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ABSTRACT

              The relationship of certain input variables to
output was determined by a multiple regression analysis, using a
sample of 44 suburban elementary school districts. The four input
factors were: (1) socioeconomic characteristics, (2) assessed
valuation, (3) per-pupil operating expenditure, and (4) educational
treatments. The output was mean scores on the Stanford Achievement
Test fo the fourth and seventh grades. For both grades, the factor
most highly related with achievement was socioeconomic
characteristics. The average class size factor was significantly
related with achievement at grade seven, and the special area
teachers factor related with achievement at grade four. (Author/RA)

INPUT AND OUTPUT ANALYSIS OF SUBURBAN

ELEMENTARY SCHOOL DISTRICTS

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Title: Input and Output Analysis of Suburban
                Elementary School Districts

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ABSTRACT

This study shows the relationship of certain input
variables to output, of 44 suburban elementary school
districts. Input factors consisted of: socioeconomic
characteristics; assessed valuation; per pupil operating.
expenditure; and educational treatments. Output was
corrected mean grade test scores at fourth and seventh
grades.

Incremental multiple regression techniques
included six models of various combinations. The F test
for incremental gain in multiple correlation showed that
socioeconomic characteristics are the most highly related
factors with achievement at both grades. Tests for
incremental gain within models showed: Special area
teachers were significant at the fourth grade; and
Average class size was significant at the seventh grade.

PREVIOUS RESEARCH

A considerable amount of work has been done in exploring and evaluating various effects of the input and output relationship as they apply to various functions of education. For many years, such studies were referred to as cost-quality studies. Initiated by Cubberly in 1911, a review of the literature shows that there were numerous studies of the cost-quality relationship (Ayres, 1920; Norton, 1926; Powell, 1933; Mort and Cornell, 1938; 1941; Woollatt, 1949; Furno, 1956; Kiesling, 1970).

While early cost-quality studies placed their emphasis on the financial side of the ledger, and usually agreed on what they found--more money does more things--there was not complete concurrence as to what quality really was.

During much of the same period of time, 1930's and 1940's, there was considerable interest and research on human ecology, resulting in stratified classifications of American society to meet the needs and desires of whoever made the study.

Following World War II, more emphasis was given to socio-economic characteristics as they related to either cost factors or quality factors. Until the late 1950's and early 1960's, quality of education was mainly a measure of school practices, or some phase of educational programs. These studies made large contributions to the need for knowledge about what schools can and can not do to improve the end product, or goal. But most of the studies used process variables as their dependent variable.

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With the advent of the space age in the late 1950's, approaches to the study of quality of education concerned themselves with various measures of school output, such as school performance. Thomas completed his dissertation in 1962, using 206 high schools from the Project TALENT survey. Benson submitted his report to the state Fact Finding Committee in March, 1965. That study encompassed 392 elementary and secondary schools in the State of California. The Coleman report was completed July 2, 1966, comparing regions of the country, rural and urban, and whites and non-whites at grades 1,3,6,9 and 12. The study done by Burkhead, with Fox and Holland was published in 1967, and concentrated on high schools in Chicago and Atlanta. Kiesling's study was of fifth and eighth grades in 86 school school districts in New York state, and was completed in 1970.

In spite of the diverse nature of the samples, all studies sought to relate the most important contributing factor to achievement, using a number of different variables to identify both school and community characteristics.

The research of what schools do, or should do, has moved from an array of Mort's adaptability measures to such specifics as to what the sex of the teacher is, when certain subjects are taught, at certain grade levels.

Leonard Ayres had both insight and a vision; when he spoke of those who would work to develop ways of measuring education, and when he compared it to other fields of human endeavor.

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They scan the history of science and remember that
through the development of measurement astronomy grew out
of astrology, chemistry emerged from alchemy, and physics
developed from mystery.

They read the history of education and realize that
the astonishing progress of the past decade has come from
shifting the form of inquiry from asking "What results can
or might we get?" to "What results are we getting?"[1]

The results of recent research in education have shown
that accurate and precise information can be used, in various
combinations, to show the effect one factor may or may not have
on another. Further studies are still needed at both elementary
and secondary levels of American public education. With this
as an incentive, this study was undertaken.

