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ABSTRACT

The relationship between elementary school enrollment and fifth-grade achievement was explored using data from a large urban Missouri school district. The district's 39 elementary schools received uniform allocations of resources from the district and used the same instructional materials but varied considerably in K-5 enrollment, socioeconomic status (SES), and student achievement. Stanford 9 NCE reading, mathematics, language, science, and social science achievement scores were compared for schools having K-5 enrollments of less than 200, 200-299, 300-399, 400-499, and 500 or more. Controlling for SES, as indicated by percentage of students receiving free or reduced-price lunch, statistically significant differences were found among the mean levels of achievement of students in the five school enrollment groups. Smaller schools tended to be in the older inner-city part of the district, while larger schools were found in the newer suburban parts of the district. There was a general decline in achievement as school enrollments increased, for both the inner-city and suburban schools. (Contains 29 references.) (Author/SV)

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ABSTRACT

The study was concerned with the relationship between school enrollment and elementary student academic achievement in a large urban school district. The Stanford 9 NCE reading, math, language, science and social science achievement scores for fifth grade students in K-5 schools with enrollments of less than 200, 200-299, 300-399, 400-499 and greater than 500 were compared after controlling for socioeconomic differences. Statistically significant differences were found among the mean levels of achievement for students in the five school enrollment groups. The smaller size enrollment schools tended to be in the older inter-city part of the district and the larger schools were found in the newer suburban parts of the district. There was a general decline in achievement as the school enrollments increased for both the inter-city and suburban schools.

SCHOOL SIZE AS A FACTOR IN ELEMENTARY SCHOOL ACHIEVEMENT

There are numerous studies concerning the effect of school size on adolescents' school achievement and behavior. The majority of the studies indicate that smaller schools promote educational attainment through creating a cohesive sense of community and facilitate the bonding of students with their schools (Friedkin & Necochea, 1988; Fowler, 1992; Lee & Smith, 1995; Roeser, Midgley & Urdan, 1996). Small schools tend to benefit low SES students more than high SES students (Freidkin & Necochea, 1988; Howley, 1992, 1994 & 1996; Fetler, 1989). Although large schools may provide greater diversity of courses and resources than small schools, large enrollments may detrimentally affect students' learning and engagement in schools (Barker & Gimp 1964; Fowler, 1992; Lee & Smith, 1995). Considering the pros and cons of large and small high schools, Entwisle (1990) believes that a school with enrollment between 500 and 1,000 is ideal for adolescents. However, Monk (1986) suggested a total enrollment of 400 students is sufficient for an adequate curriculum.

Research projects concerning the school size effect on elementary school student achievement are far fewer than for middle schools and high schools. In addition, studies associated with elementary schools are very frequently confounded with studies of high schools. The results of a two year study of the relationship between school size and cognitive learning within elementary and secondary schools implied that achievement in the majority of learning areas has a negative relationship with school size (Eddington & Gardener, 1984a, 1984b, 1985). After controlling for SES, Kiesling (1967) found that math and verbal ability test scores were negatively correlated with elementary school size. In a study of K-12 students reading comprehension, it was found that students' reading ability was positively related to the amount of in-school reading practice, which was negatively correlated with school size (Topping & Paul, 1999). Plecki (1991) and Lenox (2000) also observed a negative correlation between elementary school size and student achievement.

Nevertheless, Caldas (1993) reported that generally neither school size nor class size had any meaningful effect on both elementary and high school achievement for public schools.

Although Caldas (1993) recognized that school size was more determinate of achievement in central city schools than non-central city schools.

Socioeconomic status may be a factor influencing the relationship between school size and elementary student achievement. A hierarchical linear model study of students' academic achievement found that school size significantly affects the relationship between mathematics achievement and individual socioeconomic status (Ma & Klinger, 2000). In a study of individual student achievement, Huang and Howley (1993) also found that small elementary schools in Alaska benefited disadvantaged students more than high-SES students. Howley (1996) also reported similar findings for both elementary and high school students in West Virginia.

PURPOSE OF THE STUDY

The purpose of this study was to extend the previous research concerning the relationship between school size and student

achievement. More specifically this study was designed to explore the relationship between elementary school enrollment and fifth grade achievement as measured by Stanford 9 NCE scores. A secondary goal was to study the interaction between school size and achievement in the various academic areas measured by the Stanford 9.

SOURCE OF DATA

The data are from a large urban Missouri school district with 39 elementary schools. Resources are uniformly allocated to the schools within the district and the 39 elementary schools all use the same instructional materials. However, the schools vary considerably in K-5 enrollment, socioeconomic status and student achievement. Fifth grade building level Stanford 9 NCE achievement scores in reading, mathematics, language, science and social science were employed as measures of the dependent variable. The elementary schools were placed into five enrollment groups to form the levels of the independent variable. The percent of students receiving free or reduced price lunch served as a socioeconomic status indicator and was employed as a covariate in the analysis.

