DOCUMENT RESUME

ED 129 843 TM 005 463

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TITLE A Study of the Characteristics of School Outliers.
PUB DATE [Apr 76]
NOTE 19p.; Paper presented at the Annual Meeting of the American Educational Research Association (60th, San Francisco, California, April 19-23, 1976)

EDRS PRICE MF-$0.83 HC-$1.67 Plus Postage.
DESCRIPTORS Academic Achievement; *Achievement Rating; Analysis of Variance; Demography; Elementary Education; *Elementary Schools; Multiple Regression Analysis; *Performance Factors; Private Schools; *Program Effectiveness; Public Schools; Resource Allocations; Socioeconomic Background; *Statistical Analysis
IDENTIFIERS *outliers

ABSTRACT

Multiple regression studies of schools are capable of detecting only "average" effect. A basic assumption of such studies is that all schools are functioning within the parameters of a given educational technology and that differences in output can be attributed to different levels of input. With decentralized decision making characteristics of public elementary and secondary education, it is entirely possible that some schools are functioning within totally different parameters than are the bulk of schools. If these "different" schools are small in number, their effect would be lost in a multiple regression analysis. Using data of the public elementary schools in New York State, regression analysis was used to identify outlier schools, socioeconomic characteristics being the independent variables and average pupil achievement being the dependent variable. Schools with an unusually large residual score were considered outliers, and were compared with other schools using analysis of variance. Both positive and negative outliers tended to be small innovative schools, but the positive achievers were different with respect to resource applications in a direction which supports conventional wisdom about quality schools. The paper concludes by discussing the implications for future research. (BW)

A Study of the Characteristics of School Outliers

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The last decade has produced a number of large scale statistical studies which have placed in question the effectiveness of traditional schooling arrangements. Some of the more frequently discussed and quoted include: Burkhead (1967); Coleman (1966); Hanushek (1970); Husen (1973); Jencks (1972); and Katzman (1971). All of these studies used multiple regression as the principal tool of analysis. They pointed out that, on the average, the independent effect of schooling was small; yet within at least some of the samples - and probably all - there were schools which were unusually effective. The purpose of this study was to identify unusually effective and ineffective schools from the population of elementary schools in New York State and to examine them for distinguishing differences in program, personnel and achievement characteristics.

Disillusionment with multiple regression analysis as an appropriate tool for the study of school effect has brought about a growing interest in the potential of studying outlying schools. Methodological considerations were discussed extensively in a monograph by Robert Klitgaard and George Hall (1973). Noting that large scale statistical studies have failed to identify any important and consistent school effects, they go on to suggest (1973:1):

> "Perhaps educational research has looked in the wrong places for evidence of effectiveness. Previous studies have indicated that, on average, school policies do not greatly affect measurable student scholastic and occupational performance. Suppose this is true. Might there remain, nevertheless,

a group of schools that are different? Are there any exceptions to small average tendencies and insignificant regression coefficients? The mathematics of previous studies allow for such a possibility, as long as the number of exceptions is not large."

Klitgaard and Hall examined six data sets for outliers: Michigan schools, New York City elementary schools, Project Talent, New York State school districts, New York State Schools (a limited sample of those which were included in this study), and Project Yardstick. They did identify groups of "over" achieving schools which comprised between two and nine percent of various samples. Klitgaard and Hall (1973:71) concluded:

"Moving away from average effects in educational research and policy making does seem worthwhile. We have located schools and districts that consistently perform better than their peers. It is probably worthwhile to continue such research, and to begin looking for unusually effective classrooms and programs."

Implicit in the use of multiple regression analysis to study school effect are assumptions of common objectives, common production functions, and competition among schools. The third assumption obviously does not pertain to public schools. With respect to the first two, there is ample evidence that there is much uniformity in practice as to the purposes, organization and operation of schools. However, with the extreme decentralization of decision-making in education and the absence of a science based technology, it would seem likely that at least a few schools would deviate substantially from the norms in terms of objectives and the application of resources. If highly successful or unsuccessful, such schools would emerge as statistical deviates or outliers.

Procedures. The data for this study were collected by the Bureau of School Programs Evaluation of the New York State Education Department (Irvine, 1976) and included information on 2,624 public and private elementary schools. This represents over 80% of the schools providing instruction to both third and sixth graders in the state.

A conceptually simple criterion of school achievement (called the General Factor Score) was developed which was the sum of all average school achievement test scroes for reading and mathematics in grades three and nine for the 1972-73 school year. An analysis by Nichols (1976) showed that such a procedure provided approximately equal weightings to the component scores.