OBJECTIVE OF THE INQUIRY

This study was an attempt to find what input factors
contribute to a more productive output at the elementary school
level. More so today than in times past, schools at all levels
are an integral part of society. It is necessary, therefore,
to examine the major function of the school--that of teaching-
learning--in terms of the society of which it is a part, and
to evaluate the impact that one has on the other.

METHODS AND TECHNIQUES

Input factors consisted of four different types, each
with various degrees of control by those responsible for the
education of children.

1. Socioeconomic characteristics: size of population; type of resident; income level; education level; occupation status; and home value.

2. Financial worth of a school district, as measured by the equalized valuation of assessed property per pupil in average daily attendance.

3. Per pupil operating expenditure for each school district, averaged over a five year period.

4. Educational treatments consisted of two kinds. One is school practices which pertain to the many aspects of school policy, finance, facilities, and personnel. The other is school programs, and are centered around curriculum, instruction, and special services for either students or teachers.

The output, or dependent variable, in this study was the corrected mean grade equivalent score on the Stanford Achievement Test, 1964 edition. Those scores were collected for fourth and seventh grades from 44 elementary school districts of sub-urban Cook County, Illinois.

The general model used in this study can be expressed by the multiple regression equation:

$Y = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4$ where:

Y = dependent factor--achievement test scores,

X_1 = independent factor--socioeconomic characteristics,

X_2 = independent factor--assessed valuation per pupil,

X_3 = independent factor--per pupil operating expenditure,

$X4$ = independent factor--educational treatments.

Stepwise multiple regression techniques were employed to determine: (1) the socioeconomic variables that best predicted the nature of the student; and (2) educational treatment variables which best identify various phases of school practices and educational programs. Incremental multiple regression techniques included six models of various combinations of the four input factors on achievement.

DATA SOURCES

Data for socioeconomic characteristics were gathered from census tracts and cartographic information in the U.S. Census of Population; 1960. Data for assessed valuation and per pupil operating expenditure were made available through the Office of Superintendent of Public Instruction, and the Cook County Superintendent of Schools. Educational treatments and achievement test scores were gathered from 44 elementary school districts. During the year that the tests were administered, 1967-1968, there were 119 elementary school districts in Cook County.

RESULTS

Socioeconomic Characteristics and Achievement

The most interesting--but not surprising--result is that most studies, including this one, agree that the nature of the student, measured in various ways, accounts for the greatest part of the variance in predicting academic achievement. Table 1 shows the order of selection of the variables which were found significant at fourth and seventh grades in this study, and the

TABLE 1

SELECTION AND ORDER OF SIGNIFICANT VARIABLES IN THIS STUDY
COMPARED WITH BENSON, THOMAS AND BURKHEAD USING THE
F TEST FOR INCREMENTAL GAIN WITHIN MODELS[a]

Study Identified	First Variable	Second Variable	Third Variable
This Study Fourth Grade	Median Value of Homes[b]	Special Area Teachers[c]	Per Cent of Non-white[d]
This Study Seventh Grade	Median Years of Schooling[b]	Average Class Size (negative)[b]	Median Income of Families[c]
Benson's California Study	Median Years of Schooling[b]	Median Household Income	Instructional Expenditure Per Pupil[d]
Thomas' National High School Study	Mean Starting Salary for Male Teachers[b]	Quality of Housing	Per Cent of Boys Last Year's Class Who Went to College
Burkhead's Chicago Study	Median Income of Family[d]	Materials and Supplies Expenditures Per Pupil[d]	Teacher Experience (median)[d]
Burkhead's Atlanta Study	Median Income of Family[d]	Enrollment/ Faculty Ratio[d]	Average Faculty Salary[d]

[a]Charles S. Benson and others, State and Local Fiscal
Relationships in Public Education in California. See also J.
Alan Thomas, "Efficiency in Education: An Empirical Study,"
Administrator's Notebook, 11:1-4 (October, 1962); Jesse Burk-
head and others, Input and Output in Large-City High Schools.

