AN INVESTIGATION OF THE RELATIONSHIP BETWEEN SIZE OF ELEMENTARY SCHOOL AND ACADEMIC ACHIEVEMENT

by

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CHAPTER I

ORIGIN AND IMPORTANCE OF STUDY

Introduction

The post-World War II "baby boom" that produced tremendous increases in public school enrollments in the 1950s and 1960s in the United States reversed itself in the 1970s. Enrollment in regular elementary and secondary day schools reached 51.3 million in 1970, declined to 50.1 million in 1975, and is projected to further decrease to 46.1 million by 1985,[1] or a decline of approximately 10 percent.

At the elementary (K-6) level, total school enrollment in regular day schools peaked in 1967 at 32.0 million and declined to 29.6 million in 1975. Projections indicate that enrollment will continue to decrease to 27.8 million in 1981 and then begin to gradually increase reaching 29.1 million in 1985.[2]

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[1] Martin M. Frankel and Forrest W. Harrison, Projections of Educational Statistics to 1985-86 (Washington, D.C.: U.S. Department of Health, Education, and Welfare, Office of Education, National Center for Educational Statistics, 1977), p. 8.

[2] Ibid., p. 15.

The impact of declining enrollment on public education is such that the National Institute of Education in the preface to a volume on declining enrollments predicted that:

> The phenomenon of declining enrollments will most likely have a greater impact on education in the next decade than any other foreseeable trend. How we in education choose to handle it will either reinforce or undo the progress we have made toward achieving the goals we have pursued during the past decade.[1]

The major reason for declining enrollment is, on the national level, lower birth rates. The total fertility rate has declined from 3.7 in 1957 to 1.8 in the mid-1970s. Total number of births has fallen from over four million to 3.3 million in 1977.[2]

At the state and local levels, the national averages are tempered by another factor--mobility. "Sixty percent of U.S. residents, ages 20 to 29, changed residence between 1975 and 1978. More than 40 percent of U.S. children, ages 5 to 9, moved in that period."[3]

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[1]Susan Abramowitz and Stuart Rosenfeld, eds., Declining Enrollment: The Challenge of the Coming Decade (Washington, D.C.: U.S. Department of Health, Education, and Welfare, National Institute of Education, 1978), p. xiii.

[2]Steve Behrens and Liza Greenberg, "Communities Can Benefit as Schools Adjust to Changing Population," Zero Population Growth National Reporter 11 (January/February 1979): 4.

[3]Ibid.

The mobility combined with various economic and social pressures such as high housing costs, deteriorating neighborhoods, "no-growth" policies of some jurisdictions, and changing job markets has been the major reason that the decline in enrollment has not and will not be uniform or even universal for local districts.

> Experiencing the full impact of the drop are communities lying on the perimeters of urban areas that developed rapidly during the post-war years. These districts, called first-ring communities by demographers, are being hardest hit by declining school enrollment. Having matured over the past twenty-five years, the homes in many of these districts have become high priced due to the rapid escalation of land values. This has placed them out of the financial reach of young couples. Additionally, little land has remained available for further development. The uncertain economic conditions of the first half of the decade of the 1970s have served to make relocation impossible for many property owners whose children are no longer living at home. These considerations, in conjunction with the reduced birthrate, have set in motion conditions leading to declining school enrollments and economic crises in first-ring suburban communities throughout the United States.[1]

The twenty-seven member school districts of the Council of the Great City Schools all experienced, for the reasons cited above, a decline in enrollment from 1968 to 1975. The smallest percentage decrease was Dade County

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[1] Leonard Bornstein, Before You Close a School: Economic and Political Factors. Resource Guide--Declining Enrollments (Bethesda, Md.: ERIC Document Reproduction Service, ED 149 448, 1976), p. 1.

(Miami), Florida with 0.9 percent, the largest was St. Louis which experienced a 24.7 percent decline.[1] The mean percentage decline was 15.2. The most outstanding example of declining enrollment is the Salt Lake City, Utah, district which declined from 42,000 students in 1959 to 26,000 in 1972, a decrease of 38 percent.[2]

Obviously, one of the results of declining enrollment in any school district is that many schools have enrollments that are greatly under capacity; or, stated another way, have empty classrooms. While other uses can be found for some surplus space, continuing underenrollment combined with financial pressures to reduce cost has created a need to close schools. However, there is a large difference between realizing the need to close schools and actual closures.

Katherine Eisenberger summarized the situation very well when she stated:

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[1]Reported in Milton Bins and Alvin H. Townsel, "Changing/Declining Enrollments in Large City School Systems," in Declining Enrollment: The Challenge of the Coming Decade, ed. Susan Abramowitz and Stuart Rosenfeld (Washington, D.C.: U.S. Department of Health, Education, and Welfare, National Institute of Education, 1978), pp. 131, 133.

[2]Delbert H. Fowler, Declining School Enrollments, paper presented at the Annual Meeting of the National Association of Secondary School Principals, Anaheim, Cal., February 10-15, 1978 (Bethesda, Md.: ERIC Document Reproduction Service, ED 151 920, 1978), p. 2.

> Superintendents in communities across the country are asking the same questions. The problems they face are the same: dwindling school enrollment, half-filled elementary classrooms, high taxes, and, because of all of this, the prospect of school closings.
>
> Some schools that were built for the "baby boom" years are now operating at 60% to 70% of capacity. Administrators and boards looking at the cost factors know that one answer is to close a school and redistribute those children to the remaining schools in the district. In this way, all schools can operate at close to a 100% capacity level. This is efficient. This is economical. This is logical. Yet it is anathema to a large segment of the community.
>
> In their resistance, parents demand that the board offer counterplans; that some other schools be suggested for closing that the district reorganize into grade level schools--anything, anything to keep their local school from closing.
>
> But why? Why all this frustration and anger over a school building from formerly loyal district supporters?
>
> The first factor for administrators and boards to deal with is the realization that there are no loyal district supporters; there are only loyal school supporters.[1]

Once it has been decided that there is a need to close schools, many factors are considered in selecting the ones for closure. A typical set of factors is that developed by Minneapolis' Building Utilization Study:

1. The present utilization of the school plant
2. The available pupil space in adjacent school locations
3. The present and future enrollments
4. The life safety of the building
5. Rehabilitation needs and costs
6. School-Park Board complexes

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[1] Katherine E. Eisenberger, "Closing a School: Some Ways to Ease the Trauma," School Management 7 (August/September 1974): 33.

7. Cost of operation
8. Consolidation costs and transportation
9. Budget considerations.[1]

In many instances, however, the decision on which particular school should be closed rests on the size of the schools being considered based on an hypothesized relationship between school size and other variables. The major arguments for closing small schools, as opposed to larger ones, are usually operating costs per pupil and the normally undefined or ill-defined "quality of educational program." While many educators allege that the quality of the educational program suffers when a school gets too small, there are counter-arguments presented by others that small schools are "better." Many citizens demand "proof" to the contrary; and without that "proof," will simply not waver in their belief that "small is good."

While fairly convincing arguments can be made by both sides, the debates usually center around inputs into a child's education or cite the opinion of an "expert."

Statement of the Problem

Declining enrollment and the resulting need to close schools is affecting school districts throughout the country.

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[1]Educational Facilities Laboratories, Surplus School Space: Options and Opportunities (New York: Educational Facilities Laboratories, 1976), p. 49.

In many instances, the decision on which particular school out of a cluster of schools should be closed rests on the sizes of the schools being considered. The purpose of this study was to examine the relationship between elementary school size and an output of education, academic achievement. Deciding which school among a group of schools is the best candidate for closure is one of the most difficult actions a superintendent and board of education must make. This study was designed to assist decision-makers and the public in their deliberations.

Specifically, this purpose translates to the following research question:

What is the relationship between size of elementary school and academic achievement?

There are also several subquestions which were addressed:

1. Is there a school size(s) which maximizes academic achievement?

2. Is there a minimum school size beyond which academic achievement is adversely affected?

3. Is there a maximum school size beyond which academic achievement is adversely affected?

Definition of Terms

To promote understanding and clarity, the following terms are defined as they relate to this study.

Academic Achievement. Current status of individual with respect to skill in question.[1] Degree to which specific educational skills and abilities have been developed.[2] The term "academic" relates to the cognitive domain.

Aptitude. An individual's potential for learning a given skill when he/she is provided with appropriate instruction.[3] The ability to use and manipulate abstract and symbolic relationships.[4]

Elementary School. A school which contains no grade higher than six.

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[1] J. Stanley Ahmann, Testing Student Achievements and Aptitudes (Washington, D.C.: The Center for Applied Research in Education, Inc., 1962), p. 81.

[2] A. N. Hieronymus and E. F. Lindquist, preparers, Manual for Administrators, Supervisors, and Counselors, Levels Edition, Form 5 & 6, Iowa Tests of Basic Skills (Boston, Mass.: Houghton Mifflin Co., 1974), p. 46.

[3] Ahmann, Testing, p. 81.

[4] Robert L. Thorndike and Elizabeth Hagen, Examiner's Manual, Cognitive Abilities Test, Multi-Level Edition (Boston, Mass.: Houghton Mifflin Co., 1971), p. 3.

School Size. Total number of students registered in a school on the official date for enrollment count as required by local and/or state law or regulation (also known as total school enrollment).

Limitations of the Study

There are certain pragmatic and methodological constraints which place limitations on the findings of this study. These are noted so that the findings can be appropriately interpreted.

There are many factors to be considered in determining which school of a group should be closed. The quality of the educational program is only one, although an extremely important one. This study has not examined other critical considerations such as operating costs, transportation, racial balance, school organization, the socialization process, the psychological effects of the school environment, and the condition of the school facility.

Additionally, this is a macro study which was designed to assist in comprehensive educational planning. When a district must face the decision of which school to close, the educational program of each specific school must be carefully examined.

Another extremely important limitation concerns the measure of achievement. As achievement is a function of many factors and affects the cognitive, affective, and psychomotor domains, and as what was utilized was a measure of academic achievement which tests only a portion of the cognitive domain, care must be exercised to not over generalize the results of this study.

This was an ex post facto study; and therefore, all relationships are noncausal and there was no control over the testing procedures. Limitations are minimized, however, as a single district's test results were employed in this study.

Finally, this study was limited to analysis of school variables reported as means. Individual student achievement, aptitude, and other variables were not examined. Therefore, this study will not determine if school size has a larger impact on achievement for some students--for example, Blacks--than others.

CHAPTER II

REVIEW OF RELATED LITERATURE

Introduction

A review of the literature related to this study was conducted in an attempt to determine what research has been accomplished in examining an output of education at the elementary level, specifically academic achievement, and its relationship to school size. Also included is more general research which falls into two broad categories--the optimum size of elementary schools and the factors which influence optimum size. The latter two generally examine inputs to or processes of education. Literature which was pertinent to more than one category was reviewed only once.

It was found that there was three basic types of studies: reviews of literature; opinion surveys; and, most limited in number, statistical research. The literature included in this chapter is reported on these bases.