A regression equation was calculated which predicted the General Factor Scores from seven variables describing the location and type of school and demographic characteristics of the school's student population. The means, standard deviations and correlation matrix of these variables are reported in Table 1 as are the regression coefficients and related statistics. The seven variables explained 69.6% of the variance in the achievement criterion.

Using the raw score regression equation shown in Table 1, a predicted General Factor Score was calculated for each of the 2,624 schools. The predicted scores for each school was subtracted from the actual score to obtain a residual score. The residual scores indicated the degree to which schools' General Factor Scores were higher or lower than would be expected from student background variables.

The distribution of residual scores had the following characteristics:

Mean	.000
Standard Deviation	3.161
Shew	-.029
Kurtosis	.446

Table 1: Regression statistics: predicting General Factor Score from school type, school location, and demographic characteristics of school student population

Vari. No.	Variable Name	Correlations								Mean	Standar Deviati
		1	2	3	4	5	6	7	8		
1	Public - Private[1]	1.00	-.18	-.16	-.28	-.14	.13	.07	.29	1.23	.45
2	Percent Negro	-.18	1.00	.31	.63	.12	.25	-.04	-.63	10.09	19.92
3	Percent Spanish American	-.16	.31	1.00	.66	.49	.05	-.03	-.60	5.58	14.63
4	Percent Families on Welfare[2]	-.28	.63	.66	1.00	.40	.12	-.16	-.77	2.85	2.03
5	New York City[3]	-.14	.42	.49	.49	1.00	.56	.52	-.33	-.08	.63
6	Center City[4]	.13	.25	.05	.12	.56	1.00	.47	-.14	-.13	.68
7	Suburb of Large City[5]	.07	-.04	-.03	-.16	.52	.47	1.00	.22	.13	.78
8	Mean 3rd and 6th Grade Tests	.29	-.63	-.60	-.77	-.33	-.14	.22	1.00	34.64	5.73
	Constant	--	--	--	--	--	--	--	--	--	--

Multiple Correlation (R) 834
R Squared (Proportion of Variance Accounted For) .695
F Test of Significance of R 854.183
Probability Value of F .0001

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1 1 = public; 2 = private

2 1 = none; 2 = 1-10%; 3 = 11-20%; 4 = 21-30%; etc.

3 1 = New York City; 0 = center city or suburb; -1 = other location

4 1 = other center city; 0 = New York City or suburb; -1 = other location

5 1 = suburb of large city; 0 = New York City or other center; -1 = other location

Regression Coefficients (Standardized)	Regression Coefficients (Raw)
.12	1.50
-.29	-.08
-.30	-.12
-.36	-1.01
.11	.98
-.16	-1.37
.15	1.14
--	--
--	37.00

The slight negative skew indicates that the negative residuals tended to be more extreme than the positive ones, but this value is not statistically significant and is so small as to be unnoticeable in a plotted distribution. The positive kurtosis indicates that the tails of the distribution were longer than those of a normal distribution. A kurtosis of .45 would be slightly noticeable in a plotted distribution, and it is highly significant statistically with the large sample of schools (p .0001). Thus, the slight positive kurtosis was the only deviation of the distribution of residuals from a normal distribution with the expected mean and standard deviation.

According to the central limits theorem one would expect a normal distribution of residuals if the schools' deviation from expected were due to the combined effect of a large number of influences operating more or less independently of each other. The positive kurtosis suggests that there was also a fairly potent influence operating on a relatively few schools to make their residual scores extreme. This influence could be particularly effective or ineffective educational programs. However, it could also be some uncontrolled background factor or factors, or simply errors in the data.

The residual difference between the actual and predicted school scores became the statistic for identifying school outliers. Schools which had a residual score in excess of 5 were classified as positive outliers. Those having a residual less than -5 were classified as negative outliers. Schools which had a residual score between .5 and -.5 were classified as non-deviates.

The three groups were subjected to a one way analysis of variance on 177 variables relating to school pupil background, location, professional personnel, program, and achievement. Parallel analyses were made for private and public schools combined and for public schools alone.

Findings. One hundred forty-eight schools were identified as positive outliers ("over" achievers). Of these, 43 or 29% were private schools; 105 were public. In the negative outlier group ("under" achievers), there were 145 schools. Fifty, 34%, were private and 95 were public. In the non-deviate group, 104, 32%, were private and 219 were public.