[b]Significant at the .01 level.

[c]Significant at the .025 level.

[d]Significant at the .05 level.

order and selection of variables in the studies done by Thomas,
Benson, and Burkhead. Coleman's findings are reported separate-
ly, due to the nature of his study.

The results of this study show that three socioeconomic
characteristics: (1) median value of homes, (2) per cent of non-
white, and (3) median years of schooling, are strong if not
significant predictors of high achievement at fourth grade. At
seventh grade, two characteristics: (1) median years of school-
ing, and (2) median income of families, are significantly re-
lated to high achievement.

Benson's study of California school systems found median
years of schooling and median household income significant, in
that order. Thomas found the quality of housing second in im-
portance to mean starting salary for male teachers. Burkhead
identified median income of family in both Chicago and Atlanta
high schools to be the socioeconomic characteristic which is
significantly related to achievement.

In reporting on the influence of student background
factors on achievement, Coleman states:

> . . . in the sixth grade, the child's report of items in
> his home, indicating its economic level, has the highest
> relation to achievement for all minority groups, while
> parents' education has the highest relation for whites.
> In later years, parents' education comes to have the high-
> est relation for nearly all groups.[2]

Per Cent of Non-white and Achievement

Neither Benson nor Thomas collected data on the per cent
of non-white for their studies. Burkhead collected such data,

but did not use it in his analysis for either Chicago or Atlanta.
Only Colemen collected, used and reported on the relationship
between non-whites and achievement, and he consistently found a
negative relationship between the per cent of non-white and
achievement scores in all regions of the country and in metro-
politan and non-metropolitan areas.

What Coleman found in his study has been corroborated in
this one. The per cent of non-whites in suburban elementary
schools is negatively related to achievement at the fourth grade
level, and is the third most important variable when tested for
incremental gain within the model.

Assessed Valuation Per Pupil and Achievement

Early studies that related wealth of a school district
with quality of education, using adaptability measures, found a
high relationship.

When achievement was used as the dependent variable,
Benson found the zero order correlation with assessed valuation
to be practically nonexistent with median reading scores (.001),
and was only slightly better with median arithmetic scores
(.048). Neither Thomas, Burkhead, nor Coleman used or consid-
ered assessed valuation in their studies.

The zero order correlation in this study between assessed
valuation and achievement was .280 and .124 at fourth and seventh
grades, respectively. When controlling for the all-important
socioeconomic factor, assessed valuation was found not to be
significant.

An explanation of the findings of this study is that suburbs of the City of Chicago are, in some cases, highly industrialized. While this provides an adequate, if not substantial, tax base from which to operate schools, assessed valuation only provides the ability, and does not measure the effort that a school district puts forth to obtain its objective.

Per Pupil Operating Expenditure and Achievement

The cost-quality studies initiated and instituted by Mort and his associates during the 1940's and first half of the 1950's generally agreed that a positive correlation of around .60 existed when expenditure levels were related to measures of adaptability.

More recent studies are not so unanimous, and in fact take issue with the importance of expenditure levels as a determinant of quality of education.

While Benson found the instructional expenditure per ADA to be significant at the 5 per cent level for the whole test sample, in explaining achievement, he did not find it significant in explaining low achievement districts. Thomas stated that "the manner in which money was spent appeared to be more important than the level of expenditure."[3] Burkhead reported the "current expenditures are greater in the low and the high-income areas than in the middle" income areas of Chicago.[4] In Atlanta, Burkhead found the "current expenditures as such have very little influence on school output."[5]

The zero order correlation in this study between per pupil operating expenditure and achievement was .413 and .454 at fourth and seventh grades, respectively. When per pupil expenditures were combined with socioeconomic variables in a stepwise procedure, per pupil operating expenditures added very little. When these combined factors were submitted to the F test for incremental gain, per pupil operating expenditures at both fourth and seventh grades were found not to be significant.

The most recent studies that have used the input-output approach, including this one, seriously question the long-standing position that Mort and others have taken "that expenditure level is at one and the same time one of the most powerful predictors of quality and one of the simplest measures to obtain."[6] That it is one of the simplest measures to obtain is, of course, not under question. The fact still remains that when output is measured by achievement scores, the expenditure level is <u>not</u> the most powerful predictor of school quality, once socioeconomic characteristics are taken into account.