Optimum Size of Elementary School

An interesting paper which was written in 1968 in support of maintaining small schools, summarizes the state of research on optimum elementary school size:

> How big, or small, is the ideal school? There is little agreement on an answer to this question. Most of the answers are opinions, based on experience or derived from a particular philosophy of education, with few research findings available. Indeed, research of this kind is extremely difficult to conduct.[1]

Nonetheless, many articles and comments are worthy of notation. In 1954, Otto raised the following points:

> One issue that is basic to all of the aforementioned elements of planning is "What is the optimum-size elementary school?" In spite of the importance of this question, research is practically devoid of any evidence (or even a pointed attack on the problem) that would be helpful in deriving an answer. The best that can be done is to raise issues involved, and to report the trend of thought derived from experience.
>
> When does an elementary school get too large or too small for the best interest of children? A school should be large enough to permit the formation of class sections and age groupings that will create the best learning situation.[2]

In the same year, MacVittie, in an article which set out to show that elementary schools are too large, concluded--based on building economics, health programs, and school activities--that capacities of elementary schools

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[1] Quoted in (source not identified) Margery Burns, The Case for the Small Schools, speech before the Minnesota Interim Commission on Education, April 1968 (Bethesda, Md.: ERIC Document Reproduction Service, ED 023 534, 1969), p. 6.

[2] Henry J. Otto, Elementary School Organization and Administration (New York: Appleton-Century-Crofts, Inc., 1954), pp. 617-18.

should range from 300 to 400 pupils and each building should have no more than 12 to 14 rooms.[1]

In an effort to determine optimum size of elementary school, Teets (1956) examined the relationships between elementary school size, per pupil cost, and extent of educational opportunity. The extent of educational opportunity was determined by individual school scores on a four-area checklist--staff services, facilities, equipment and instructional materials, and organization and administration.

Teets found that the "extent of educational opportunity increases as the size of the school increases, up to 700 in membership."[2] Therefore, he concluded that the optimum size range was 600 to 699 students.

A study conducted by the Department of Health, Education and Welfare in 1959 concluded that:

> The size of elementary schools is dependent upon a number of local factors, all of which will not be present in any one situation. It is the general opinion, however, of many school administrators, supervisors, and teachers that an elementary school should have a range

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[1] Robert W. MacVittie, "Are Our Elementary Schools Too Large," Nation's Schools 53 (June 1954): 57.

[2] Louis Edward Teets, "Relationship in Elementary Schools Between Size, Per Pupil Cost, and Extent of Educational Opportunity" (Doctoral dissertation, University of Florida, 1956), p. 132.

of 300 to 500 pupils for an effective educational program.[1]

In the spring of 1961, the Research Division of the National Education Association conducted a survey among elementary school principals. One of the questions asked was: "What size elementary school do you think is most desirable for effective instruction, supervision, and administration?"[2]

While not overwhelmingly supporting larger schools, the largest percentage of respondents, 26.1 percent, did favor the 400-500 pupil size school, while approximately 60 percent of the principals preferred schools in the 300-600 pupil range.[3] The median size most preferred was 421.

Whitt examined the delivery of education primarily from a business management perspective for the Great Plains School District Organization Project. He concluded that "to provide economy and effectiveness with efficiency" the

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[1] James L. Taylor, Lillian L. Gore, and Hazel F. Gabbard, Functional Schools for Young Children (Washington, D.C.: Government Printing Office, 1961), p. 70.

[2] Glen Robinson, "Principals' Opinions About School Organization," National Elementary Principal 41 (November 1961): 39.

[3] Ibid.

elementary school should be composed of 300 to 500 plus students.[1]

In another paper prepared for the Great Plains Project, Inman concluded that the consensus of the literature "suggests a minimum of one teacher per grade level with two or three classrooms for each grade level recommended. A maximum seems to be four classrooms per grade."[2]

A volume on planning new schools by Engelhardt stated the following as concerns size of school:

> The one-room schoolhouse is out-moded. Today's standards indicate that an elementary school should have, as an absolute minimum, one teacher per grade; two, three, or four classrooms per grade are even better. Size of elementary school is, in fact, limited only by the appeal of a "neighborhood school" and the concern for having small children travel too long on buses. . . . a small school has difficulty in providing the specialists needed to meet today's education demands--librarians, nurses, teachers of science, arts, music, physical education, and specialists in remedial reading and speech.[3]

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[1]Robert L. Whitt, Structuring Education for Business Management (Bethesda, Md.: ERIC Document Reproduction Service, ED 020 034, 1968), p. 20.

[2]William E. Inman, "Size and State School System Organization," in Roger D. Farrar and Ralph D. Purdy, Comps., The Factor of Size and School District Organization (Bethesda, Md.: ERIC Document Reproduction Service, ED 025 022, 1969), p. 2.

[3]Nickolaus L. Engelhardt, Complete Guide for Planning New Schools (West Nyack, N.Y.: Parker Publishing Co., Inc., 1970), p. 2.

In the state of Washington, a special levy study commission examined finance and curriculum of the public schools in the state. In this large report, the effect of size on a number of variables was reviewed. The conclusion after reviewing research dating back to a 1932 doctoral dissertation was that:

> Because of the multitude of the variables uncovered, it is not possible to provide the magic numbers to determine an adequate school size. However, with the available research, conclusions, recommendations, and opinions, there is sufficient commonality apparent to allow for a few generalized conclusions.
>
> Enrollment recommendations for elementary attendance centers are not plentiful, but based upon the studies reviewed, the consensus indicates that a 300 to 400 pupil elementary school is recommended.[1]

Maltby concluded, based on a review of the literature, that there should be two sections per grade as a minimum and that 400 to 800 students was optimum.[2]

In 1974, Andrews studied the environmental impact of closures. Based on a review of the literature relating size to output measures, he concluded that:

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[1]Washington State Temporary Special Levy Study Commission, Temporary Special Levy Study Commission, Volume I: Summary Report and Research Reports, Final Report (Bethesda, Md.: ERIC Document Reproduction Service, ED 055 316, 1972), p. 356.

[2]Gregory P. Maltby and others, Master Plan for School Facilities: North Clackamas School District No. 12, Milwaukie, Oregon (Bethesda, Md.: ERIC Document Reproduction Service, ED 065 912, 1972), p. 116.

> The picture which emerges from this review of the literature is a confused one. There is a contradictory nature to the conclusions of many of the studies and in others the conclusions are not readily translatable into policy recommendations. It is, however, possible to begin to draw some inferences from this review.
>
> . . . The optimum size of an elementary school should lie in the range from 200-500 pupils. Related to this is the emerging viability of the smaller elementary school in terms of providing quality education.
>
> . . . It would seem that too often the prime criteria for closing smaller elementary schools is related to economic or administrative factors. If the economic savings are achieved at the expense of the quality of education available to students, it might be a wiser decision to maintain the elementary schools within a size range of 200-300 students.[1]

In 1976, a Small Schools Task Force appointed by the Eugene, Oregon, School Board reached several conclusions after reviewing four areas of research related to school size: opinion survey, economic analysis, achievement tests, and behavioral and environmental research. The Task Force could find:

> . . . no clear evidence that a school of less than 150 is inferior to a larger one. Since the desirable qualities of participation, involvement, and responsiveness increase as size decreases, we conclude that a maximum elementary school size should lie near the bottom of the range which is usually considered optimum by the educators' opinions. Therefore, when it becomes necessary to build new schools a size of 200 to 350 students is most desirable.

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[1] Richard L. Andrews, Roger Soder, and Donald A. Eismann, The Environmental Impact of School Closures (Bethesda, Md.: ERIC Document Reproduction Service, ED 112 521, 1976), pp. 41-42.

> Too often the prime criteria for closing smaller elementary schools are related to economic or administrative factors. If the economic savings are achieved at the expense of the quality of education, the Task Force believes that it is a wiser decision to maintain small schools. . . .[1]

Hess, in 1978, accomplished a very thorough review of the literature on school size. Included was research related to academic, economic, and institutional (interpersonal staff relationships, organizational conditions, staff development, and management patterns), and psychological and environmental factors. Their conclusions are worthy of notation.

> The general range of research on the subject of school size at the elementary level seems to focus on 300-800 students as an ideal population level. Few important studies recommend elementary pupil population levels below 300 students. The noteworthy survey conducted in the Montgomery County Maryland schools [discussed below] fixed that figure as an absolute minimum level for effective student achievement. Research on the topic of academic curricula tended to recommend minimum student populations in excess of the 300 level. Research dealing with economic factors focused on 500 as a minimum level for effective economic operation. Institutional factors seemed best suited to institutions with populations in the same range. Psychological influences of school size were seen as most beneficial when pupil populations were no lower than 300.
>
> Acceptable maximum levels for elementary school populations ranged from close to 500 to almost 1,000. As in the case of the minimum levels, researchers dealing with

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[1]Eugene (Oregon) Public Schools, Small Schools Task Force, Final Report (Bethesda, Md.: ERIC Document Reproduction Service, ED 117 804, 1976), p. 29.

economic and institutional factors tended to recommend higher figures than those dealing with academic, psychological and environmental factors. A number of studies did recommend maximum school sizes in excess of 800 pupils, yet the weight of academic and psychological arguments did seem to weigh in favor of such a lower figure.[1]

Factors Influencing the Optimum Size of Elementary School

While the references cited above discuss the optimum size of elementary school, few detail what the important factors influencing the ideal size might be. While some of the research which follows also cites an optimum size, the discussion of factors is highlighted.

Basler investigated the optimum size of elementary schools based on twenty factors which were determined as influencing size. These were employed as a result of interviews with sixty-nine elementary school principals in Iowa. The principals were asked their opinions on what factors were influenced by, or were related to, size. These factors are:

1. Amount of principal's time allocated to school
2. Amount of secretarial help
3. Organization for administration, supervision and instruction
4. Principal being busy with office routine

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[1] Fritz Hess and others, "School Size and Its Effects on Achievement and Other Educational Issues," in Issues in Education: A Documented Look at Seven Current Topics (Bethesda, Md.: ERIC Document Reproduction Service, ED 158 391, 1979), p. 13.

5. Staff working as a unit
6. Personal acquaintance of principal with staff
7. Unified staff planning
8. Rigidity of scheduling
9. Playground behavior problems
10. Teachers' knowledge of total pupil population
11. Pupils' knowledge of total pupil population
12. Teachers' knowledge of total parent population
13. School spirit and pride
14. Closer school-community relations
15. Pupil tension and apprehension
16. Individual pupil problems
17. Extra-curricular activities
18. Ability grouping
19. Standing in line
20. Rules, regulations and need for passes.[1]

It is noteworthy that the factors usually mentioned as being the advantages of small schools--such as pupil-teacher relationships, school pride, school-community relations, and principal, teacher, and pupil knowledge of total school population--are incorporated in Basler's study. Even considering these, Basler concluded that the double-sectioned school (defined as a school having twelve to fifteen teachers, or 360-450 students) is able to accrue the advantages of a larger school while at the same time retaining either entirely or to a considerable degree most of the advantages generally attributed to a small school.[2]

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[1]David B. Basler, "An Investigation of Certain Factors Influencing the Optimum Size for Elementary School Attendance Units" (Doctoral dissertation, University of Iowa, 1960), p. 211.

[2]Ibid., p. 218.

Sollars studied the optimum size of elementary schools in relation to program quality and costs with data gathered in twenty-one school districts in central Ohio. To determine program quality, Sollars applied the following indicators:

1. Program indicators
    a. Number of textbooks, supplementary books, and library books available
    b. Use of resource people
    c. Number of field trips
    d. Method of grouping of pupils
    e. Presence of a written philosophy and objectives
2. Pupil indicators
    a. Frequency of behavior problems
    b. Pupils' knowledge of pupil population
3. Teacher indicators
    a. Preparation
    b. Certification
    c. Years of teaching experience
    d. Extent of foreign and domestic travel
    e. Professional interest
    f. Knowledge of pupil population

g. Pupil-teacher ratio

h. Amount of pupil-free time available for planning.[1]

Sollars concluded that:

> An increase in advantages shown by all indicators . . . occurs as school size increases in the 0 to 499 pupil range. A decrease in advantages occurs in schools in the 500 to 799 pupil range. An upward turn in advantages occurs in schools of 800 or more pupils but these advantages do not approximate those evidenced in the 300 to 499 pupil range. . . . [Thus,] the findings of the study indicate that when all indicators are considered, the 300-499 pupil range is the size category in which the favorable indicators approach the maximum and unfavorable indicators approach the minimum.[2]

A statement on elementary school size prepared for the Arlington County (Virginia) Public Schools listed several factors that

> . . . cause the small elementary school to be considered a less effective base for instructional activities and a less efficient administrative unit when compared with the elementary school that can offer two or more classroom groups at each grade level.[3]

The factors that, according to Arlington County, cause the small school to be less effective and efficient are:

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[1]Adopted from Ralph D. Sollars, "The Relationship of Size of Elementary Schools to Operational Cost and Program Quality" (Doctoral dissertation, Ohio State University, 1962), pp. 39-50.

