repairs or replacements needed to keep the school building in good working condition. The second type was termed a mission instrument mainly used in research studies. Items in the mission type of instrument normally have a research base indicating that some research has been completed to verify that there is a positive direct relationship between a certain building elements and student achievement. This has been done through a comparison between the building element and student achievement.

Because some researchers have used data derived from maintenance/engineering type evaluative instruments in research studies, it is incumbent to include such instruments in any discussion of instruments used to ascertain the condition of a school building for research purposes.

MAINTENANCE AND ENGINEERING INSRUMENTS

Instruments that measure and record the maintenance problems of a school building should be utilized for just the purpose of identifying all the building elements and machinery that needs some attention or re-placement. The success of the instrument in identifying all the repair/ replacement needs of the school building is in doing just that. There is no need to validate such

an instrument. If building elements that need repair and were not identified by the instrument in a maintenance inspection, the proper thing to do would be to add additional questions or items to cover what was missed.

The same rationale applies to so-called engineering instruments. These are evaluation instruments that are produced by an engineering firm for the purpose of determining if the building is sound and in good working condition. Such instruments may well evaluate parts of the building structure that annual maintenance evaluative instruments may not cover. The soundness of the foundation of the school building may be assessed in an engineering-type of instrument that may not be assessed by a maintenance-type of instrument. The need to replace the heating is another item that may or may not be included in the annual inspection. Nevertheless, there is a need for engineering instruments to evaluate parts of the building that a maintenance-type instrument may not include. As like the maintenance-type of instrument an engineering evaluation instrument cannot be validated as to effectiveness or reliability. The instrument either assesses everything that it is supposed to evaluate, or it does not and needs revision.

Data derived from maintenance and engineering type of evaluative instruments have been used in several research studies to ascertain the condition of the school building (Duran-Narucki. 2008; El Nemr & Cash, 2022; Gravelle, 1998; Pirus, Marlon, Calvo, & Glenn 2005). Such use of data from a maintenance instrument has in effect compromised their findings. Researchers of such studies usually state that the results of their analyses may not be as robust as other researchers or that there is no difference between achievement scores of students in building rated as either in satisfactory or unsatisfactory condition.

. There is no need to validate a maintenance or engineering type of instrument for several reasons. The first reason is the necessity of adding items to the instrument to measure a particular building element that is present one year and not another year. For instance, while assessing the building for items that need to be repaired or replaced a particular feature may not be on the instrument and is simply added when observed. The addition of new items for the instrument in essence means a different instrument. Secondly, the instruments do not measure the same item consistently. In other words, the maintenance/engineering type instrument is designed to identify needed repairs, but not necessarily the same item on each inspection. Undoubtedly there are some items included on the instrument that are standard but may not cover all possible needs. The worn-out carpeting may appear only once on the instrument or may not even be identified as a particular item but is added to the data collected by the instrument. If in the annual evaluation of the school building some items of need of repair are not identified, the reason would lie with the individual doing the evaluation and not the instrument itself.

MISSION TYPE EVALUATION INSTRUMENTS

The other type of school building evaluation instrument is what Roberts (2013) refers as a mission type instrument. Such instruments are especially designed to evaluate the elements or features of the building that previous research has indicated have a positive influence upon student achievement. Such features as positive thermal control of the classroom (Air Conditioning, Air Quality, Heating/Cooling), the necessity of good lighting, acoustical control in the classroom, proper classroom furniture, cleanliness, and proper toilet facilities are essential to positive student learning and teacher attitudes (Earthman, 2004). The measurement of these building elements or features are normally included in mission type building evaluation instruments and essential if usable data is to be obtained for research purposes. See the Appendix for listing of such selected instruments.

Cash (1993) may have been the first and probably the only researcher to try to validate a mission type of instrument The instrument she attempted to validate was the Commonwealth Appraisal of Physical Environments (CAPE). She utilized the CAPE to determine the condition of the middle schools in Virginia and then compared the academic scores of students in these schools to determine significant difference in scores. She found significant differences in achievement scores of students in school buildings rated as being in either satisfactory or unsatisfactory condition.

In an effort to validate the CAPE, Cash asked five principals who were not in her study to assist in the validation process. Each of the five principals completed an assessment of their school building using the CAPE. Cash also evaluated the high school building in which she was principal. Her responses were measured against the results of the five principals. The results of the evaluations were remarkably similar, thereby providing a measure of reliability that the instruments provided similar data. This validation exercise seems to be the only validation of the CAPE that is known.