Educational Treatments and Achievement

While all studies which used the input-output approach agreed on the overwhelming influence that socioeconomic variables have on achievement, each study found other factors which were important enough to be mentioned.

Benson found instructional expenditure per pupil a significant variable when submitted to the F test for incremental gain.

Thomas found that the mean starting salary for male teachers was the most important variable in predicting achievement at the high school level. Burkhead found that materials and supplies expenditures per pupil and the experience of teachers in Chicago, and enrollment/faculty ratio and average faculty salary in Atlanta were significant predictors of achievement. Coleman, in speaking of the effects of school on achievement, states:

> Given the fact   .t no school factor accounts for much variation in achievement, teachers' characteristics account for more than any other.[1]

This study selected 14 educational treatment variables, all of which were thought to have some importance to elementary education.

At the fourth grade level, only one was found to be of any importance when tested for incremental gain within the model. This variable was the number of special area teachers per 1,000 students. Special area teachers in this study included: art, library, vocal and instrumental music, physical education, and reading teachers who teach classes of their special area at the elementary school level.

At the seventh grade level, one educational treatment variable was also found to be of importance when tested for incremental gain within the model. This variable was average class size, negative, which means the smaller the classes, the greater the achievement. This variable is comparable to the enrollment/faculty ratio variable that Burkhead found important in his study of Atlanta high schools.

While only one educational treatment variable found sig-
nificant in this study was similar to one found in Burkhead's
study, there is a relationship between the findings of this
study and the findings of Benson, Thomas, Burkhead and Coleman.
These implications and recommendations are the final part of
this report.

Implications and Recommendations

The findings of this study have shown that socioeconomic
characteristics such as quality of the home, amount of school-
ing of adults, and the earning power of adults are the most
highly related factors with educational outcomes when measured
by achievement test scores. This supports what Benson, Thomas,
Burkhead, and Coleman have also found, and substantiates the
fact that better educated adults who make larger incomes and
live in more expensive homes more than likely raise children
who perform better in school.

None of these variables are directly under the control
of either boards of education or superintendents of schools.
If they were, it is difficult if not impossible to state what
they might do, and what effect their action might have. If
influential campaigns were waged for adults to continue their
education by evening or Saturday classes, the median years of
schooling could be raised. What influence this could have on
their children's performance can only be left to conjecture.
A study of communities that provide strong adult education pro-
grams and the relationship to their children's performance might

help to answer this question.

The greater number of the 44 elementary school districts in this study had enrollments of students who were predominantly white. A little over 15 per cent of the districts had enrollments of non-white, ranging from 4.3 per cent to 26.6 per cent of the total enrollment. Of these districts, only one had achievement test scores which were above the mean for the entire sample, at both fourth and seventh grade levels.

The findings of this study measure only variability between school districts. The important fact is that a school district with some per cent of non-white can now be identified, and further studies made to determine student characteristics that help to account for the individual pupil variability.

On the whole, educational treatments did not add significantly to predicting achievement once socioeconomic variables had been allowed to operate. However, two variables, special area teachers and average class size (negative) did demonstrate enough predictive power to be of interest to administrators. Both of these variables cost money.

If a composite of findings is in order, then the instructional expenditure which Benson found to be important may be part of the answer to the manner in which money should be spent, as Thomas has stated. Coleman's findings on teacher characteristics might be interpreted by asking: What do they teach, how well do they teach it, and how large a size of class do they teach?

It might also be asked: How do teachers of such subjects
as art, music, physical education, and library help to raise the
achievement level, especially when achievement tests do not
usually measure accomplishments in those areas?

To answer this, two theories are proposed. One, if
regular classroom teachers do not teach their own art, music,
physical education, and library, they will in most cases have
more time to prepare for subjects that they do teach. Better
preparation should make for better presentation, which could
bring about increased learning, and consequently better per-
formance.