[2]Ibid., p. 135.

[3]Arlington County (Virginia) Public Schools, Study of Suburban School Size: Highlights (Arlington, Va.: Arlington County Public Schools, 1965), p. 18.

1. Problems of instruction--pupil organization
   a. Grouping. Each class contains a total range of achievement--the opportunity to assess the individual needs of students and reduce the differences in a class is not present. This is true initially and as the year continues; regardless of the change in children, it continues to be true.
   b. Class size. There may be very large classes or very small classes--combination classes are not readily formed. This is true as the year starts, and if student personnel change during the year and are added to the already large class, there is no possibility for relief.
   c. Retention. If students are retained they spend the second year in the same grade with the same teacher.
   d. There is no opportunity for matching student needs with teacher strengths.
   e. An elementary student is placed in contact with only one teacher. Opportunities for cooperative teaching, which allows teachers to complement each other's strengths, are limited in a small school.
2. Problems of instruction--teaching staff
   a. Each teacher works as the only teacher of the grade to which he is assigned--has no one at the same grade level to plan with, to share problems with, etc.
   b. Inservice activities are difficult to plan. The teaching staff is too small to plan for as a unit; they must usually combine with another school.
   c. Although we need to assign the very best teachers to small schools because of the wide range of abilities in each class and the comparative isolation, many good teachers do not like assignments in small schools. Teachers prefer the stimulation of a large daily contact with other professionals.
   d. Teachers are asked to assume more responsibilities--both as representatives of the school to county groups, and as sponsors to co-curriculum activities.
3. Problems in providing services
   a. Clerical. The basis for providing secretarial help to teachers is not sufficient for continuous service.

b. Itinerant services. Art, music, speech therapy, reading, school-based physical education, and school nurse are very difficult to schedule on "like time" basis to a small school. Much travel for helping teachers is required, frequency of contact is reduced, and space for these people to work is usually limited.
c. Library is not staffed full time.

4. Problems in administrative staffing
   a. It is difficult to hold principals. Principals who are assigned to small schools are always hoping to get a larger school. They move when this opportunity arises, creating a higher rate of administrative turnover in the small school.
   b. The principal, if assigned to two schools, is not always at the school in which he is needed.
   c. The principal, if also assigned teaching responsibilities, is not available to talk to parents, teacher, etc., when teaching.
   d. Secretarial services are part-time.
   e. Cafeteria operation presents difficulties of small-unit operation.
5. Problems to school system

   Recognizing the problems listed above, more time, attention, and services are concentrated on the small school than on groups of similar size located in large schools. The small school operates to some extent at the expense of the large schools.[1]

In 1972, Pearce attempted to determine whether there is a minimum elementary school size in Georgia. Eighty-seven indicators of program quality were applied to 587 elementary schools. Thirty-three of the indicators differentiated (at the .05 level of significance) as to a minimum size of school.[2]

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[1] Arlington County Public Schools, School Size, pp. 19-20.

[2] Clyde Clinton Pearce, Jr., "An Investigation into the Relationship of School Size and Program Quality of Public Elementary School in Georgia" (Doctoral dissertation, University of Georgia, 1972), p. 137.

The list of discriminating program indicators is a lengthy one, but can be grouped into several major categories. The entire list is not provided as it is very similar to the factors described more succinctly by other researchers.

1. Organization--seven indicators
2. Administration--two indicators
3. Teaching staff--one indicator
4. Resource staff--one indicator
5. School plant--seven indicators
6. Library--five indicators
7. School food service--one indicator
8. Curriculum--nine indicators.[1]

Based on the above, Pearce concluded that "schools of less than 300 enrollment were at a considerable disadvantage in the frequency of presence of the program quality indicators."[2]

Montgomery County, Maryland, Public Schools conducted a study in 1973 in reaction to declining elementary enrollments. One of the key areas studied was the effect of the size of school on educational program. The following

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[1] For a detailed listing, see Ibid., pp. 117-127.

[2] Ibid., p. 137.

advantages and disadvantages of small schools were developed by a task force which interviewed teachers and principals:

Advantages

The small school, especially one with declining enrollment and uneven distribution of children in grades, is more likely to utilize innovative teaching methods and to encourage individual teaching and open classroom situations with working groups that cut across grade levels.

The small school is more likely to develop an "emerging staff," that is, one that reaches out to take on administrative responsibilities and has a voice in running the school.

Small schools provide a "family atmosphere" in which teachers can know all of the children in the school and many of their parents and develop close, supportive relationships with both groups.

The community has a close relationship to the school and is likely to provide volunteers and other support to the school, which may serve as a community center.

The principal knows the staff well and can make maximum use of individual talents.

Staff members are aware of happenings in the entire school and feel a part of it; a child may know students on more grade levels than would be the case in a larger school, thereby contributing to overall social development.

Present staffing policies allot a full-time principal regardless of school size and additional teaching positions to elementary schools of less than 300 students with the result that more professional staff is available per pupil.

Disadvantages

Staffing a small school can sometimes be difficult. When enrollment is declining and pupils are not evenly distributed by grade, allocating staff may result in awkward combinations.

If there is only one teacher per grade (or grouping), little choice of teacher or teaching method is available to the student.

A smaller professional staff has proportionally fewer diverse approaches and specialities to offer; staff

members have fewer colleagues with whom to share ideas and experiences.

Children are limited in contacts with others because the student body of a small school is more likely to be homogeneous than that of a larger school, as it may draw from a smaller geographic area.

In small schools, specialists have less opportunity to group children with related problems. Since the specialist has to divide time between several small schools, time is lost in travel, and there is less opportunity to know the students.

Since funds for books and materials are supplied on a uniform dollar per pupil formula for all schools, small schools are able to purchase fewer items and thus offer less variety of books, materials, and equipment.[1]

Phillips examined the relationship between size of elementary school and selected indicators of program quality in North Carolina schools. Based on responses by principals to indicators of quality by size range he concluded that 400-699 was the most desirable size range.[2]

Phillips found that the following nineteen "indicators of quality" were statistically related (at the .05 level) to size of elementary school:

1. The elementary school has a full-time certificated librarian

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[1]Montgomery County (Maryland) Public Schools, Report of the Small Schools Task Force (Rockville, Md.: Montgomery County Public Schools, November 1973), pp. 3-4. Hereinafter all Montgomery County Public School documents will be cited as MCPS.

[2]Cecil Owen Phillips, "The Relationship Between Elementary School Size and Selected Indicators of Program Quality in North Carolina Public Elementary Schools" (Doctoral dissertation, Duke University, 1977), p. 133.

2. The school is administered by a certificated full-time supervising principal

3. The school has a minimum of the following audio-visual equipment and materials: One overhead projector per every fifty students enrolled

4. The school has a minimum of the following audio-visual equipment and materials: One permanently mounted screen per teaching station

5. The school has a minimum of the following audio-visual equipment and materials: A portable listening station with six to ten sets of earphones at the ratio of one per three teaching stations

6. Teachers, students and parents actively participate in decision-making which affects them

7. The school library has not less than four square feet per child or a minimum of 1,000 square feet in the library reading room

8. The school is accredited by at least one officially recognized accrediting agency

9. The school has a full-time secretary

10. The school has a minimum of the following audio-visual equipment and materials: One duplicating machine for

the media center and one additional machine for each 500 students enrolled

11. The school has a minimum of the following audio-visual equipment and materials: One opaque projector for the media center and one additional projector per 500 students

12. Every child in the school has access to a weekly news magazine

13. Every child is scheduled for a minimum of one hour per week in the library. The children also have freedom to go to the library at times other than those scheduled

14. The curriculum allows for an informal, child centered program

15. The principal has developed a school handbook of policies and procedures for teachers

16. The principal holds a Master's degree or better in school administration

17. The school reflects an open concept at all levels

18. The school has a minimum of the following audio-visual equipment: One filmstrip per child enrolled in school

19. The faculty reflects a balance of old experienced; young idealist; male, female; and black and white personnel (at least one of each) whose ideas are accepted in a nonthreatening way.[1]

Size of Elementary School and Academic Achievement

The review of literature which follows specifically relates school size to academic achievement. In general, norm-based achievement tests are used as the measure of achievement.

In 1954, Theophilus analyzed pupil achievement as measured by the Iowa Basic Skills Tests. His sample was Iowa elementary schools with over 200 students. The maximum school size is not identified. He concluded that as size of school increased, achievement increased;[2] however, there was no control for other variables.

Street, Powell, and Hamblen used Stanford Achievement Tests to measure levels of achievement in seventh and eighth grades in eastern Kentucky. (Presumably the elementary

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[1]Adopted from Phillips, "Relationship," pp. 131-32.

[2]Wadhawa Singh Theophilus, "Relationship Between Size of School, Expenditures, and Quality of Education in Elementary Schools" (Doctoral dissertation, Iowa State University, 1954), pp. 58-59.

schools served through grade 8.) The authors determined that students in larger schools (greater than 300) demonstrated higher achievement than those in smaller ones.[1] Of the 112 schools examined, however, 47 were one-room schools with enrollment as low as four students. The authors were of the opinion that the larger schools had better facilities and better-prepared teachers.

In 1964, Strong analyzed pupil achievement, as measured by the Stanford Achievement Test Battery average, of 1,053 sixth grade students in 17 elementary schools in Hamilton County, Ohio. He concluded that the size of elementary school had "little effect" on academic achievement when socio-economic background and IQ levels are comparable.[2]

In 1968, William B. Fetters analyzed underachieving and overachieving elementary schools to find characteristics in which they differed. Sixth grade students, in selected schools were administered "standardized ability and achievement tests [type of test is not identified] and provided

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[1]Paul Street, James H. Powell, and John W. Hamblen, "Achievement of Students and Size of School," The Journal of Educational Research 55 (March 1962): 266.

[2]Will Rogers Strong, "An Analytical Comparison of Large and Small Schools with Respect to Achievement of Pupils and Attitudes of Teachers" (Doctoral dissertation, Indiana University, 1964), p. 148.

socio-economic, attitudinal, motivational, and other personal data about themselves." Actual and predicted verbal scale scores were determined and these student "differentials" were then

> . . . analyzed to determine to what extent they are more alike for students in the same school than they are for students in different schools. If we should find just as much variability among the d's [differentials] of children in the same school as there is among students in different schools, our conclusion would be that there are no real differences among schools with respect to our measure of their quality; and there would be no point in proceeding any further in the study.[1]

The underachieving and overachieving schools were further divided into rural and urban schools. The results, as concerns size of school, were that there is no statistically significant difference in the size distributions of overachieving and underachieving schools for rural schools. In urban schools, however, overachieving schools tended to be larger. "Forty-two percent of the overachieving schools had at least 81 sixth graders with usable data as compared with only 12% of the underachieving schools."[2] This was significant at the .05 level.

