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ABSTRACT

Research conducted in Georgia reveals that pupils in school buildings with modern facilities attain higher achievement than pupils in buildings with older facilities. All public schools in Georgia containing eighth grade students were classified as non-modernized, partially modernized, or modern according to results of questionnaires administered to building principals in 1975-76. Academic achievement data providing the dependent variable for the analysis were derived from scores on the Iowa Tests of Basic Skills taken by each school's eighth-grade students in 1975-76. Independent variables were school building age and socioeconomic status of each building's student population (based on the percentage of students participating free or at reduced rates in the school's lunch program). Analysis indicated that when the socioeconomic status variable was statistically controlled, school building age was significantly related (at the .05 level) to the composite, vocabulary, and mathematics scores on the Iowa Tests. (Author/PGD)

THE IMPACT OF SCHOOL BUILDING AGE ON PUPIL ACHIEVEMENT

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South Carolina

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THE IMPACT OF SCHOOL BUILDING AGE ON PUPIL ACHIEVEMENT

For centuries, education was envisioned primarily as people--teachers and learners. Very little attention was given to "the things of education" to improve the physical environment within school buildings. However, physical developments of the classroom in the last three decades such as air-conditioning (Stuart & Curtis, 1964), carpeting (Conrad & Gibbons, 1963), improved classroom illumination (Luckiesh & Moss, 1940), and carefully planned wall color (Rice, 1953) have been found to have a positive impact upon academic achievement. Consequently, one would expect to see improved pupil achievement in better facilitated school buildings of recent construction.

PURPOSE OF RESEARCH

The purpose of this study is to investigate the relationship of school building age and academic achievement of pupils taught within school buildings of varying age. The specific purpose is to determine the relationship of school building age and achievement of eighth grade pupils in the State of Georgia in 1975-76 on the Iowa Test of Basic Skills when the variance attributed to socio-economic status has been removed.

PROBLEM STATEMENT

What is the relationship between school building age and the achievement of eighth grade pupils from Georgia standard schools in 1975-76?

Pupils involved in this study were housed in (1) old non-modernized school buildings, (2) partially modernized school buildings, and (3) modern

school buildings. The achievement scores of these students on the Iowa Test of Basic Skills in vocabulary, reading, language, work-study and mathematics were examined.

Specifically this study is intended to seek answers to the following questions:

1. How much variance in the achievement of eighth grade pupils is attributed to the age of school buildings when socio-economic variable is statistically controlled?
2. How does the academic achievement of eighth grade pupils in old non-modernized school buildings compare with the academic achievement of eighth grade pupils in partially modernized school buildings?
3. How does the academic achievement of eighth grade pupils in partially modernized school buildings compare with the academic achievement of eighth grade pupils in modern school buildings?
4. How does the academic achievement of eighth grade pupils in modern school buildings compare with the academic achievement of eighth grade pupils in the old non-modernized school buildings?

REVIEW OF RELATED LITERATURE

Physical environments such as thermal, acoustical, visual and aesthetic environments and their relationship to student achievement were examined by many researchers.

Studies have revealed that the proper control of thermal environment in the classroom will affect the ability of student to grasp instruction. (Manning & Olsen, 1964; Mayo, 1955; McDonald, 1960; Peccolo, 1962; McCardle, 1966; Stuart & Curtis, 1964)

Studies have also shown that the reduction of undesirable background noises or the amplification of the desired sounds will affect learning. (Dixon, 1953; Conrad & Gibbons, 1963; Cunliff, 1967)

The visual environment affects a learner's ability to perceive visual stimuli and affects his mental attitude and thus performance. (Tinker, 1939; Luckiesh & Moss, 1940; Chorlton & Davidson, 1959; Blackwell, 1963; Sampson, 1970)

Evidence from several studies supports the hypothesis that selected combination of wall color in classroom has an impact on academic achievement. (Rice, 1953; Ketchem, 1964; Helson, 1965; Ertal, 1973)

The relationship of school building age and student achievement is an indirect relationship because school building age is a measure of the cumulative effects of thermal, acoustical, visual and aesthetic environments which have been documented to be significantly related to student achievement.

Thomas (1962) found that school building age was one of the independent variables having the greatest effect on educational outcomes.