Descriptive statistics for the school measures are presented in Table 1.

Table 1
Descriptive Statistics for the 39 Elementary Schools

Measure	Mean	St. Dev.	Minimum	Maximum
K-5 Enrollment	296.54	130.29	144	636
% F/R Lunch	50.90	27.87	7.4	90.3
Achievement Measures				
Reading	48.45	9.61	27.7	63.1
Math	45.92	10.65	23.4	62.8
Language	47.48	11.16	21.6	64.4
Science	53.83	10.90	24.3	69.6
Social Science	50.09	11.60	24.5	77.4

DATA ANALYSIS

The school measures are all highly interrelated. Table 2 contains a correlation matrix for the school measures.

Table 2
Correlation Matrix for School Measures

Measure	Enrol.	%F/R	Read	Math	Lang.	Sci.	Soc. Sci.
Enrollment	1.00	-.52	.37	.34	.46	.40	.27
% F/R		1.00	-.90	-.89	-.90	-.88	-.84
Reading			1.00	.95	.96	.96	.94
Math				1.00	.92	.95	.94
Lang.					1.00	.93	.89
Science						1.00	.94
Soc. Sci.							1.00

Using df = 35 and two tailed tests, for $\alpha = .05$, $r_{cv} = .325$ and for $\alpha = .01$, $r_{cv} = .418$

The -.52 correlation in Table 2 between K-5 enrollment and % F/R lunch indicates that the socioeconomic level of the schools is negatively related to school size and that the larger schools are in the more affluent neighborhoods. The fifth grade achievement measures are all positively correlated with K-5 enrollment. This implies that the higher achievement levels in the larger schools may be associated with the SES levels of the students within the schools. This negative relationship between SES and student achievement is well documented in the research literature (Alspaugh, 1991; Hanson, 1996; Lucas, 1996). School size and SES are confounded factors in their effects upon student achievement. Table 3 contains the semi-partial correlations between K-5 enrollment and the

Stanford 9 achievement measures with the percent F/R lunch removed from school enrollment. Therefore, SES needs to be removed as a covariate in studying the effects of school size upon achievement.

Table 3
Semi-partial Correlations Between K-5 Enrollment and Fifth Grade Stanford 9 NCE Achievement Measures with the Factor of % F/R Lunch Removed from School Enrollment

Achievement Measure	Semi-partial Correlation
Reading	-.22
Mathematics	-.27
Language	-.02
Science	-.12
Social Science	-.31

For the analysis the schools were divided into five K-5 enrollment groups as follows, <200, 200-299, 300-399, 400-499, and >=500. The school enrollment groups were employed as the between subjects factor in the two factor analysis of covariance. The five Stanford 9 achievement measures served as the within subjects factor. The percent of students receiving free or reduced lunch was the covariate. The results of the two factor analysis of covariance is presented in Table 4.

Table 4
Two Factor Analysis of Covariance with School Size as the Between Subjects Factor, Academic Area as the Within Subjects Factor and Percent F/R Lunch as the Covariate

Source	SS	DF	MS	F	p
Covariate					
% F/R Lunch	13684.12	1	13684.12		
Between Subjects					
Enrollment Group	1021.85	4	255.46	2.96	0.03
Within	2847.45	34	86.29		
Within Subjects					
Academic Area	328.41	4	82.10	11.19	0.00
Enrollment * Academic Area	229.74	16	14.36	1.96	0.02
Within	968.53	134	7.34		
Total	19080.10	193	98.86		

School enrollment had a statistically significant effect on the fifth grade Stanford 9 scores across the five academic areas ($F = 2.96$, $p < 0.05$). The overall original and adjusted achievement means from the analysis of covariance for the five K-5 enrollment groups are presented in Table 5. The elementary schools in the three smaller size groups, <200, 200-299 and 300-399 tend to be in the older inter city attendance areas. The schools in the two larger

size groups, 400-499 and >=500 enrollment groups tend to be in the new suburban areas of the district.

Table 5
Combined Stanford 9 NCE Achievement Scores for the Five Enrollment Groups Before and After Adjustment for % F/R Lunch Rates

K-5 Enrollment	Number of Schools	%F/R Lunch	Stanford 9 Scores Original	Adjusted
<200	7	69.54	46.64	53.80
200-299	18	60.61	45.23	48.96
300-399	6	25.28	55.02	45.23
400-499	3	34.60	56.44	50.18
>=500	5	30.36	55.32	47.44
Total	39	50.90	49.16	49.12

The means from Table 5 are graphed in Figure 1. The adjusted means in Figure 1 show a general tendency for the achievement scores to decline as the school enrollment increases. The shift in the achievement patterns from the three small enrollment groups to the two large enrollment groups reflects inter-city versus suburban attendance areas. The school buildings in the first three enrollment groups are small neighborhood schools built before the development of school transportation, as we now know it. The school buildings in the two larger enrollment groups were built more recently in the suburban areas of the district. The pattern

within the adjusted mean achievement levels in Figure 1 is a reflection of the inter-city versus suburban split within the school district.