Other researchers have used a modified version of the CAPE to identify the condition of school buildings in either satisfactory or unsatisfactory condition, (O'Neill, 2000; Phillips, 1997; Plumley, 1978). No validation processes were reported in these studies. In 2019, Earthman revised the CAPE to include items related to newer classroom technology. The Revised CAPE has not been validated and needs to be validated.

In 2022, El Nemr and Cash utilized the Revised CAPE in a study of schools in Virginia. They also used the Facility Condition Index (FCI) as a measure of building condition. The FCI is not noted for accurate measurement of the physical condition of the school building, because it is a ratio of the cost of maintenance needs of the building to the total value of the building. El-Newr and Cash used the FCI in conjunction with the Revised CAPE in an effort to ascertain the condition of the school buildings in the study. The findings of the study were not as robust as other studies that did not include an engineering type of instrument to measure the condition of the school building. The Revised CAPE is now being utilized in a study currently underway achieving much improved results.

Some researchers have performed validation exercises on the instrument designed to record teacher or student attitudes. These studies used either the CAPE or a modified form of the CAPE or indeed a different instrument to ascertain the condition of the school building. The researchers of these studies then used the data on school building condition to determine if there was a significant difference between attitudes scores of students in these two categories of school buildings.

One of the earliest studies examining the relationship between school building condition and student/teacher attitudes was conducted by Karst (1984). He investigated the possible relationship between school building quality and student and teacher attitudes in a large metropolitan area in Louisiana. The population consisted of 499 students in six elementary, junior high, and senior high school buildings. A total of 130 teachers also participated in the study. The condition of the school buildings was assessed using the Model for Evaluation of Educational Buildings (MEEB) developed by Carroll McGuffey & Brown (1978). Based upon the assessment, the buildings were divided into upper and lower quality buildings, based upon the scores assigned by the assessors.

The attitudes of the students and teachers were assessed providing data for a comparison between the two groups. The assessment instrument used to measure attitudes was simply referred to as E-4 and E-10 without further identification or description. The E-4 was administered to teachers and the E-10 to the students. There was no validation of the MEEB instrument. In addition, the MEEB could be classified as a maintenance type of instrument

Leigh (2012) also investigated the relationship between the condition of the classroom and teacher's attitudes about their classroom. He utilized the Revised Commonwealth Assessment of the Physical Environment (RCAPE) to classify the school buildings as either in satisfactory or unsatisfactory condition. The instrument used to measure teacher attitudes was the My Classroom Appraisal Protocol, (MCAP) (Earthman, 2004) and was administered to the teachers. Results of the CAPE building evaluation and MCAP were subjected to a t-test to determine significance. There was a significant difference between the attitude scores of teachers in the two categories of school buildings indicating school building condition had an influence upon teacher attitudes.

As part of the study Leigh then determined content validity of the MCAP by asking all teachers in three school buildings to respond and complete the instrument. At the same time teachers were asked to complete an assessment of the instrument for purposes of future administration. Revisions to the items resulted from this exercise. A Cronbach Alpha was completed on the results of this administration of the MCAP and a Cronbach alpha of .84 was found indicating a high level of reliability. The CAPE instrument was not validated.

Another validation of a teacher opinion instrument was completed by Uline, Tschannen-Moran, et. al., 2006). The instrument they validated was the School Climate Index which was designed to measure teacher attitudes about the condition of the school building in which they were teaching. The Cronbach alpha was not reported.

These are the only validations of instruments used in research efforts relating to the relationship between school building condition and student or teacher attitudes that are recorded. Perhaps there have been other validation of instruments, but none recorded to assess the condition of school buildings for research purposes, which is quite different.

Use of data on the condition of a school building derived from a maintenance type instrument for research purposes may not produce the same results as data from a mission type of instrument might produce. These instrument, however, have been used in research studies with some degree of success. That said, the instrument must contain some items that are directly related to student achievement or attitudes. As an example, Gravelle (1998) evaluated the school buildings in Idaho for a research study. She utilized the Building Condition and Suitability Evaluation (BCSE) instrument produced by the Department of Education. The instrument had 60 items to be scored by the principal of the school building. This instrument could be termed an engineering-type of building evaluation instrument according to Roberts (2013). Gravelle did find significant differences in student achievement scores between students in satisfactory or unsatisfactory school buildings. Her findings, however, were not as robust as found by Cash (1993), Hines (1996), Earthman, Cash, & Van Berkum, (1995), Crook, (2006), who used a mission-type instrument (Roberts. 2013).

Gravelle (1998) indicated that the instrument was very thorough, but that many of the items did not relate directly to student learning. This finding would seem to indicate that those items in the instrument that did not relate directly to student achievement tempered the final results of her study. Gravelle might have found stronger results if she had utilized the results of only those items that did directly relate to student achievement as a measure of building condition.