Burkhead, Fox & Holland (1966) indicated that school building age was significantly related to reading scores at .05 level.

McGuffey and Brown (1978) examined the relationship of school building age and student achievement by school district in Georgia. The findings of the study showed that generally less than 3% of the variance in achievement test scores could be explained by the age of facilities after the variance accounted for by socio-economic factors was removed.

Plumley (1978) examined the relationship of school building age and student achievement of fourth graders in selected schools of Georgia.

Findings revealed that an average of 5.3% of the variance in achievement could be attributed to school building age when SES variables were statistically controlled.

METHODS AND PROCEDURES

Research Design

An ex post facto research design was used to investigate functional relationships among the variables since the manipulation or the assignment of variables to different treatments was not feasible due to a manifestation of their occurrence.

Population

The population was the school building for each of the state standard public schools containing the eighth grade in 1975-76 in the State of Georgia.

Variables

The dependent variable was the achievement scores of eighth grade pupils of Georgia on the Iowa Test of Basic Skills in 1975-76. These scores consisted of the composite scores, the vocabulary scores, the reading scores, the language scores, the work-study scores and the mathematics scores.

The independent varisble of major concern in this study was the age of school buildings determined by the year of construction or major modernization. The other independent variable was socio-economic status determined by the percentage of pupils participating in the paid school lunch program.

Sources of Data

The data for this investigation was obtained from the results of the eighth grade Georgia pupils in the Iowa Test of Basic Skills in 1975-76

and from demographic information provided by the principals of Georgia standard schools containing the eighth grade.

A questionnaire was used to collect data from the principals. It included questions which collected the demographic data of the school: the name and the location of the school, and the year of original construction of the school building. Questions were asked about the pupils' immediate physical environment: whether the eighth grade instructional rooms were air-conditioned in the school year 1975-76, whether they were carpeted, whether they were installed with fluorescent lighting and whether they were painted with pastel colors within the three years preceding the school year 1975-76. Further questions were asked on the total number of eighth grade pupils in the school in 1975-76 school year, how many of them were non-white, and how many of them participated free or at reduced prices in the school lunch program.

Operational Definitions

School Building Age --- The year of original construction or the year of major modernization of the school building.

Major Modernization --- Renewal of a school building to include air-conditioning and any two of the following: carpeting, fluorescent lighting, and painting instructional areas with pastel colors.

Partial Modernization --- Renewal of school building to include at least two of the following: air-conditioning, carpeting, fluorescent lighting and painting instructional areas with pastel colors.

Old Non-modernized School Buildings --- School buildings without air-conditioning and facilitated with none or only one of the following:

carpeting, fluorescent lighting and painting the instructional area with pastel colors.

Partially Modernized School Buildings --- Old non-modernized school buildings that have undergone partial modernization in the instructional areas.

Modern School Buildings --- School buildings that include air-conditioning, and any two of the following: carpeting, fluorescent lighting and painting the instructional areas with pastel colors on the day of their establishment or major modernization.

Academic Achievement --- The composite scores, the vocabulary scores, the reading scores, the language scores, the work-study scores, and the mathematics scores of the eighth grade pupils from Georgia standard schools on the Iowa Test of Basic Skills (ITBS), 1975-76.

Socio-economic Status --- Percentage of eighth grade pupils in the school participating in the paid school lunch program.

Standard School --- To be designated a standard school by the Georgia State Department of Education it is necessary that the school respond either affirmatively, or "not applicable" to all required criteria published in "Standards for Public Schools of Georgia".

Pastel Color --- The kind of color to include lighter shades of blue, yellow, orange, red and green, but exclude black, grey and dark shades of brown, green, blue and red.

Statistical Treatment

The statistical treatment of data started with the use of hierarchial inclusion method in multiple regression to analyse the relationship between

the dependent variable (achievement scores of ITBS) and the independent variables (school building age, percentage of pupil participating in paid school lunch program). The independent variables entered into the regression equation in a predetermined order. The independent variable, school building age, was force-entered into the regression equation after the inclusion of socio-economic status (SES) variable.