A second thesis is: teachers of special areas are usually
specialists in their respective fields. Their expectations may
generate excellence in the learner, which could carry over into
the academic areas. This in turn could also motivate the class-
room teacher to perform her task at a higher level of pro-
ficiency, since she may not want to be considered lacking in
her all-important field of endeavor.

Recently, studies have sought to answer the perplexing
question of what makes a good school? This study, hopefully,
has added needed information at the elementary school level to
aid administrators in securing "greater returns from the money
expended."[8]

Footnotes

[1]Leonard P. Ayres, The Measurement of Educational Processes and Products, p. 8.

[2]James S. Coleman and others, Equality of Educational Opportunity, p. 302.

[3]J. Alan Thomas, "Efficiency in Education: An Empirical Study," Administrator's Notebook, 11:4 (October, 1962).

[4]Jesse Burkhead and others, Input and Output in Large-City High Schools, p. 59.

[5]P. 72.

[6]Paul R. Mort and others, Public School Finance, p. 87.

[7]Coleman and others, p. 325.

[8]Ellwood P. Cubberly, Research Within the Field of Education, p. 5 quoted by Austin D. Swanson, "The Cost-Quality Relationship," The Challenge of Change in School Finance, p. 151.

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TABLE 1

SYMBOL, MEAN AND STANDARD DEVIATION OF EIGHT
SOCIOECONOMIC CHARACTERISTICS FOR
44 ELEMENTARY SCHOOL DISTRICTS
OF COOK COUNTY

Symbol	Characteristics	Mean	Standard Deviation
POP	Population--size of community	14,102.70	14,714.01
PNW	Per cent non-white	2.70	6.37
4YC	Per cent with four years of college or more	11.49	7.87
MYS	Median years of schooling	11.71	.93
IOT	Per cent earning $10,000 or more	35.07	13.57
MIF	Median income of families	$8,915.65	$1,809.25
PMW	Per cent professional and managerial workers[a]	26.70	11.15
MVH	Median value of homes	$20,806.56	$4,70269

[a]Both male and female workers were counted in these two
occupational categories.

TABLE 2

SYMBOL, MEAN AND STANDARD DEVIATION OF ASSESSED VALUATION
PER PUPIL AND PER PUPIL OPERATING EXPENDITURE FOR A
FIVE-YEAR AVERAGE FOR 44 ELEMENTARY DISTRICTS

Symbol	Definition	Mean	St. Dev.
AVPP	Assessed Valuation Per Pupil	$35,752.52	$21,779.74
PPOE	Per Pupil Operating Expenditure for five years average: 1963-1964 through 1967-1968	$606.54	$124.68

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TABLE 3

SYMBOL, DEFINITION, MEAN AND STANDARD DEVIATION OF 14
EDUCATIONAL TREATMENT VARIABLES[a]

Symbol	Educational Treatment	Mean	St. Dev.
CO	Central office administrators per 1,000 students	0.95	0.85
SP	Supervisory personnel per 1,000 students	1.09	2.44
ST	Special area teachers per 1,000 students	7.42	3.37
MT	Per cent of total teaching staff that are male teachers	19.48	5.72
MM	Per cent of staff with masters degree or more	24.39	12.30
SB	Students per building-enrollment divided by attendance centers	495.39	170.64
CS	Average class size-enrollment divided by number of teachers	22.12	3.22
LV	Total number of library volumes divided by number of students	9.97	4.97
BB	Beginning salary at the bachelor's level	$5,849.48	$128.96
BM	Beginning salary at the master's level	$6,339.79	$187.96
MS	Maximum salary paid to teachers	$10,354.43	$960.60
YR	Years to reach maximum on salary schedule	17.34	2.61
EN	Total enrollment of the school district	2,298.34	1,602.62
EA	Per cent of average daily attendance to enrollment	89.71	3.07

[a]N = 44

FIGURE 1

TWO AREAS OF ELEMENTARY SCHOOLS OPERATIONALLY DEFINED

Degree of Control	Policies into Practices		Policies into Programs	
	Area	Treatment	Area	Treatment
Great	Personnel	Central Office Administrators		
	Personnel	Male Teachers	Instruction	Supervision
	Personnel	Preparation		
	Students	Class Size		
Some	Facilities	Students per Building	Curriculum	Library Books per Student
Less	Finances	Salary Schedule	Special Services	Special Area Teachers
Least	Enrollment		Attendance	