Table 2 reports the means and standard deviations for the three groups on the criterion variable and on the control variables (the independent variables in the regression equation used in predicting achievement). As would be expected, there was little variation among the three groups within each analysis on the control variables. The total group averaged about 12% Negro enrollment with approximately 1/6 of the schools exceeding 30%. Spanish American enrollment averaged over 6% with approximately 1/6 exceeding 20%. The public schools averaged more than 12% of their pupils on welfare; the percentage is lower for private schools. Private schools also tended to enroll a smaller percentage of students from minority groups. On the achievement criterion, positive outliers averaged approximately one standard deviation above the total group mean; negative outliers averaged approximately one standard deviation below. The average for non-deviates fell near the total group mean. Private schools on the average achieved slightly higher than public schools.

Table 3 lists those schools and program variables for which there was a difference among group means which was significant at a .05 level or above. Both positive and negative outliers averaged about 100 students less than the non-deviates. Regardless of classification, private schools, averaging 220 pupils, were much smaller than public schools, averaging 584 pupils. Generally, as the analysis shifts from the total group of schools to public schools only, the direction of difference in school and program characteristics remains the same but in some instances the magni-

Table 2: Means and standard deviations of criterion and control variables for six groups of outlier and non-deviate schools.

Control and Criterion Variables	Public and Private Schools						Public Schools Only					
	Positive Outlier		Non-Deviate		Negative Outlier		Positive Outlier		Non-Deviate		Negative Outlier	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Public-private[1]	1.29	.45	1.32	.47	1.35	.48	1.00	.00	1.00	.00	1.00	.00
Percentage Negro	10.79	18.00	9.14	19.83	12,25	22.15	12.83	19.62	12.77	23.08	12.55	22.32
Percentage Spanish Am.	4.65	12.93	5.58	14.13	4.04	10.13	5.95	14.85	7.67	16.52	5.52	12.08
Percentage families on welfare[2]	2.69	2.25	2.86	2.14	2.72	1.39	3.08	2.48	3.38	2.37	3.12	1.37
New York City[3]	- .05	.61	- .12	.60	- .03	.60	.03	.65	- .08	.68	.05	.67
Other city[4]	.14	.73	- .07	.65	.13	.71	.12	.71	- .13	.63	.07	.68
Suburb of large city[5]	.05	.67	.12	.81	.07	.68	.07	.70	.20	.81	.11	.70
Criterion of Achievement	41.24	4.87	34.88	4.99	28.14	3.72	40.00	5.02	33.35	5.31	27.21	3.65

1 1 = public; 2 = private

2 1 = none; 2 = 1-10%; 3 = 11-20%; 4 = 21-30%, etc.

3 1 = New York City; 0 = center city or suburb; -1 = other location

4 1 = other center city; 0 = New York City or suburb; -1 = other location

5 1 = suburb of large city; 0 = New York City or other center city; -1 = other location

Table 3: Means and levels of significance of school and program variables which differentiate among the groups with a chance probability of less than .05

School and Program Variables	Public and Private Schools[2]			Public Schools Only[2]		
	Positive Outlier	Non-Deviates	Negative Outlier	Positive Outlier	Non-Deviates	Negative Outlier
Total enrollment K-6	426	517	402	525	637	526
		+++	--	-	+++	-
Special Programs[1]						
Academically talented[1]	.257	.149	.083	.210	.187	.084
	+++		--			-
Compensatory[1]	.162	.245	.290	.171	.311	.305
	-			--		
Building Arrangement						
Students/total room ratio	16.80	18.87	16.49	18.60	19.21	17.87
	- -	+++	---		+	-
Students/reg. classroom ratio[3]	26.88	28.74	27.71	27.87	28.89	28.53
	-	+				
% Total rooms reg. classrooms	63.05	65.52	59.92	66.89	66.79	62.56
		+++	---		+	---
Organization[1]						
Traditional classroom arrang.	.939	.957	.890	.943	.973	.905
		+	--		+	-
Open classrooms[3]	.243	.115	.172	.248	.146	.200
	++	--				
Multi-age grouping[3]	.324	.204	.290	.267	.219	.274
	+	--				
Non-graded classes[3]	.223	.164	.317	.210	.160	.263
		--	+++			
Guidance counselors	.270	.341	.461	.276	.411	.589
	-		++	---		+++

1 1 = program present; 0 = program not present

2 Individual group means that differ from the mean of all other groups combined are indicated by + for high means and - for low means. The number of pluses or minuses indicate the probability level: three = .001; two = .01; one = .05; and none = larger than .05.

3 not significant for public schools only

tude of the difference drops. It would appear that private schools more than public schools tend to organize programs around the academically talented, multi-age grouping, and non-graded classes.