In accounting for variance, the standard regression method was used to decompose the sum of squares into components attributable to each of the independent variables. Variation due to building age was determined by adding this independent variable to the equation and treating it as if it had been added to the regression equation in a separate step after socio-economic variable had been included. The increment in R^2 due to the addition of building age was taken as the component of variance attributable to building age.

The analysis of covariance was used to determine whether the scores of the three groups (old non-modernized school buildings, partially modernized school buildings, and modern school buildings) differed significantly from one another. SES was used as covariate.

FINDINGS

Statistical analysis indicated that school building age was significantly related to the composite scores, the vocabulary scores and the mathematics scores of the Iowa Test of Basic Skills when the socio-economic variable had been statistically controlled. The F-values for school building age in the SES statistically controlled ITBS composite scores equation, the

vocabulary scores equation, and the mathematics scores equation reflected a significance level of .05. (see Table 1)

Table 1

F-values for School Building Age Variable

by Achievement Classification

	Iowa Test of Basic Skills					
	Compo.	Vocab.	Read.	Lang.	Work..	Math.
Year of original Construction or Modernization of School Buildings	4.0975	7.7132	1.0637	2.8440	2.1556	4.0779
Significance Level	.044	.006	.304	.093	.144	.045

In the composite scores equation, when SES variable was statistically controlled, school building age accounted for .982% of the variance in pupil achievement.

In the vocabulary scores equation, when SES variable was statistically controlled, school building age accounted for 1.919% of the variance in pupil achievement.

In the mathematics scores equation, when SES variable was statistically controlled, school building age accounted for 1.127% of the variance in pupil achievement.

Statistical analysis also indicated that the achievement of pupils in partially modernized school buildings was consistently higher than the achievement of pupils in old non-modernized school buildings. The difference

between the two types of school buildings in vocabulary scores was found to be significant at the .05 level. (see Table 2)

Table 2

Analysis of Covariance (Type I vs. Type 2)-
Summary Table of Deviations in Pupil Achievement

Grand Mean	Type	Unadjusted Deviation	Adjusted Deviation
		ITBS Composite Section	
924.70	1	-8.58	-4.60
	2	7.65	4.10
		ITBS Vocabulary Section	
915.07	1	-13.07	-8.75
	2	11.66	7.81
		ITBS Reading Section	
927.68	1	-8.42	-4.33
	2	7.52	3.86
		ITBS Language Section	
911.96	1	-6.15	-2.62
	2	5.49	2.34
		ITBS Work-Study Section	
932.50	1	-5.95	-2.35
	2	5.31	2.10
		ITBS Mathematics Section	
930.89	1	-5.32	-2.24
	2	4.74	2.00

Type 1 - Old non-modernized school buildings.

Type 2 - Partially modernized school buildings.

The achievement of pupils in modern school buildings was consistently higher than the achievement of pupils in partially modernized school buildings, except in the reading section of the Iowa Test of Basic Skills. (see Table 3)

Table 3

Analysis of Covariance (Type 2 vs. Type 3)-
Summary Table of Deviations in Pupil Achievement

Grand Mean	Type	Unadjusted Deviation	Adjusted Deviation
		ITBS Composite Section	
936.28	2	-3.92	-.84
	3	3.69	.79
		ITBS Vocabulary Section	
931.89	2	-5.16	-2.10
	3	4.87	1.98
		ITBS Reading Section	
936.75	2	-1.55	1.62
	3	1.46	-1.52
		ITBS Language Section	
920.99	2	-3.55	-.88
	3	3.34	.83
		ITBS Work-Study Section	
940.87	2	-3.06	-.14
	3	2.88	.13
		ITBS Mathematics Section	
940.54	2	-4.91	-2.22
	3	4.62	2.09

Type 2 - Partially modernized school buildings.

Type 3 - Modern school buildings.