The general model used in this study can be expressed by the multiple regression equation: $Y = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4$ where:

Y = dependent factor--achievement test scores,
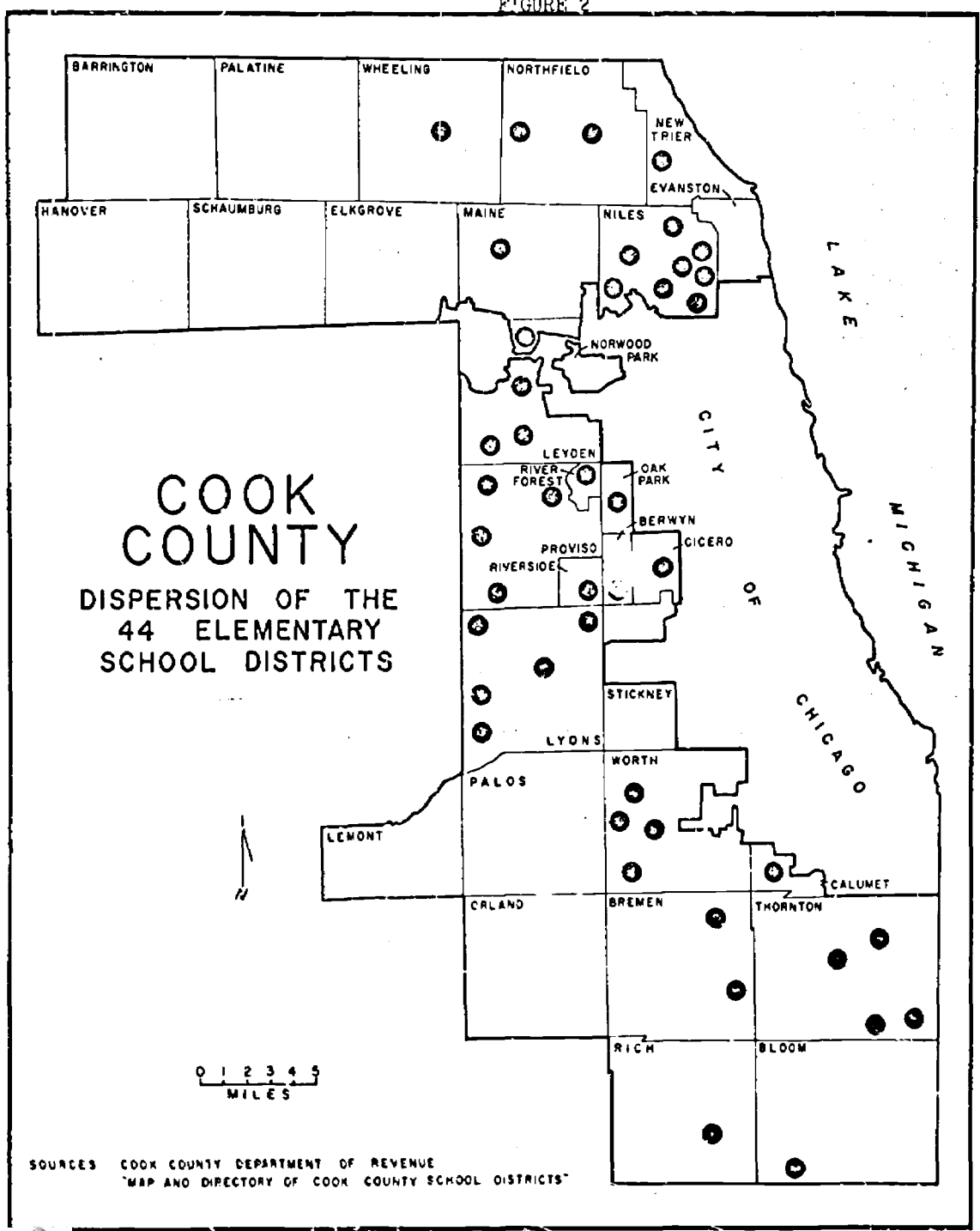
X_1 = independent factor--socioeconomic characteristics,

X_2 = independent factor--assessed valuation per pupil

X_3 = independent factor--per pupil operating expenditure,

X_4 = independent factor--educational treatments.