The findings of another researcher were similar to what Gravelle found. In 2008, Darwin-Narucki conducted a research study to determine if the condition of the school building influenced both student attendance and achievement. Her study was conducted in the New York City Public School System using the elementary schools. She also used the engineering type of evaluation

instrument produced by the public school system. In spite of the fact such instruments, in many instances, do not produce the same kind of data as mission type instruments, she did find that the condition of the school building influenced both student attendance and achievement. There was a significant difference in attendance rates and in achievement scores of students in satisfactory and unsatisfactory school buildings.

The same results were not found by Picus, Marion, Calvo, & Glenn, (2005). in their study of the school buildings in Wyoming. The researchers, in order to ascertain the condition of the school buildings, used an evaluative instrument developed by the MGT engineering firm. The instrument was the usual type of engineering instrument that measured many building elements that were not directly related to student achievement, such as the integrity of the foundations, the quality of the carpeting, or the quality of the wall treatment, for example. The researchers could not find any significant difference in achievement scores of students enrolled in either satisfactory or unsatisfactory school buildings. Unfortunately, the researchers reported the school building condition did not influence student learning. There were other aspects of the study, besides the use of an engineering instrument, which were dubious. The superintendents of each school district evaluated the local school building to determine the condition of the school building. Brannon (2000) found that the principal of the individual school building was more informed about the condition of the school building than the superintendent or any other school official. Also, Picus, et. al (2005) used student achievement scores that were averaged over a three period of time supposedly to better represent the achievement of students. Naturally, the means of student grades over a three-year period of time is not representative of the student grades received in the exact year in which the study was completed. These factors might also have compromised the findings of the researchers.

VALIDATION

Validity is the action of checking or proving the validity or accuracy of something. Another definition is: The determination of the degree of validity of a measuring device. In other words, actions to determine if an evaluation instrument measures what it is intended to measure. In the field of school buildings such an instrument would be an instrument that determines the usability of the building for educational and research purposes.

With the advent of recent research regarding the possible influence the school building has upon the performance of students and teachers a different type of assessment instrument was developed. It was not until 14 years later that other researchers seriously started the research effort to determine the influence the school building has upon the students. (Cash, 1993; Edwards, 1993). Since that time serious researchers have completed several studies to ascertain what the existing research has found to be the case in this area, (Bailey, 2009, Hewitt & Earthman, 2017; Lemasters, 1997; Weinstein, 1979). These studies have been reviews of research investigating the possible influence the school building has upon student and teacher attitudes and performance. In the latest such research review, Hewitt & Earthman (2017) identified 103 different studies related to this topic. Eventually they used thirty-six of the studies where a mission type of instrument was used to determine the condition of the school building and directly related to the possible influence a school building has upon student achievement for their analysis. All of these studies reported a significant difference between achievement scores of students enrolled in satisfactory and unsatisfactory school buildings.

With such a plethora of studies in this area of research, the thought of validation became an issue. Should the instrument used to obtain data on student and teacher attitudes and achievements be validated? Likewise, should the instrument utilized to obtain data on the physical condition of the school building be validated. The issue never became a prominent issue with researchers. The matter of validation of the CAPE could hinge on the repeated use of the instrument arriving at the same results as was the case in the original study by Cash (1993). Repeated successful use of the CAPE could indicate a reliability validation. This in effect could be considered at least a reliability check of the CAPE after repeated results.

COHORT DETERMINATION

In addition to the application of the proper data gathering instrument to determine the condition of the school building, there is the matter of determining the cohort of school buildings to be compared to ascertain if there is a significance difference between achievement scores of students in satisfactory or unsatisfactory school buildings. This regards the determining of school buildings as being either in satisfactory or unsatisfactory condition. In all instances the instrument used to ascertain the condition of the school building has a scale that provides data on the condition of the building and results in a final score for each building. These data then can be utilized in comparing each building condition with student achievement scores.

The final score of each building in the study is normally arrayed in some ordinal position on a scale ranging from bottom score to top score. After the final score of each school building is displayed in the list, the researcher must decide which school buildings can be classified as being in either satisfactory or unsatisfactory condition. The division of school buildings ranked between satisfactory or unsatisfactory can be a matter of personal judgment. Normally the top half of the scale should contain the scores of buildings in satisfactory condition and the bottom half of the scores would indicate school buildings in poor condition. Yet there is a graduation of scores from the bottom score to the top score. As rational as that ranking may seem, there is a very little difference between the school building listed as number 49 and the school building listed as 50, consequently there is little difference in school building scores at that point to divide the schools into either satisfactory or unsatisfactory condition. Comparing the student scores in these buildings then results in little difference or possibly no significant difference. The school building scores in the two middle quartiles in effect moderate the scores of the school buildings in the bottom and top quartile resulting in a compromised school building score for the two bottom and top quartiles.