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[1]William B. Fetters, Elmer F. Collins, and Jack W. Smith, Characteristics Differentiating Under- and Over-achieving Elementary Schools (Bethesda, Md.: ERIC Document Reproduction Service, ED 021 318, 1969), p. 2.

[2]Ibid., p. 9.

Also in 1968, the achievement of students in the Fresno City Unified School District, California, was analyzed through PROJECT DESIGN, an ESEA Title III project. Achievement and aptitude data available through local and state testing programs were analyzed.

Test scores for each school were compared on the basis of a large-small classification. Large schools were defined as having over 600 students; small schools as below 600.

The conclusion, as stated in the report, is that

> . . . size does not appear to be a factor in the mean achievement of the elementary school students . . . [and] the variance of aptitude means of the students in both large and small schools at this level likewise does not appear to be significant.[1]

Stephen Michelson conducting research on educational equality examined the effect of school size on sixth grade reading scores in the District of Columbia. He concluded that there was a negative relationship between school size and performance on reading tests. However, this relationship was statistically insignificant.[2]

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[1]Louise Pierce and Richard Mallory, Analysis of Achievement: PROJECT DESIGN. Interagency Planning for Urban Educational Needs, Number 5 (Bethesda, Md.: ERIC Document Reproduction Service, ED 038 747, 1970), p. 70.

[2]Stephen Michelson, "For the Plaintiff--Equal School Resource Allocation," The Journal of Human Resources 7 (Summer 1972): 305.

During the 1974-75 school year, the California State Department of Education measured student achievement in response to the California Assessment Program. All second and third grade students in the state (293,060 and 295,373 respectively) were tested in reading achievement using the Reading Test. Sixth grade pupils (338,913) were administered a new California-developed achievement test titled, Survey of Basic Skills: Grade 6.[1]

Based on an analysis of test results and other variables, it was determined that

> . . . In the elementary grades, pupils in larger schools tended to have lower scores than those in smaller schools. However, when previous test scores and socioeconomic status were held constant, these differences disappeared.[2]

The most recent original research was conducted by Summers and Wolfe for the Federal Reserve Bank of Philadelphia. This study examined which school inputs affected the rate of growth in achievement for individual students in public schools in Philadelphia. Achievement was measured

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[1]California State Department of Education, Student Achievement in California Schools: 1974-75, Annual Report (Bethesda, Md.: ERIC Document Reproduction Service, ED 124 592, 1976), p. 1.

[2]Ibid., p. 58.

by test scores on the Iowa Tests of Basic Skills. Multiple regression analysis was employed.

One of the inputs examined was school size. For this variable, the study concluded that

> . . . Larger [elementary] schools have a negative effect, particularly for Black pupils. An increase of 300 in enrollment means .6 months less achievement growth for White pupils, 3.5 months less achievement growth for Black pupils.[1]

Summary

The available research on the relationship of elementary school size and academic achievement is both limited and conflicting. Much of the research on school size consists of expert opinions, results of polls, or reviews of the literature.

It is generally agreed that school size can influence a school's organization, delivery of auxiliary services, and cost per pupil. Whether these and related factors translate into impacting the educational opportunities afforded students and their academic achievement is still questionable.

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[1]Anita A. Summers and Barbara L. Wolfe, "Which School Resources Help Learning? Efficiency and Equity in Philadelphia Public Schools," in Business Review (Philadelphia: Federal Reserve Bank), February 1975, p. 12.

The review of relevant literature reported in this chapter revealed a definite need for further research. In addition to providing conflicting conclusions, the few studies which specifically addressed the relationship of school size and academic achievement had flaws which may have influenced the results. Several of the studies did not control for confounding variables; several grouped schools into ill-defined small-large categories; and, where it could be determined, the studies used grade-equivalent scores that were treated as interval level data.

The most comprehensive study was the one conducted by Summers and Wolfe. Individual students were examined and a large number of variables measured and controlled. Unfortunately, the authors employed grade equivalents. Interestingly, theirs is the only research which concluded that smaller schools had higher academic achievement.

Because declining enrollment and the need to close schools is affecting school districts throughout the country, and because decisions on which school(s) to close are so often based on emotion, in part because of the lack of definitive research, a study which adequately addresses the relationship of school size and academic achievement is needed.

CHAPTER III

PROCEDURE

Population and Sample

It has been found that suburban school districts close to the central city have been affected very severely by declining enrollment.[1] Additionally, the impact of declining enrollment is generally greatest for the larger school districts in a state, particularly those with above-average wealth per pupil.[2]

In this study an attempt was made to employ a population which meets these criteria. One must be cautioned, however, that the results of this study that can be generalized beyond the population are limited. If an attempt is made to generalize, it should be determined that the comparison group is similar to the population studied.

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[1] Bornstein, Before You Close a School, p. 1.

[2] Allan Odden and others, "The Fiscal Impacts of Declining Enrollments: A Study of Declining Enrollments in Four States--Michigan, Missouri, South Dakota and Washington," in Declining Enrollment: The Challenge of the Coming Decade, ed. Susan Abramowitz and Stuart Rosenfeld (Washington, D.C.: U.S. Department of Health, Education, and Welfare, National Institute of Education, 1978), pp. 218-19, 226.

An excellent example of a wealthy, large, "close-in," suburban school district is the Montgomery County, Maryland, Public Schools (MCPS). The school district borders on northwest Washington, D.C., and is coterminous with the county. In September 1978, there were 106,803 students in a 500 square mile area containing 186 schools.[1]

The rapid growth in student enrollment that occurred in many school districts throughout the country in the 1950s and 1960s was evidenced dramatically in MCPS. From 1950 to 1972 enrollment grew from 27,772 to 126,311 pupils. In the period from 1960 to 1970, growth of 5,000 to 6,000 students per year was common, and 74 new schools were constructed and occupied to accommodate the rapid increase during this period.

In 1969, however, evidence of a sudden change in enrollment trends became available. The rate of growth in student enrollment started declining in 1969 until only a 104 pupil increase was registered between September 1971 and September 1972. After 1972, the enrollment declined by ever-increasing numbers with an enrollment drop of 5,190 students

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[1]Enrollment and school facility information available in MCPS, FY 1980 Capital Improvements Program (Rockville, Md.: MCPS, 1978).

occurring between September 1977, and September 1978. The decline in enrollment in MCPS is expected to continue; and current projections call for 86,901 pupils by September 1984, or a loss of approximately 40,000 students, or 31 percent, in twelve years.

MCPS has closed twenty-four schools in the last several years in an attempt to keep pace with declining enrollment. The projected continuing decline will probably mean additional closures.

The county is considered to be one of the wealthiest in the nation. In 1976, the median family income was estimated to be $26,700 and the average per pupil expenditure in FY 1979 was $2,276.[1] Of the total student population in 1978, 18.0 percent was classified as a minority, with the breakdown as follows: Black, 10.0 percent; Asian, 3.6 percent; Hispanic, 3.1 percent; and American Indian, 0.5 percent.[2] During the 1977-78 school year, there were 131

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[1]Montgomery County (Maryland) Planning Board, Maryland-National Capital Park and Planning Commission, Montgomery County Census Update Survey: Summary Report-1977 (Silver Spring, Md.: Montgomery County Planning Board, March 1978), p. 2; MCPS, FY 1979 Operating Budget (Rockville, Md.: MCPS, 1978), p. H-1.

[2]MCPS, Statistical Profiles: 1978-79 (Rockville, Md.: MCPS, April 1979), p. 20.

elementary schools with a total enrollment of 53,538 pupils. The distribution of schools by size is indicated in table 1. The minimum school size was 127, and the maximum 755.[1]

MCPS students have scored high on nationally-normed, standardized tests. The April 1978 test results indicate that the national percentile rank for a student with a MCPS mean score on the Cognitive Abilities Test (mean score) in grade 3 would be 78 and in grade 5, 76. On the Iowa Tests of Basic Skills (composite score), the national percentile rank of students with the MCPS mean would be 76 in grade 3 and 70 in grade 5.[2]

In 1972 the State of Maryland legislature passed a law which has become known as the "Maryland Educational Accountability Act." As a result, the State Board of Education acted to prepare a Maryland Accountability Program (MAP) which included four major components: goals and objectives setting, assessment, process evaluation, and program cost. To aid in the implementation of the MAP, a "comprehensive and uniform" testing program was initiated statewide.

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[1] MCPS, FY 1979 Capital Improvements Program (Rockville, Md.: MCPS, 1977), chapter II.

[2] MCPS, Annual Test Report, 1977-78 (Rockville, Md.: MCPS, December 1978), p. 11.

TABLE 1

NUMBER OF ELEMENTARY SCHOOLS, BY TOTAL ENROLLMENT SIZE,[a] MONTGOMERY COUNTY (MARYLAND) PUBLIC SCHOOLS, SEPTEMBER 30, 1977

Enrollment	Number of Schools
100-149	1
150-199	3
200-249	11
250-299	14
300-349	23
350-399	13
400-449	17
450-499	21
500-549	7
550-599	10
600-649	7
650-699	2
700-749	1
750-799	1
Total	131

SOURCE: MCPS, FY 1979 Capital Improvements, chapter 2.

[a]Head Start pupils are excluded.

Data were collected for the MAP which provides an extremely rich base. Information was available for all schools in the state; however, MCPS was selected in an effort to examine schools which were homogenous. In this way, uncontrolled variance can be limited. Administrative policies which govern all elementary schools in the district are developed by the MCPS central office.

All grade 3 and 5 students in MCPS are administered the Iowa Tests of Basic Skills and Cognitive Abilities Test annually. The results of these tests are reported as mean school scores. The results of the tests administered in April 1978 are the latest available and will be utilized in this study as measures of achievement and aptitude respectively.

The population of this study consists of the entire elementary school enrollment (grades K-6) of the Montgomery County (Maryland) Public Schools during the 1977-78 school year. The sample that was drawn is students in grades 3 and 5 of that school system who were administered the Iowa Tests of Basic Skills and Cognitive Abilities Test during that school year and attend an elementary school with grades K-6.

While the vast majority, 114, of the 131 elementary schools in the school district serve grades K-6, there are

several variations that exist including K-2, K-3, K-4, K-5, 3-6, and 4-6. Because these variations undoubtedly influence the school environment, it was believed appropriate to not include them in the sample. The elimination of the schools was not expected to introduce any systematic bias.

Essential Data

In order to determine the effect, if any, of school size on achievement it was deemed appropriate to control for variables which have been determined in previous research studies to have a relationship with achievement. In this way, interactions can be controlled for in order to evaluate the specific contribution of size.

The data utilized for this study were reported in documents prepared by MCPS and the Maryland State Department of Education. Studies which reported research on the variables which influence one measure of school output, achievement, were reviewed to provide rationale for the inclusion of certain variables in the analysis. The following is a description of the variables selected, the rationale for their inclusion, and the method of measurement employed. All variables will be measured on an individual school basis. School climate, organization, or instructional method

variables were not included as it is hypothesized, based on the review of the literature (see chapter II), that these variables are, in fact, dependent to some degree on size.

It must be pointed out, that determining which variables to include in this study was a somewhat subjective task. Previous studies range from concluding that absolutely nothing schools do or do not do really makes a difference[1] to studies which have found a broad array of variables which have a relationship to achievement.[2]

Several variables that have been found to have a relationship to achievement were not included because by examining one, large district these were held relatively constant. Major examples are--teacher salaries, expenditures per pupil, and availability of instructional materials.