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COOK
COUNTY

DISPERSION OF THE
44 ELEMENTARY
SCHOOL DISTRICTS

BARRINGTON PALATINE WHEELING NORTHFIELD

NEW TRIER

EVANSTON

HANOVER SCHAUMBURG ELKGROVE MAINE NILES

NORWOOD PARK

LEYDEN

RIVER FOREST OAK PARK

BERWYN

PROVISO CICERO

RIVERSIDE

STICKNEY

LYONS WORTH

PALOS

LEMONT

ORLAND BREMEN THORNTON CALUMET

RICH BLOOM

LAKE

MICHIGAN

CITY OF CHICAGO

0 1 2 3 4 5
MILES

SOURCES   COOK COUNTY DEPARTMENT OF REVENUE
"MAP AND DIRECTORY OF COOK COUNTY SCHOOL DISTRICTS"

TABLE 5

VALUES OF INCREMENTAL DETERMINATION FOR SIX KEY
INDEPENDENT VARIABLES AT FOURTH GRADE LEVEL

Elements of Total Variation	Sum of Squares	Per Cent Predicted Variance	F Ratio
Total sum of squares	8,419		
Influence of MVH[d]	3,017	35.88	23.454[a]
Residual	5,402		
Influence of MVH	3,017	45.29	7.230[b]
Added influence of ST	800		
Residual	4,602		
Influence of MVH and ST	3,817	49.42	3.349[c]
Added influence of PNW	342		
Residual	4,260		
Influence of MVH, ST and PNW	4,159	52.42	2.523
Added influence of MIF	252		
Residual	4,008		
Influence of MVH, ST, PNW & MIF	4,411	56.55	3.716[c]
Added influence of MYS	349		
Residual	3,659		
Influence of MVH, ST, PNW, MIF and MYS	4,760	57.00	.397
Added influence of PMW	37		
Residual	3,622		

[a]Significant at .01 level.

[b]Significant at .025 level.

[c]Significant at .10 level.

[d]MVH = Median Value of Homes
ST = Special Area Teachers per 1,000 Students
PNW = Per Cent Non-white
MIF = Median Income of Families
MYS = Median Years of Schooling
PMW = Per Cent Professional and Managerial Workers

TABLE 6

VALUES OF INCREMENTAL DETERMINATION FOR SEVEN KEY
INDEPENDENT VARIABLES AT SEVENTH GRADE LEVEL

Elements of Total Variation	Sum of Squares	Per Cent Predicted Variance	F Ratio
Total sum of squares	14,692		
Influence of MYS[c]	7,663	52.13	45.783[a]
Residual	7,029		
Influence of MYS	7,663	60.06	8.349[a]
Added influence of CS	1,154		
Residual	5,875		
Influence of MYS and CS	8,817	61.47	1.500
Added influence of MVH	224		
Residual	5,651		
Influence of MYS, CS and MVH	9,041	64.32	3.195[b]
Added influence of MIF	412		
Residual	5,239		
Influence of MYS, CS, MVH & MIF	9,453	66.59	2.731
Added influence of IOT	322		
Residual	4,917		
Influence of MYS, CS, MVH, MIF and IOT	9,775	67.57	1.148
Added influence of PNW	158		
Residual	4,759		
Influence of MYS, CS, MVH, MIF, IOT and PNW	9,933	68.89	1.571
Added influence of POP	182		
Residual	4,577		

[a]Significant at .01 level.

[b]Significant at .10 level.

[c]MYS = Median Years of Schooling
CS = Average class size-enrollment divided by teachers
MVH = Median Value of Homes
MIF = Median Income of Families
IOT = Per Cent Earning $?,000 or more
PNW = Per Cent Non-white
POP = Population--size of community

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