The better strategy in comparing scores of school buildings would be to take the top and bottom quartile of scores and made a comparison between these two groups of school buildings. The rationale for this strategy is that the extreme of the scores of school buildings represent the best and worse condition of the school building and would better show the effect of the condition of the school building on student achievement. Using the extreme positions would be a better comparison and possibly result in a significant difference. Whereas comparison of the entire cohort of school building scores in the top and bottom halves would marginalize the effect of the condition of the school building.

The researchers of most studies employing the comparison of school building condition to student scores methodology do not stipulate how the division of school building scores is determined. It could well be that the researchers are using the top and bottom halves of building scores as the two

cohorts for comparison rather than using top and bottom quartile of scores. Again, this would result in the marginalization of the effect of the school building condition. Thus, the researchers might then stipulate there is a weak correlation or no correlation at all. This would then be an error that would result in reporting doubtful findings.

SUMMARY

Over the course of more than half a century, there have been many evaluative instruments developed to measure the condition of the school building for research purposes. Some of the instruments have been very effective in measuring the exact condition of the school building for research purposes. Likewise, there have been some instruments or derivations of instruments that have not proven as effective as other instruments.

There also have been some researchers who have utilized data from maintenance/ engineering type of instruments to measure the condition of a school building for research purposes. The results of these studies have been mixed at best. Gravelle (1978) and Duran Narucki (2008) employed maintenance type of instruments and found a degree of evidence that the condition of the school building did have an influence upon students. The same cannot be said for the Picus, et. al. (2005) study. There were, however, other features of the study that might have influence results, such as having the superintendent of schools evaluate the school buildings rather than the individual principals. The averaging of student achievement scores over a three-year ceroid might be another compromise in this study.

The question always rises regarding a need for new instruments. The fact is that new instruments to measure school building condition for research purposes are not needed. This is because there are several instruments on the market that will measure the building condition accurately. The secret to effectiveness remains with the composition of the instrument. If the instrument contains items that have a research basis and accurately measure the building feature or element that directly influences student/teacher performance, it will produce the data needed for the study.

Some of the maintenance/engineering instruments used in research studies may contain sufficient items directly related to student learning, but the items in the instrument that report needed repairs or replacements tend to minimize the effect of the research-based items with resulting questionable data.

The conclusion of this manuscript is, however, that for best results of studies trying to determine the possible influence school building condition has upon student or teacher performance or attitude is to utilize a mission type of instrument where the items on the survey instrument are directly related to student academic achievement.

In the Appendix, some of the more useful evaluative instruments are listed according to the category of research. This may not be the most exhaustive list, but it does list the better-known instruments that have been utilized. The list contains those instruments that measure the condition of the school buildings. Also contained in the list are those instruments designed to gather data on student and teacher performance and attitudes. Finally, there is a list of maintenance/engineering type instruments that have been used in research studies.

APPENDIX

Evaluation Instruments Utilized in Research Studies

Building Condition
Guide for School Facility Appraisal (Hawkins & Lilly, 1992)
Model for Evaluation of Educational Buildings, MEEB (McGuffey, 1974)
*Commonwealth Appraisal of Physical Environment CAPE (Cash, 1993)
The Design Appraisal Scale for High Schools – DASH-1 (Anderson, 1999)
State Assessment of Facilities in Education SAFE (Earthman, 1995)
Assessment of Building Conditions in Elementary Schools, (Lanham, 1999)
Commonwealth Appraisal of Physical Environment Revised CAPER (Cash & Earthman, 2016)

Teacher Attitudes
**My Classroom Appraisal Protocol (Earthman, 2006)
National Classroom Appraisal Protocol (Earthman, 2005)
**The School Climate Index (Uline & Tschannen-Moran, et al. 2006)
Teacher Opinion of Physical Environment (Lemasters 2006)

Student Achievement & Attitudes
Student School Building Assessment Scale (Earthman 2008)
Our School Building Attitude Inventory (McGuffey, 1971)

Maintenance/Engineering Type Assessment Instruments that usually do not measure building condition
Building Condition and Suitability Evaluation (Idaho State, 1998)
CDW-G 21st-Century Classroom Assessment Tool (CDW, Ryan Kurtz)
Design Assessment Scale Elementary (2000)
Building Condition Survey-NYC (Duran-Narucki, 2008)
MGT (Picus, et.al, 2008)
Facility Condition Index (US Accounting Office, 2009)

*This study is the only one that has been validated and measures building condition
**These studies have been validated, but measure student/teacher attitudes

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