Student Characteristics

1. Academic Achievement. Academic achievement was employed as the output measure of schooling. The Iowa Tests

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[1]The most outstanding example is Christopher Jencks and others, Inequality: A Reassessment of the Effect of Family and Schooling in America (New York: Basic Books, Inc., 1972).

[2]See for example, New York State Department of Education, Bureau of School Programs Evaluation, Which School Factors Relate to Learning? Summary of Findings of Three Sets of Studies (Bethesda, Md.: ERIC Document Reproduction Service, ED 126 613, 1976).

of Basic Skills (ITBS) were chosen as the measure of academic achievement.

The ITBS is a multiple-choice test designed to measure achievement in five broad skill areas: vocabulary, reading comprehension, language, work-study, and mathematics. Three of these major skill areas have several subtests as indicated below:

Vocabulary	One Test
Reading Comprehension	One Test
Language Skills	Spelling, Capitalization, Punctuation, and Usage
Work-Study Skills	Map Reading, Reading Graphs and Tables, and Knowledge and Use of Reference Materials
Mathematics Skills	Mathematics Concepts and Mathematics Problem Solving

Thus, eleven subtest scores are available. Each of the subtests' scores is averaged to give skill area scores, and the five skill areas are then averaged to yield a composite score for the total ITBS.

The ITBS were nationally normed in 1970. It is generally considered a "soundly conceived and useful achievement test."[1] The tests were administered to all MCPS third and fifth grade students in April 1978.

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[1] MCPS, Annual Test Report, 1977-78, p. 352.

Individual school mean normal curve equivalent major skill area and composite scores were employed in this analysis. Normal curve equivalent scores were used so that all results were on the same scale. Additionally, normal curve equivalents can be subjected to arithmetic operations; and therefore, tests of statistical significance can be accomplished. They are also scaled so that small changes are revealed.[1]

2. Aptitude. Student aptitude generally accounts for the greatest variance in achievement scores and is considered to be a major predictor of academic achievement.[2] The Cognitive Abilities Test (CAT) was chosen as the measure of ability.

The CAT was nationally normed on the same students as the measure of achievement used in this study, ITBS, and is often used in conjunction with the ITBS. MCPS administers both the CAT and ITBS to grades 3 and 5 students during the same period of time.

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[1]For a broader discussion of normal curve equivalents, see Ibid., pp. 392-93.

[2]For a broader discussion, see Maryland State Department of Education, Maryland Accountability Program Report, Year II, School Year--1974-75 (Annapolis, Md.: Maryland State Department of Education, 1976), appendix E.

The CAT is made up of three batteries: Verbal, Quantitative, and Nonverbal. The verbal battery score was chosen for use in this study because it has the highest correlations with four of the five ITBS subtests (vocabulary, reading comprehension, language skills, and work-study skills).[1]

Individual school mean normal curve equivalent scores were employed in the analysis for the same reasons described above.

3. Socioeconomic Factors. Pupils' background is generally considered to be a major determinant of achievement.[2] Obtaining reliable measures of socioeconomic factors is, however, difficult when only dated census material is available and current, direct measures are not readily obtainable (e.g., family income, education of parents, marital status of parents, and occupation of parents).

Measures of socioeconomic status which were appropriate for this investigation and available for this study were:

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[1]Robert L. Thorndike and Elizabeth Hagen, Technical Manual, Cognitive Abilities Test, Multi-Level Edition (Boston, Mass.: Houghton Mifflin Co., 1971), p. 26.

[2]See for example, James S. Coleman and others, Equality of Educational Opportunity (Washington, D.C.: Government Printing Office, 1966), p. 325.

a. Percentage of low-income pupils. A measure of this variable is available based on the percentage of pupils who are eligible for the free lunch program.[1] Eligibility is based on family income limits which are also dependent on the number of individuals in the family. In 1977-78, the income limits varied from $3,930 for a family of one to $15,590 for a family of 12. Individual school percentage of students eligible was utilized as the measure. As percentages were employed, an arc sine transformation was used to better achieve homogeneity of variance and normality of distributions.[2]

b. Race. The percentage of black students was utilized as the measure of race. An arc sine transformation was used for the reasons cited above. The U.S. Department of Health, Education, and Welfare definition of race was employed by MCPS and this study.

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[1]This measure has been employed in other studies. See for example, Michelson, "School Resource Allocation," pp. 292-93.

[2]George A. Ferguson, Statistical Analysis in Psychology and Education, 4th ed. (New York: McGraw-Hill Book Co., 1976), p. 236.

4. Sex. The sex of the student has been found to have a relationship with achievement.[1] The percentage of female students enrolled in the individual school on September 30, 1977 was utilized in this study. An arc sine transformation of the percentages was used (see above).

Teacher Characteristics

MCPS has an affirmative action staffing policy with the goal of balancing the teaching staff on the basis of race, sex, age, and years of experience. This goal has not been met, but the implementation of the policy tends to equalize the teacher characteristics of the schools.

As true equalization of the staffs has not been reached, two teacher characteristics were measured. These are:

1. Highest Degree Status. Several studies have indicated that the level of training of the teaching staff affects achievement.[2] The percentage of the professional

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[1]See for example, Summers and Wolfe, "Which School Resources," p. 11; and California State Department of Education, Student Achievement, p. 58.

[2]See for example, James W. Guthrie, "A Survey of School Effectiveness Studies," in Do Teachers Make a Difference? A Report on Recent Research on Pupil Achievement (Washington, D.C.: Government Printing Office, 1970), p. 48; and New York Department of Education, School Factors, p. 9.

staff with a Master's Degree or above was utilized as the measure of this variable. An arc sine transformation was used in the regression analyses (see page 48).

2. Years of Experience. The years of experience of the teaching staff has been found to influence student achievement.[1] In this study, the average years of teaching experience of the school-based teaching staff was employed as a measure of this variable.

School Characteristics

1. Class Size. Several studies have indicated that class size has a relationship to achievement.[2] In this study, class size is reported as an individual school average and is defined as the number of "regular" students (not including special education in self-contained classrooms or Head Start) divided by the number of attendance sections.

2. School Size. Researchers have reached different conclusions on the influence of school size on achievement (see chapter II). This study was designed to determine if there is a relationship between school size and achievement.

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[1] See for example, Guthrie, "School Effectiveness," p. 48; and Summers and Wolfe, "Which School Resources," pp. 12-13.

[2] Ibid., p. 48; pp. 11-12.

School size was measured by the number of students officially enrolled in the individual school, with the exception of Head Start, on September 30, 1977.

Analysis

The statistical methodology utilized in this study was multiple regression analysis (mra). While multiple regression analysis has several important uses, including prediction and explanation, this technique was selected for this study in order to evaluate the contribution of a specific variable, size of elementary school, to academic achievement while controlling for other, confounding variables.

Multiple regression analysis is defined by Kerlinger and Pedhazur as "a method of analyzing the collective separate contributions of two or more independent variables, X_i, to the variation of a dependent variable, Y."[1]

The multiple regression model was in the following general form:

$$Y' = A + B_1X_1 + B_2X_2 + \ldots + B_KX_K$$

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[1]Fred N. Kerlinger and Elazar J. Pedhazur, Multiple Regression in Behavioral Research (New York: Holt, Rinehart and Winston, Inc., 1973), p. 3.

Where

Y' = predicted Y score

A = intercept constant

$X_1, X_2, \ldots X_K$ = score of an independent variable

$B_1, B_2, \ldots B_K$ = regression coefficients associated with the independent variables

The significance tests which are associated with multiple regression analysis are based on a set of assumptions as follows:

1. The sample is drawn at random

2. Each array of Y for a given combination of X's follows the normal distribution

3. The regression of Y and X's is linear

4. All the Y arrays have the same variance.[1]

However, it has been pointed out that F and t tests (the tests of significance normally employed in multiple regression analysis) are "robust" in the sense that they resist the violation of assumptions. In fact, Kerlinger and Pedhazur state that, "In general, it is safe to say that we

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[1]Norman H. Nie and others, Statistical Package for the Social Sciences, 2d ed. (New York: McGraw-Hill Book Co., Inc., 1975), p. 341.

can ordinarily go ahead with analysis of variance and multiple regression analysis without worrying too much about assumptions."[1]

Multiple regression analysis has been employed by many other researchers in examining the influence of various independent variables on achievement.[2]

Stepwise multiple regression analysis was employed in this study. The independent variables selected for this study were entered into the equation only if they met statistical criteria selected. The order of inclusion is based on the contribution of each variable, greatest to least, to the variance which is unexplained by the variable(s) previously entered into the equation. The equation is then checked; and if a variable(s) previously entered no longer meets the statistical criteria, it is deleted. This is accomplished one step at a time.

While tests of significance for several outputs of multiple regression analysis are available, the major interest of this study is to test the null hypothesis that there is no statistically significant relationship between size of

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[1] Kerlinger and Pedhazur, Multiple Regression, p. 48.

[2] See for example, Coleman and others, Equality.

elementary school and academic achievement. Therefore, the F-ratio will be employed to determine whether the regression coefficient for school size is significant.

Specifically, the increment in R^2 (coefficient of determination, or explained sum of squares, or proportion of variance of Y explained by X) due to the addition of school size to the equation will be tested for significance. The .05 level was used to test for the chance occurrence of the R^2. In this way, the null hypothesis that the regression coefficient for school size is equal to zero is tested.

If the null hypothesis is accepted, the research subquestions will be answered in the negative. However, if the null hypothesis is rejected, the multiple regression analyses will be examined to determine whether there is an optimum, minimum, and/or maximum size elementary school.

The F-ratio of the overall regression equation, its "goodness of fit," will also be examined.

The analysis utilized the following variables:

Y = academic achievement

X_1 = aptitude

X_2 = percentage of low-income pupils (eligible for free lunch)

X_3 = percentage of Black pupils

X_4 = percentage of female students

X_5 = percentage of professional staff with Master's Degree or above

X_6 = years of experience of teaching staff

X_7 = class size

X_8 = school size

A multiple regression analysis for each of the five ITBS major skill areas and the composite score for both grades 3 and 5 was conducted. Thus, twelve equations were developed and the null hypothesis that there is no statistically significant relationship between school size and academic achievement tested. An examination of the data with emphasis on multicollinearity was conducted prior to the multiple regression analyses.

CHAPTER IV

FINDINGS

Introduction

The findings of this research are reported for each of the twelve analyses that were conducted--five Iowa Tests of Basic Skills (ITBS) major skill areas and the composite score for both grades 3 and 5. Whenever possible, findings are presented in tabular form with discussion directly relating to the tables.

To assist in understanding the data, table 2 presents the means and standard deviations for the independent variables. Note that the figures reported for percentages of low-income pupils, Black pupils, female students, and staff with Master's Degree or above are based on actual data; but for the purpose of the analyses, an arc sine transformation was used for reasons cited above.

The aptitude of the sample is, as expected, fairly high. The grade 3 mean normal curve equivalent is 65.895; and the grade 5, 64.465. It has been shown that for a

TABLE 2

MEANS AND STANDARD DEVIATIONS FOR THE INDEPENDENT VARIABLES

Variables		N=114	
No.	Name	$\bar{X}$	SD
1A.	Aptitude--grade 3	65.895	7.288
1B.	Aptitude--grade 5	64.465	7.600
2.	Low-income pupils	6.579	6.227
3.	Black pupils	9.418	8.023
4.	Female students	48.840	2.887
5.	Staff with Master's Degree or above	42.903	11.133
6.	Years of experience of teaching staff	12.511	2.608
7.	Class size	26.956	1.672
8.	School size	413.623	132.747

normal population, the mean is 50, and the standard deviation is 21.06.