The achievement of pupils in modern school buildings was consistently higher than the achievement of pupils in old non-modernized school buildings. The difference between the two types of school buildings in vocabulary scores was found to be significant at the .05 level. (see Table 4)

Table 4

Analysis of Covariance (Type 1 vs. Type 3)-
Summary Table of Deviations in Pupil Achievement

Grand Mean	Type	Unadjusted Deviation	Adjusted Deviation
		ITBS Composite Section	
929.08	1	-12.96	-5.85
	3	10.89	4.92
		ITBS Vocabulary Section	
920.88	1	-18.88	-11.41
	3	15.87	9.59
		ITBS Reading Section	
929.56	1	-10.36	-2.84
	3	8.66	2.39
		ITBS Language Section	
915.87	1	-10.06	-4.32
	3	8.46	3.63
		ITBS Work-Study Section	
935.90	1	-9.35	-2.76
	3	7.86	2.32
		ITBS Mathematics Section	
936.21	1	-10.64	-4.68
	3	8.95	3.93

Type 1 - Old non-modernized school buildings.

Type 2 - Modern school buildings.

In summary, the findings cited above have supported the basic hypothesis of this study. A significant relationship between the school building age and the academic achievement of the eighth grade pupils has been supported.

RECOMMENDATIONS FOR FURTHER STUDY

1. This is one of a series of studies on the relationship of school building age and pupil achievement basing on schools as analytical units. McGuffey and Brown's initial study (1978) was conducted on a district basis. Additional research is needed to narrow the unit of analysis to individual classroom and individual pupil.
2. All of the studies on school building age and academic achievement so far have been ex post facto studies. Additional effort is needed to investigate the many unsolved problems in this field. Further research in this field by employing experimental design is recommended.

SELECTED REFERENCES

Blackwell, H.R. IERI project 70. Illuminating Engineering, 1963, 4, 212-216

Burkhead, J., Fox, T.G., & Holland, J.W. Input and output in large city high schools. Syracuse, New York: University Press, 1967.

Chorlton, J.M., & Davidson, H.F. The effect of specular reflection on visibility: Part II - field measurements of loss of contrast. Illuminating Engineering, 1959, 8, 482-488.

Conrad, M.J., & Gibbons, N. L. Carpeting and learning. Columbus, Ohio: Bureau of Education Research and Science, 1963.

Cunliff, D.D. Soft floor covering in the Los Angeles City School Districts. New York: American Carpet Institute, 1967.

Dixon, M.T. Comparing acoustical control and the efficiency of verbal communications. Unpublished doctoral dissertation, Stanford University, 1953.

Halson, H. A review of activities during the year with emphasis on the relationship between colors and lighting. Illuminating Engineering Institute Annual Report, 1965.

Kr cham, E. Those colors fit your school decor. National Schools, 1964, 74 (5) 61.

Manning, W.R., & Olsen, L.R. Air-conditioning: keystone of optimal thermal environment. American School Board Journal, 1964, 149 (2) 22-23.

Mayo, G.D. Effect of temperature upon technical training. Journal of Applied Psychology, 1955, 39 (4) 244-249.

McCardle, R.W. Thermal environment and learning. Unpublished doctoral dissertation, University of Iowa, 1966.

McDonald, E.G. Effect of school environment on teacher and student performance. Air-conditioning, Heating, & Ventilation, 1960, 57, 78-79.

McGuffey, C.W., & Brown, C.L. The impact of school building age on school achievement in Georgia. CEFP/I Journal, 1978, 16 (1) 6-9

Peccolo, M. The effect of thermal environment on learning. Unpublished doctoral dissertation, Iowa State University, 1962.

Plumley, J.P., Jr. The impact of school building age on the academic achievement of pupils from selected schools in the State of Georgia. Unpublished doctoral dissertation, University of Georgia, 1978.

Rice, A.H. Color: what research knows about the classroom. Nation's Schools, 1953, 52 (5) 1-8.

Sampson, F.K. Contrast rendition in school lighting. New York: Educational Facilities Laboratories, 1970.

Stuart, F., & Curtis, H.A. Climate controlled and non-climate controlled schools. Clearwater, Florida: The Pinellas County Board of Education, 1964.

Thomas, A. Efficiency in education: a study of the relationship between selected inputs and mean test scores in a sample of senior high schools. Unpublished doctoral dissertation, Stanford University, 1962.

Blue is beautiful. Time, September 17, 1973, PP. 66.

Tinker, M.A. The effect of illumination intensities upon speed of perception and upon fatigue in reading. The Journal of Educational Psychology, 1939, 30, 561-571.