Positive outliers were more likely to have programs for the academically talented, an open classroom arrangement and multi-age grouping. They were less likely to have compensatory education programs and guidance counselors. The number of students per classroom was likely to be lower for both groups of deviates. Traditional classrooms were likely to be found in most schools. The chance for not finding them, however, was greatest in the negative outlier schools. The non-deviate schools were generally less likely to have instituted what might be termed "innovative" programs than either of the deviate groups.

The differences in achievement statistics was consistent for the four years studied, 1969/70 - 1972/73. Findings with reference to achievement are reported in Table 4 for 1971-72 only. For all years, all grades, and all subjects, achievement means are high for the positive outlier schools and low for the negative outlier schools. The standard deviations were smaller for positive outliers than for negative outliers for all years and for all subjects except sixth grade mathematics where the reverse was true for all years. As would be expected, the skew tests were positive for negative outliers and negative for positive outliers. Most differences on the achievement means were significant at the .001 level.

Data on the characteristics of teaching staffs were available only for public schools. The findings are reported in Table 5. Positive outlier schools tended to have a smaller percentage of male teachers than did the other two groups (16, 20, and 22% respectively). They also tended to have more highly trained staffs. Non-deviates had the fewest uncertified teachers, 3.3%, while negative outliers

Table 4: Means and levels of significance of achievement related variables for 1971-72 which differentiate among groups with a chance probability of less than .05.

Achievement Related Variables	Public and Private Schools[1]			Public Schools Only[1]		
	Positive Outliers	Non-Deviates	Negative Outliers	Positive Outliers	Non-Deviates	Negative Outliers
Means						
Grade 3 - Reading	36.78 +++	32.92	27.28 ---	35.73 +++	31.50	25.79 ---
Grade 3 - Math	36.96 +++	32.25	26.87 ---	36.24 +++	30.97	25.75 ---
Grade 6 - Reading	46.00 +++	41.29	36.30 ---	45.06 +++	39.30	34.59 ---
Grade 6 - Math	37.42 +++	32.35	27.76 ---	37.00 +++	30.96	26.53 ---
Standard Deviations						
Grade 3 - Reading	9.78 ---	10.36	10.93 +++	10.28 ---	10.84	11.35 +++
Grade 6 - Reading	11.31 ---	11.82	12.28 ++	11.90 ---	12.47	12.77 +
Grade 6 - Math	11.46 +++	10.69	9.98 ---	11.83 +++	10.98	10.11 ---
Skew						
Grade 3 - Reading	-13.12 ---	- 4.66	9.84 +++	-12.58 ---	- 3.34	13.13 +++
Grade 3 - Math	- 7.25 ---	1.33	9.50 +++	- 7.11 ---	2.21	12.03 +++
Grade 6 - Reading	-14.85 ---	- 6.26	1.36 +++	-14.53 ---	- 3.62	4.30 +++
Grade 6 - Math	.486 ---	7.07	10.99 +++	1.27 ---	8.39	12.68 +++

[1] Individual group means that differ from the mean of all other groups combined are indicated by + for high means and - for low leans. The number of pluses or minuses indicate the probability level: three = .001; two = .01; one = .05; and none = larger than .05.

had the most, 5.6%. Positive outliers averaged 4.1% uncertified teachers but they had the largest standard deviation, 10.7%. A larger percentage of teachers in positive outlier schools were on tenure than for the other two groups (69, 65 and 59% respectively). Teachers in positive outlier schools had more experience in the district and in total. The means in average total experience for the three groups were 12, 11, and 10 years respectively. Teachers in positive outlier schools earned the highest salaries. Their counter-parts in the negative outlier schools earned the least.

Conclusions. The three groups of schools were traditionally oriented; however, outlier schools, both positive and negative, tended to be more innovative than non-deviate schools. For one group, traditional approaches and innovations were associated with unpredictably high achievement; for another group, the opposite was true. What made the difference? Those who still believe that schools can make a difference in children's learning can gather some comfort from the analysis of teacher characteristics. The teachers as a group in the positive outlier schools epitomized what conventional wisdom claims to be characteristic of good teaching staffs. They were better trained and more experienced. They were paid higher salaries and were more likely to be on tenure.

This information is of little practical value, however. It still does not inform as to what well trained, experienced and highly paid teachers do to bring about unexpectedly high pupil achievement. Such knowledge is essential if we are to prepare and organize teachers and the teaching processes in other than a random fashion. Such information cannot be gained by analyzing existing large scale data banks. Understanding of the teaching/learning interface can be gained only from an intimate study of interactions of persons involved in the process.