The zero-order correlations among the independent variables are presented in table 3. Table 4 presents the zero-order correlation between the independent variables and the six, grade 3 measures of academic achievement. Finally, table 5 presents the same information for the grade 5 measures of academic achievement.

Multicollinearity was determined to not be a problem by examining the zero-order correlations and the latent roots of $X'X$. While there are fairly high correlations between aptitude and low-income pupils and Black pupils, each of these also has fairly high correlations with the dependent variables.

A scatter plot of the standardized residuals was produced to determine whether there were indications of a lack of linearity and whether the assumptions about errors (see above) were met. A direct examination of the residuals revealed that they were very close to a normal distribution with no outliers.

In the discussion of the findings which follows, the regression analysis between each dependent variable and the independent variables is presented in a limited manner.

TABLE 3

ZERO-ORDER CORRELATIONS AMONG THE INDEPENDENT VARIABLES (N=114)

	Variables	1B	2	3	4	5	6	7	8
1A.	Aptitude--grade 3	.791*	-.667*	-.426*	.008	.193*	-.062	.222*	.007
1B.	Aptitude--grade 5		-.681*	-.492*	.059	.120	-.047	.182	-.047
2.	Low-income pupils			.562*	.031	-.178	.084	-.226*	-.095
3.	Black pupils				.065	-.036	.095	-.089	-.127
4.	Female students					-.095	-.203*	-.008	.013
5.	Staff with Master's Degree or above						.356*	.062	-.064
6.	Years of experience of teaching staff							-.074	-.063
7.	Class size								.328*
8.	School size								

*Significant at .05

TABLE 4

ZERO-ORDER CORRELATIONS BETWEEN THE INDEPENDENT VARIABLES AND THE SIX MEASURES OF GRADE 3 ACADEMIC ACHIEVEMENT (N=114)

	Variables	Vocabulary	Reading Comprehension	Language Skills	Work-Study Skills	Mathematics Skills	Composite
1A.	Aptitude--grade 3	.844*	.899*	.834*	.848*	.816*	.883*
2.	Low-income pupils	-.593*	-.575*	-.531*	-.587*	-.596*	-.594*
3.	Black pupils	-.389*	-.424*	-.355*	-.418*	-.357*	-.396*
4.	Female students	.056	-.022	.071	.040	.026	.036
5.	Staff with Master's Degree or above	.137	.154	.141	.126	.198*	.144
6.	Years of experience of teaching staff	-.056	-.017	-.099	-.117	.010	-.069
7.	Class size	.228*	.201*	.257*	.231*	.191*	.235*
8.	School size	-.006	.036	.046	.029	-.010	.024

*Significant at .05

TABLE 5

ZERO-ORDER CORRELATIONS BETWEEN THE INDEPENDENT VARIABLES AND THE SIX MEASURES OF GRADE 5 ACADEMIC ACHIEVEMENT (N=114)

Variables	Vocabulary	Reading Comprehension	Language Skills	Work-Study Skills	Mathematics Skills	Composite
1. Aptitude--grade 5	.914*	.935*	.869*	.892*	.864*	.926*
2. Low-income pupils	-.685*	-.651*	-.641*	-.663*	-.634*	-.669*
3. Black pupils	-.483*	-.475*	-.466*	-.473*	-.463*	-.488*
4. Female students	.025	.062	.018	.017	.044	.036
5. Staff with Master's Degree or above	.130	.130	.118	.103	.133	.119
6. Years of experience of teaching staff	-.010	-.029	-.038	-.058	-.023	-.045
7. Class size	.120	.175	.087	.168	.205*	.155
8. School size	-.066	-.033	-.059	.008	.054	-.028

*Significant at .05

The purpose of this study was not to determine a prediction equation; but rather, to evaluate the contribution of a specific variable, school size. Therefore, the tables and discussion for each of the analyses focus on this variable.

To review, a stepwise multiple regression analysis was performed for each of the twelve dependent variables. The order of inclusion of the independent variables is based on the contribution of each variable, greatest to least, to the variance which is unexplained by the variable(s) previously entered into the equation. This is accomplished one step at a time. By setting the significance level for entry and retention in the equation very high (.9999), the specific contribution of school size can be determined regardless of how small the F-ratios become. Tables 6 through 17, included in this chapter, summarize the step at which school size entered the multiple regression analysis.

For information purposes, tables 18 through 29, in the Appendix, show a restricted model for each of the twelve analyses. To enter and remain in these equations and be reported, a variable(s) must be determined to be significant at the .05 level.

Grade 3 Findings

The grade 3 findings are presented below for each of five ITBS skill areas and the composite score.

Vocabulary

Table 6 shows that school size entered the multiple regression analysis for grade 3 vocabulary at step 5. The F-ratio was only .39 however, and the significance probability associated with this F-ratio was .5311. Therefore, it was determined that school size did not make a significant contribution to the variance in grade 3 vocabulary achievement.

An attempt was then made through the restricted model to determine what variables at the .05 level made a significant contribution to the variance in vocabulary achievement (grade 3). Table 18, in the Appendix, presents the restricted model. Of the independent variables, only aptitude, as measured by the CAT, was determined to be significant at the .05 level.

Reading Comprehension

School size was again not significant. Table 7 indicates that this variable's F-ratio was .57 with a

TABLE 6

REGRESSION ANALYSIS BETWEEN GRADE 3 VOCABULARY AND INDEPENDENT VARIABLES, LIMITED TO STEP ON WHICH SCHOOL SIZE ENTERS (N=114)

Variables	Partial Regression Coefficient	Standard Error	F-Ratio	Significance Probability
1A. Aptitude	.817	.071	131.53	.0001
2. Low-income pupils	- 6.503	8.262	.62	.4329
4. Female students	11.838	11.537	1.05	.3072
7. Class size	.227	.249	.83	.3639
8. School size	- .002	.003	.39	.5311
Intercept	- 3.447			

R^2 = .719

Overall F = 55.32

Significance probability = .0001

TABLE 7

REGRESSION ANALYSIS BETWEEN GRADE 3 READING COMPREHENSION AND INDEPENDENT VARIABLES, LIMITED TO STEP ON WHICH SCHOOL SIZE ENTERS (N=114)

Variables	Partial Regression Coefficient	Standard Error	F-Ratio	Significance Probability
1A. Aptitude	.820	.049	276.41	.0001
2. Low-income pupils	9.167	6.261	2.14	.1461
3. Black pupils	-6.228	3.981	2.45	.1206
6. Years of experience of teaching staff	.106	.102	1.06	.3052
8. School size	.002	.002	.57	.4538
Intercept	4.520			

R^2 = .817

Overall F = 96.18

Significance probability = .0001

significance probability of .4538. School size entered the analysis at step five.

As can be seen in table 19, only aptitude entered the analysis in the restricted model.

Language Skills

Table 8 shows that school size did not enter the analysis until step 7. The F-ratio was .09, and the associated significance probability was .7619.

In the restricted model (table 20), aptitude was the only variable which made a significant contribution to the variance in achievement in language skills.

Work-Study Skills

School size made almost no contribution in this analysis (table 9). The F-ratio was .00 and the significance probability was .9477. Size did not enter the analysis until step 8.

Table 21 indicates that, again, only aptitude made a significant contribution at the .05 level.

Mathematics Skills

As presented in table 10, school size entered the analysis at step 5 and had a F-ratio of .15 with a significance probability of .7013.

TABLE 8

REGRESSION ANALYSIS BETWEEN GRADE 3 LANGUAGE SKILLS AND INDEPENDENT VARIABLES, LIMITED TO STEP ON WHICH SCHOOL SIZE ENTERS (N=114)

Variables	Partial Regression Coefficient	Standard Error	F-Ratio	Significance Probability
1A. Aptitude	.769	.065	141.83	.0001
2. Low-income pupils	7.582	8.161	.86	.3550
3. Black pupils	- 1.972	5.200	.14	.7052
4. Female students	11.526	15.595	1.17	.2826
6. Years of experience of teaching staff	- .079	.136	.34	.5604
7. Class size	.289	.226	1.64	.2037
8. School size	.001	.003	.09	.7619
Intercept	2.425			

R^2 = .709

Overall F = 36.96

Significance probability = .0001

TABLE 9

REGRESSION ANALYSIS BETWEEN GRADE 3 WORK-STUDY SKILLS AND INDEPENDENT VARIABLES, LIMITED TO STEP ON WHICH SCHOOL SIZE ENTERS (N=114)

	Variables	Partial Regression Coefficient	Standard Error	F-Ratio	Significance Probability
1A.	Aptitude	.848	.073	135.26	.0001
2.	Low-income pupils	.611	9.218	.00	.9473
3.	Black pupils	- 6.505	5.847	1.24	.2684
4.	Female students	6.340	11.979	.28	.5978
5.	Staff with Master's Degree or above	- .998	3.383	.09	.7686
6.	Years of experience of teaching staff	- .135	.164	.68	.4106
7.	Class size	.203	.254	.64	.4263
8.	School size	- .000	.003	.00	.9477
Intercept		4.052			

R^2 = .730

Overall F = 35.45

Significance probability = .0001

TABLE 10

REGRESSION ANALYSIS BETWEEN GRADE 3 MATHEMATICS SKILLS AND INDEPENDENT VARIABLES, LIMITED TO STEP ON WHICH SCHOOL SIZE ENTERS (N=114)

	Variables	Partial Regression Coefficient	Standard Error	F-Ratio	Significance Probability
1A.	Aptitude	.864	.085	103.49	.0001
2.	Low-income pupils	-13.708	9.936	1.90	.1705
4.	Female students	9.753	14.183	.47	.4931
6.	Years of experience of teaching staff	.230	.181	1.62	.2053
8.	School size	- .001	.003	.15	.7013
Intercept		1.121			

R^2 = .676

Overall F = 45.15

Significance probability = .0001

In the restricted model (table 22), aptitude was the only significant independent variable.

Composite

The minimal effect of school size on grade 3 achievement can be seen in table 11. School size was the last variable which entered the equation, and had an F-ratio of .00 and a significance probability of .9932.

As in all the other grade 3 analyses, aptitude was the only variable which made a significant contribution to the variance in achievement (table 23).

Grade 5 Findings

The grade 5 findings are reported in the same manner as grade 3. The five ITBS skill areas and the composite score are discussed separately.

Vocabulary

Table 12 indicates that school size entered the multiple regression analysis at step 5. The F-ratio was .26, and the significance probability was .6115. Therefore, it was determined that school size did not make a significant contribution to the variance in grade 5 vocabulary achievement.

TABLE 11

REGRESSION ANALYSIS BETWEEN GRADE 3 COMPOSITE AND INDEPENDENT VARIABLES, LIMITED TO STEP ON WHICH SCHOOL SIZE ENTERS (N=114)

	Variables	Partial Regression Coefficient	Standard Error	F-Ratio	Significance Probability
1A.	Aptitude	.874	.063	194.66	.0001
2.	Low-income pupils	1.209	7.918	.02	.8789
3.	Black pupils	- 2.676	5.022	.28	.5953
4.	Female students	6.553	10.290	.41	.5257
5.	Staff with Master's Degree or above	- 1.478	2.906	.26	.6122
6.	Years of experience of teaching staff	.016	.141	.01	.9112
7.	Class size	.190	.218	.76	.3861
8.	School size	- .000	.003	.00	.9932

Intercept -.428

R^2 = .783

Overall F = 47.44

Significance probability = .0001

TABLE 12

REGRESSION ANALYSIS BETWEEN GRADE 5 VOCABULARY AND INDEPENDENT VARIABLES, LIMITED TO STEP ON WHICH SCHOOL SIZE ENTERS (N=114)

Variables	Partial Regression Coefficient	Standard Error	F-Ratio	Significance Probability
1B. Aptitude	.801	.050	253.96	.0001
2. Low-income pupils	-15.803	6.119	6.67	.0111
6. Years of experience of teaching staff	.099	.106	.87	.3531
7. Class size	- .230	.179	1.65	.2013
8. School size	- .001	.002	.26	.6115
Intercept 11.811				

R^2 = .847

Overall F = 119.92

Significance probability = .0001

Through the restricted model, an attempt was made to determine what variables at the .05 level made a significant contribution to the variance in vocabulary achievement (grade 5). Table 24 shows that for the first time in this study, another variable, in addition to aptitude, made a significant contribution. In this case, aptitude and low-income pupils both had a significance probability of less than .05.

Reading Comprehension

As presented in table 13, school size entered the analysis at the seventh step and had a F-ratio of .05 and a significance probability of .8192.

Table 25 indicates that only aptitude made a significant contribution to the variance in achievement in reading comprehension.

Language Skills

Table 14 shows that school size entered on the seventh step and had a F-ratio of only .01 and a significance probability of .9271.

Aptitude was again the only significant variable in the analysis (table 26).

TABLE 13

REGRESSION ANALYSIS BETWEEN GRADE 5 READING COMPREHENSION AND INDEPENDENT VARIABLES, LIMITED TO STEP ON WHICH SCHOOL SIZE ENTERS (N=114)

	Variables	Partial Regression Coefficient	Standard Error	F-Ratio	Significance Probability
1B.	Aptitude	.835	.045	350.77	.0001
2.	Low-income pupils	- 2.003	5.709	.12	.7265
3.	Black pupils	- 1.437	3.652	.15	.6948
4.	Female students	2.918	7.444	.15	.6958
5.	Staff with Master's Degree or above	.697	2.070	.11	.7370
6.	Years of experience of teaching staff	.042	.101	.17	.6776
8.	School size	.000	.002	.05	.8192
	Intercept	.704			

R^2 = .875

Overall F = 106.48

Significance probability = .0001

TABLE 14

REGRESSION ANALYSIS BETWEEN GRADE 5 LANGUAGE SKILLS AND INDEPENDENT VARIABLES, LIMITED TO STEP ON WHICH SCHOOL SIZE ENTERS (N=114)

	Variables	Partial Regression Coefficient	Standard Error	F-Ratio	Significance Probability
1B.	Aptitude	.725	.060	145.98	.0001
2.	Low-income pupils	-10.381	7.635	1.85	.1768
3.	Black pupils	- 1.619	4.906	.11	.7421
4.	Female students	- 5.308	9.781	.29	.5885
5.	Staff with Master's Degree or above	.264	2.585	.01	.9188
7.	Class size	- .336	.208	2.59	.1103
8.	School size	- .000	.003	.01	.9271
Intercept		26.154			

R^2 = .767

Overall F = 49.94

Significance probability = .0001

Work-Study Skills

In this analysis (table 15), school size entered on the third step. However, it did not make a significant contribution with a F-ratio of .78 and an associated probability of .3799.

As indicated in table 27, the only variable which was significant at the .05 level was aptitude.

Mathematics Skills

For grade 5 mathematics skills, aptitude and school size both made a significant contribution (tables 16 and 28 are identical). School size had a F-ratio of 4.12 and a significance probability of .0449.

As this finding, that school size makes a significant contribution to the variance, is peculiar to this one measure of achievement, an in-depth analysis of the data was conducted. Multicollinearity was verified to not be a problem with the data by analyzing the latent roots of $X'X$.

An examination of the residuals revealed that 64.91 per cent of the predicted scores were within one standard deviation of the actual score, and 96.49 per cent were within two standard deviations. There were no outliers.

TABLE 15

REGRESSION ANALYSIS BETWEEN GRADE 5 WORK-STUDY SKILLS AND INDEPENDENT VARIABLES, LIMITED TO STEP ON WHICH SCHOOL SIZE ENTERS (N=114)

Variables	Partial Regression Coefficient	Standard Error	F-Ratio	Significance Probability
1B. Aptitude	.808	.057	202.07	.0001
2. Low-income pupils	-11.022	6.906	2.55	.1133
8. School size	.002	.002	.78	.3799
Intercept	10.902			

R^2 = .803

Overall F = 149.90

Significance probability = .0001

TABLE 16

REGRESSION ANALYSIS BETWEEN GRADE 5 MATHEMATICS SKILLS AND INDEPENDENT VARIABLES, LIMITED TO STEP ON WHICH SCHOOL SIZE ENTERS (N=114)

Variables	Partial Regression Coefficient	Standard Error	F-Ratio	Significance Probability
1B. Aptitude	.971	.052	342.50	.0001
8. School size	.006	.003	4.12	.0449
Intercept	-2.915			

R^2 = .756

Overall F = 171.92

Significance probability = .0001

A regression analysis was conducted with grade 5 mathematics skills as the dependent variable and school size as the only independent variable. It was found that school size was not significant with a F-ratio of .33, and a significance probability of .5665. Thus, school size made a significant contribution to the variance in mathematics skills achievement only when controlled for aptitude. This is perplexing as the zero-order correlation between school size and grade 5 aptitude is only -.047 (see table 3).

Utilizing the .05 level of significance, there is a 1 in 20 probability that relationships will be found significant that are in reality not significant.[1] For the reasons described above, it is believed that this chance occurrence happened in this case.

The significance probability of school size is very close to the .05 level, .0449; and the R^2 change by adding school size is only .009. Therefore, even if this finding is incorrect, the influence of school size on grade 5 mathematics skills achievement is, in real terms, quite small.

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[1]Roger E. Kirk, Experimental Design: Procedures for the Behavioral Sciences (Belmont, Cal.: Brooks/Cole Publishing Co., 1968), pp. 82-86.

Composite

Table 17 presents the regression analysis between the independent variables and the grade 5 composite ITBS score. School size entered on the sixth step and had a F-ratio of .11 with an associated probability of .7434.

In table 29 it can be seen that at the .05 level only aptitude made a significant contribution to the variance in achievement.

Summary

In all twelve analyses (the explanation of the grade 5 mathematics skills results are described in that section), it was found that elementary school size did not make a significant contribution to the variance in academic achievement.

In all analyses, the aptitude of the students accounted for the majority of the variance (ranging from .666 to .874). Only in the case of grade 5 vocabulary, did any of the other control variables--in this case, low-income pupils--make a significant contribution.

As there was no statistically significant relationship between size of elementary school and academic achievement, the research subquestions must be answered in the negative.

TABLE 17

REGRESSION ANALYSIS BETWEEN GRADE 5 COMPOSITE AND INDEPENDENT VARIABLES, LIMITED TO STEP ON WHICH SCHOOL SIZE ENTERS (N=114)

Variables	Partial Regression Coefficient	Standard Error	F-Ratio	Significance Probability
1B. Aptitude	.873	.051	291.49	.0001
2. Low-income pupils	- 7.642	6.437	1.41	.2378
3. Black pupils	- 1.856	4.172	.20	.6572
4. Female students	- 2.977	8.303	.13	.7206
7. Class size	- .113	.178	.40	.5263
8. School size	.001	.002	.11	.7434
Intercept 9.290				

R^2 = .861

Overall F = 110.91

Significance probability = .0001

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

This chapter provides a summary of this study and conclusions and recommendations based on the findings.

Summary

Introduction

Lower birth rates and mobility of the population combined with various social and economic forces have caused public school enrollments to decline in this country. Most severely impacted to date have been the elementary grades.

Because of specific, local factors, not all school districts have experienced declining enrollment, nor has the severity of the decline been uniform. The largest decreases have taken place in the central cities and "close-in," suburban school systems.

One of the results of declining enrollment has been that some schools are underenrolled. Once this situation becomes severe and financial pressures to save money great

enough, a need to close schools is created. However, there is a large gap between deciding there is a need to close schools and deciding which schools to close.

The size of schools being considered is often the most important factor in deciding which school among a cluster of schools should be closed. While other factors are important in decision-making, many individuals hypothesize a relationship between school size and other variables, particularly academic achievement. The focus on the sizes of schools being considered for closure, however, normally centers on opinions regarding school size and on inputs into students' education. The relationship between elementary school size and academic achievement is not known.

Statement of the Problem

Deciding which school(s) among a cluster of schools to close is one of the most difficult and emotion-laden decisions superintendents and boards of education must make. This study was conducted to assist decision-makers and the public in their deliberations.

The purpose of this study was to examine the relationship between elementary school size and an output

of education, academic achievement. This purpose translates to the following research question: What is the relationship between size of elementary school and academic achievement?

Three research subquestions were also addressed:

1. Is there a school size(s) which maximizes academic achievement?

2. Is there a minimum school size beyond which academic achievement is adversely affected?

3. Is there a maximum school size beyond which academic achievement is adversely affected?

Procedure

The sample used in this study was grade 3 and 5 students in the Montgomery County (Maryland) Public Schools who were administered the Iowa Tests of Basic Skills and Cognitive Abilities Test during the 1977-78 school year and attended an elementary school with grades K-6 (approximately 13,000 pupils).

Variables which have been found in previous studies to have a relationship with achievement were employed in this study as control variables. These were: aptitude, percentage of low-income pupils, race, sex, highest degree

status of professional staff, years of experience of teachers, and class size.

The statistical methodology employed in this study was multiple regression analysis. This technique was selected in order to evaluate the contribution of a single variable, school size, to academic achievement while controlling for other, confounding variables.

Twelve multiple regression analyses were conducted--one for each of the five ITBS major skill areas and composite scores for both grades 3 and 5. The null hypothesis that there is no statistically significant relationship between school size and academic achievement was tested.

Findings

The six multiple regression analyses conducted for grade 3 achievement yielded F-ratios for the addition of school size to the equations from .00 to .57. The associated significance probabilities ranged from .9932 to .4538.

Five of the six grade 5 multiple regression analyses yielded F-ratios from .01 to .78 for the addition of school size to the equations. The significance probabilities associated with these F-ratios ranged from .9271 to .3799.

In only one analysis, grade 5 mathematics skill area, did school size have a statistically significant relationship to achievement. The F-ratio was 4.12, and the significance probability was .0449.

This latter finding is believed spurious, however, as:

1. There is no statistically significant relationship between grade 5 mathematics skills achievement and school size alone (there is a significant relationship only when aptitude is controlled).

2. The zero-order correlation between school size and grade 5 aptitude is only -.047.

3. The significance probability for the addition of school size is .0449 which is very close to the .05 level of significance selected for this study.

5. The R^2 change by adding school size to the equation is only .009.

Conclusions

The conclusions based upon the findings of this study are offered below.

Based on the twelve multiple regression analyses that were conducted for the five skill areas and composite

scores on the ITBS for both grades 3 and 5, it is concluded that for the sizes of schools included in the sample, there is no statistically significant relationship between size of elementary school and academic achievement. While the grade 5 mathematics skill achievement relationship to school size is intriguing, it is concluded, for reasons described in chapter IV, that there is no significant relationship for this measure either.

Based on the above, it is further concluded, on the basis of the data available and for the students tested, that there is no school size which maximizes academic achievement, nor is there a minimum or maximum school size beyond which academic achievement is adversely affected.

As indicated on table 2, the population of Montgomery County Public Schools has certain characteristics which must be noted before generalizing these conclusions to another school district. It should be determined that the comparison group is similar to the population studied. Particularly note the mean and standard deviation of the following variables: aptitude, low-income pupils, Black pupils, staff with Master's Degree or above, and class size. These measures might affect the generalizability of the study as they undoubtedly influenced the findings. Also,

note that the range of school size in this study was limited. The minimum school size was 127 pupils, and the maximum was 755.