The studies of the past decade have generally followed an input-output approach, making few, if any, assumptions about the interactions of variables. The conceptual weakness of this approach was recognized by Donald Levine in his analysis of Christopher Jenck's (1972) study of Inequality. Levine (1973:163) writes:

> "If effective educational practice is a matter of interactions, then attention must center on those ultimately responsible for structuring and controlling the interactions; that is, teachers and students. The use that these agents make of the school resources usually measured in input-output analysis may be more significant than the absolute levels and kinds of resources."

Jesse Burkhead (1973:204) the first economist to apply micro-economic techniques to the study of educational production functions, was probably the first to recognize the substantial limitations of the application. In reviewing the results of economic reserach in education during the past 12 years, he writes:

> "Some, but certainly not all, economists who have worked on the micro-economics of education now feel that continued research in the cognitive domain is largely fruitless unless it is somehow combined with research in the affective domain outcomes. This is the responsibility of psychologists, sociologists, and educators, not of economists . . . The difficulties of this kind of research are substantial. The first is a lack of communication among educators, psychologists, and sociologists."

The literature in anthropology, psychology, and sociology as well as in education contains many references to interaction and social climate type factors which may be linked to pupil achievement. Gearing et al. (1973), Gearing and Tindall (1973)

Brophy and Good (1970), Rist (1970), Rosenfeld (1971) and Talbert (1973) have analyzed arrays of formal and informal social identities and corresponding arrays of established role elaborations among these. Cole and Miller (1967) found that achievement oriented values predicted grades independently of ability and Gross (1967) observed that value conflicts between teacher and pupil may have a deterent effect on achievement. Self-esteem is related to effective performance in a given setting according to Fitts (1965) as is the pupil's perception of control over his behavior and its consequences, his sense of competence, and the amount of anxiety experienced in classroom activities.

Silberman (1970) has noted that classrooms differ structually on several dimensions such as the amount of choice pupils have in determining classroom activities, the frequency of group activities which require the cooperative use of various communications skills to solve common problems, the number of activity centers in the classroom, and whether the teacher works mainly with the class as a whole or with individuals and small groups. Schmuck and Schmuck (1971) identified six dimensions of social climate: leadership, patterns of attractions and liking, classroom norms related to work and social behavior, freedom of openness of communication, group cohesiveness, and the legitimacy of open evaluation of classroom activity. Scheff (1963) noted a linkage between formal labeling and deviant behavior and the number of alternatives available to handle unusual behavior. Bartlett (1972) studied relationships between teaching style and deviant behavior.

The general literature on organizations [e.g., Larsch and Lawrence (1970), Mott (1972), Paylor and Bowers (1972), and Tannenbaum (1968)] has implications for school organizations. Teacher perceptions of their relationships within heirarchical and peer networks, communication patterns, the distribution of influence by decision areas, orientations to tasks and to role, and the character of task support

systems may well affect the way teachers relate to their schools and to mission accomplishment.

The studies identifying these factors have been highly fragmented and no attempt has been made to weave them into a single conceptualization. After a very careful review of the extensive research on educational effectiveness, the Rand Corporation in a report to the President's Commission on School Finance (Averich et al., (1971:165)) criticized that research by noting that while scholars from several disciplines study educational phenomena, they follow "relatively narrow, intra-disciplinary paths. There have been few attempts to connect these paths; nor is there a clear map down any given path." To develop the complex experimental designs necessary to unravel the puzzles of educational interaction effects, they observe that "it will be necessary to merge the various research approaches."

In summary, it would appear that the research of the past decade related to schooling, learning and teaching has several inherent shortcomings.

1. On the basis of questionable assumptions, schooling research has invariably looked for an average effect rather than isolate and analyze those schools which are unusually effective or ineffective.
2. The research has used measures of resource input as independent variables rather than measures describing their interaction (the teaching/learning interface).
3. The conceptalizations guiding the interaction research have been unidisciplinary and inadequate to account for the very large number of forces operating in a classroom.

Before significant advancements can be made in the understanding of the teaching/learning interface, it will be necessary to integrate the conceptualiza-

tions and to adapt the research approaches of anthropology, psychology, sociology and education into ones which are capable of describing and analyzing the complexities of the educational process. Despite their noteable lack of success in the past, such a task could not be accomplished by other than multi-disciplinary research teams. The in depth study of the teaching/learning interface in outlier schools would provide an unusually interesting and stimulating problem on which multi-disciplinary teams could focus.

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