Finally, it must be reemphasized that this study was a macro study; and therefore, the specifics of each closure decision must be carefully examined. There may be relationships between school size and other factors, specifically cost of operation, that were not addressed by this study; and in individual cases, academic achievement may indeed be influenced by the size of school. But whenever students are considered on a school-by-school basis (not individual students), there does not appear to be a relationship between school size and academic achievement.

Recommendations

In view of the findings and conclusions of this study, the following recommendations are suggested for further research.

1. This study should be replicated in other school systems, both urban and suburban, to determine if similar results are achieved.

2. Although this study found an apparently spurious relationship between grade 5 ITBS mathematics skills

achievement and school size, it is suggested that particular emphasis should be placed on analyzing this relationship in other school systems.

3. Elementary schools with enrollments both larger (in excess of 800 students) and smaller (those schools with enrollments less than 125 pupils) than the range analyzed in this study should be examined to determine if similar results are obtained. There may be relationships between very large and/or very small schools and academic achievement.

4. The decision to close a school should not rest solely on a perceived relationship between school size and academic achievement. The relationship between other factors, such as financial considerations, transportation, and utilization and condition of the school plant, should be examined as they relate to school size and the decision to close.

Implications

This research corroborates some of the other studies on size of elementary schools and academic achievement cited in chapter II, especially those with a large data base and/or those which controlled for confounding variables. The Strong, Fetters (for rural schools), Pierce and Mallory, Michelson, and California State Department of

Education studies all found no relationship between school size and achievement.[1]

Theophilus; Street, Powell, and Hamblen; and Fetters (for urban schools) concluded that larger schools had higher achievement.[2] However, it could not be determined that these studies controlled for confounding variables that potentially influenced the results.

The Summers and Wolfe study was the only one that concluded that smaller schools had higher academic achievement.[3] Individual students were examined and a large number of variables measured and controlled. Unfortunately, the researchers employed grade equivalents which were treated as interval level data as the measure of academic achievement.

Because the results of the research summarized above are mixed, it is suggested that the findings of these

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[1]Strong, "Analytical Comparison"; Fetters, Collins, and Smith, Characteristics; Pierce and Mallory, Analysis of Achievement; Michelson, "For the Plaintiff"; and California State Department of Education, Student Achievement.

[2]Theophilus, "Relationship"; Street, Powell, and Hamblen, "Achievement of Students"; and Fetters, Collins, and Smith, Characteristics.

[3]Summers and Wolfe, "Which School Resources."

studies be examined in depth based on the size of the data base, methodology employed, and the specific research question tested. Pending this examination and based on the results of this study and its findings in relation to other research in this area, it is strongly recommended that any decision on a specific closing not rest solely on the size of school and a perceived relationship with academic achievement.

The decision on which school(s) to close should be based on other concerns such as enrollment projections, racial balance, utilization of the school plant, condition of the facility, transportation implications, and financial considerations. Also, there may be relationships between size of elementary school and other factors including cost of operation, organizational conditions, staff relationships, management practices, the socialization process, and psychological and environmental variables which were not examined by this study. These relationships, if any, may have effects which are not revealed in academic achievement as measured by the Iowa Tests of Basic Skills. The affective and psychomotor domains and portions of the

cognitive domain not measured by the ITBS may be influenced by the size of elementary school attended.

Thus, decision makers cannot ignore the size of the elementary schools under consideration for closure. Additional research is required to examine possible relationships with variables other than academic achievement.

The reader is cautioned that this study did not address the relationship of academic achievement to any variables other than school size. Seven independent variables (all but school size) were included as controls, not to examine their contribution to the variance in achievement. This caution particularly applies to class size.

Additionally, this study examined elementary schools only. No attempt should be made to generalize the results of this research to secondary schools.

It is believed that the findings and conclusions of this study can have a positive impact on closure decisions. Too often decisions on which school(s) to close are based on emotion, in part because of the lack of definitive research. As teaching students cognitive skills is one of the most important functions of education and as academic achievement is a measure of the degree to which these skills have been mastered, the importance of this study in making closure decisions cannot be minimized.

Since it was concluded that there is no statistically significant relationship between size of elementary school and academic achievement, decision makers and the public will hopefully focus their attention on other factors when determining which schools should be closed. The belief that closing particular size schools because the educational program is in some way better or worse based upon achievement scores appears to be unfounded.

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APPENDIX

TABLE 18

REGRESSION ANALYSIS BETWEEN GRADE 3 VOCABULARY AND INDEPENDENT VARIABLES, RESTRICTED MODEL (N=114)

Variable(s)	Partial Regression Coefficient	Standard Error	F-Ratio	Significance Probability
1A. Aptitude	.866	.052	277.60	.0001
Intercept	4.245			

R^2 = .713

Overall F = 277.60

Significance probability = .0001

TABLE 19

REGRESSION ANALYSIS BETWEEN GRADE 3 READING COMPREHENSION AND INDEPENDENT VARIABLES, RESTRICTED MODEL (N=114)

Variable(s)	Partial Regression Coefficient	Standard Error	F-Ratio	Significance Probability
1A. Aptitude	.794	.037	472.64	.0001
Intercept 8.152				

R^2 = .808

Overall F = 472.64

Significance probability = .0001

TABLE 20

REGRESSION ANALYSIS BETWEEN GRADE 3 LANGUAGE SKILLS AND INDEPENDENT VARIABLES, RESTRICTED MODEL (N=114)

Variable(s)	Partial Regression Coefficient	Standard Error	F-Ratio	Significance Probability
1A. Aptitude	.752	.047	256.75	.0001
Intercept	16.899			

R^2 = .696

Overall F = 256.75

Significance probability = .0001

TABLE 21

REGRESSION ANALYSIS BETWEEN GRADE 3 WORK-STUDY SKILLS AND INDEPENDENT VARIABLES, RESTRICTED MODEL (N=114)

Variable(s)	Partial Regression Coefficient	Standard Error	F-Ratio	Significance Probability
1A. Aptitude	.886	.052	287.36	.0001
Intercept	7.470			

R^2 = .720

Overall F = 287.36

Significance probability = .0001

TABLE 22

REGRESSION ANALYSIS BETWEEN GRADE 3 MATHEMATICS SKILLS AND INDEPENDENT VARIABLES, RESTRICTED MODEL (N=114)

Variable(s)	Partial Regression Coefficient	Standard Error	F-Ratio	Significance Probability
1A. Aptitude	.938	.063	223.13	.0001
Intercept	2.648			

R^2 = .666

Overall F = 223.13

Significance probability = .0001

TABLE 23

REGRESSION ANALYSIS BETWEEN GRADE 3 COMPOSITE AND INDEPENDENT VARIABLES, RESTRICTED MODEL (N=114)

Variable(s)	Partial Regression Coefficient	Standard Error	F-Ratio	Significance Probability
1A. Aptitude	.884	.044	396.11	.0001
Intercept	6.701			

R^2 = .780

Overall F = 396.11

Significance probability = .0001

TABLE 24

REGRESSION ANALYSIS BETWEEN GRADE 5 VOCABULARY AND INDEPENDENT VARIABLES, RESTRICTED MODEL (N=114)

Variable(s)	Partial Regression Coefficient	Standard Error	F-Ratio	Significance Probability
1B. Aptitude	.803	.050	262.15	.0001
2. Low-income pupils	-13.672	6.012	5.17	.0249
Intercept 6.098				

R^2 = .842

Overall F = 296.10

Significance probability = .0001

TABLE 25

REGRESSION ANALYSIS BETWEEN GRADE 5 READING COMPREHENSION AND INDEPENDENT VARIABLES, RESTRICTED MODEL (N=114)

Variable(s)	Partial Regression Coefficient	Standard Error	F-Ratio	Significance Probability
1B. Aptitude	.855	.031	779.28	.0001
Intercept	1.653			

R^2 = .874

Overall F = 779.28

Significance probability = .0001

TABLE 26

REGRESSION ANALYSIS BETWEEN GRADE 5 LANGUAGE SKILLS AND INDEPENDENT VARIABLES, RESTRICTED MODEL (N=114)

Variable(s)	Partial Regression Coefficient	Standard Error	F-Ratio	Significance Probability
1B. Aptitude	.778	.042	345.21	.0001
Intercept	10.171			

R^2 = .755

Overall F = 345.21

Significance probability = .0001

TABLE 27

REGRESSION ANALYSIS BETWEEN GRADE 5 WORK-STUDY SKILLS AND INDEPENDENT VARIABLES, RESTRICTED MODEL (N=114)

Variable(s)	Partial Regression Coefficient	Standard Error	F-Ratio	Significance Probability
1B. Aptitude	.868	.041	438.19	.0001
Intercept	7.164			

R^2 = .796

Overall F = 438.19

Significance probability = .0001

TABLE 28

REGRESSION ANALYSIS BETWEEN GRADE 5 MATHEMATICS SKILLS AND INDEPENDENT VARIABLES, RESTRICTED MODEL (N=114)

Variable(s)	Partial Regression Coefficient	Standard Error	F-Ratio	Significance Probability
1B. Aptitude	.971	.052	342.50	.0001
8. School size	.006	.003	4.12	.0449

Intercept - 2.915

R^2 = .756

Overall F = 171.92

Significance probability = .0001

TABLE 29

REGRESSION ANALYSIS BETWEEN GRADE 5 COMPOSITE AND INDEPENDENT VARIABLES, RESTRICTED MODEL (N=114)

Variable(s)	Partial Regression Coefficient	Standard Error	F-Ratio	Significance Probability
1B. Aptitude	.920	.035	674.55	.0001
Intercept	1.328			

R^2 = .858

Overall F = 674.55

Significance probability = .0001

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AN INVESTIGATION OF THE RELATIONSHIP BETWEEN SIZE OF ELEMENTARY SCHOOL AND ACADEMIC ACHIEVEMENT

by

Harry Philip Rohr

(ABSTRACT)

Local school districts throughout the country are experiencing declining enrollment, frequently resulting in the need to close elementary schools. Often, the decision on which school to close is dependent on the size (enrollment) of the schools being considered. The purpose of this study was to examine the relationship between size of elementary school and academic achievement.

The sample used in this study was composed of grade 3 and 5 students in the Montgomery County (Maryland) Public Schools who were administered the Iowa Tests of Basic Skills and Cognitive Abilities Test during the 1977-78 school year and attended an elementary school with grades K-6 (approximately 13,000 pupils).

Variables which have been found in previous studies to have a relationship with achievement were employed in

this study as control variables. These were aptitude, percentage of low-income pupils, race, sex, highest degree status of professional staff, years of experience of teachers, and class size.

The statistical methodology employed in this study was multiple regression analysis. This technique was selected to evaluate the contribution of a single variable, school size, to academic achievement while controlling for other, confounding variables. Twelve multiple regression analyses were conducted--one for each of the five Iowa Tests of Basic Skills major skill areas (vocabulary, reading comprehension, language skills, work-study skills, and mathematics skills) and composite scores for both grades 3 and 5.

It was found, for all the analyses, that elementary school size did not make a significant contribution to the variance in academic achievement. Also, on the basis of the data available and for the students tested, it was concluded that there is no elementary school size which maximizes academic achievement, nor is there a minimum or maximum elementary school size beyond which academic achievement is adversely affected.

Therefore, it was recommended that the decision on which elementary school(s) to close should not rest on a perceived relationship between school size and academic achievement. Other factors, such as financial considerations, transportation implications, and utilization and condition of the school plant, should be of primary concern.