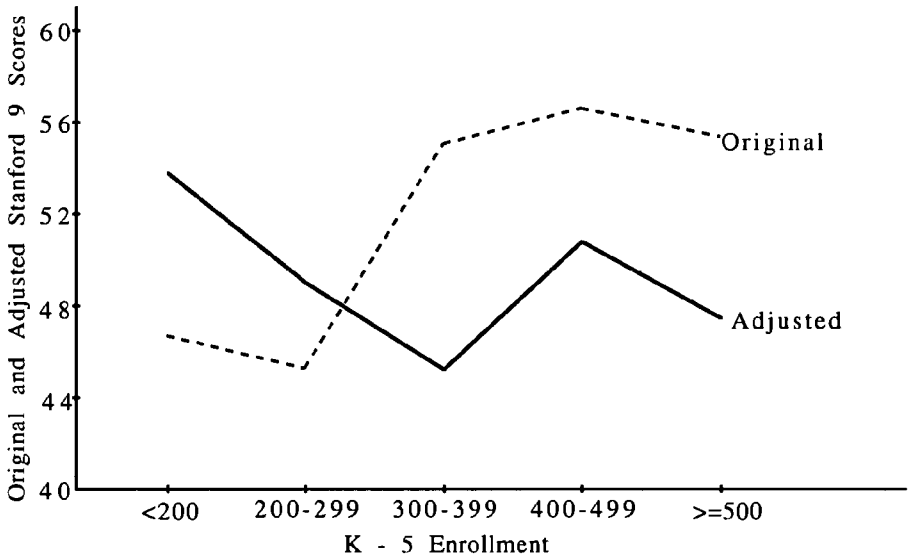

Figure 1. Overall Original and Adjusted Stanford 9 NCE Achievement Scores

Table 6 contains the results of a Scheffee's Post Hoc comparison of the adjusted achievement means for the five enrollment groups. The pairwise differences were only statistically significant between the <200 group and the 200-299, 300-399 and >=500 groups.

Table 6

Post Hoc Comparisons of the Mean Achievement Levels on the Fifth Grade Stanford 9 for the Five Enrollment Groups

Enrollment	<200	200-299	300-399	400-499	>=500
<200		4.84*	8.57*	3.62	6.36*
200-299			3.73	-1.21	4.52
300-399				-4.95	-2.21
400-499					2.74
>=500					

* P < .05

The analysis of covariance in Table 4 also found a statistically significant difference among the means for the five academic areas ($F = 11.19$, $p < 0.01$). The mean achievement was highest for science and lowest for math. The district wide means for the within subjects factor consisting of the five Stanford 9 achievement measures are contained in the bottom line of Table 7.

Table 7
Fifth Grade Mean Stanford 9 NCE Achievement Scores After Adjustment for Percent of Free/Reduced Lunch Rates by School Enrollment

Enrollment	Reading	Math	Language	Science	Soc. Sci.
<200	52.03	51.27	49.41	57.84	58.44
200-299	49.05	45.31	47.60	53.22	49.65
300-399	43.71	43.50	44.02	50.61	44.32
400-499	49.37	46.50	48.47	56.23	50.32
>=500	46.44	43.19	47.93	52.87	46.77
Total	48.12	45.95	47.49	54.16	49.90

The interaction between school enrollment and academic area was also significant ($F = 1.96$, $p < 0.05$). This indicates that students' achievement in the five academic areas varies as a function of school enrollment. The adjusted cell means for the five academic areas and five enrollment groups are presented in Table 7.

The adjusted cell means for the interaction in Table 7 are graphed in Figure 2. The subject means display a pattern similar to that of the overall mean Stanford 9 scores in Figure 1. There was a decreasing trend of Stanford 9 subject scores with increasing school enrollment for both the inter-city and suburban schools. Schools with enrollments less than 200 achieved the highest mean Stanford 9 scores in all the five academic areas of reading, math, language,

science and social science. However, not all of the Stanford 9 scores for the five subjects differed significantly among schools of different enrollment. A simple main effect analysis using an univariate analysis of covariance for each of the five academic areas was performed as a follow-up to the interaction. The results revealed significant differences in Stanford 9 scores for only three of the subjects, reading ($p < 0.05$), math ($p < 0.05$) and social science ($p < 0.01$) among the schools of five different sizes. The lack of significance in language ($p = 0.52$) may be due to the unequal variance among the schools ($F = 2.74$, $p = 0.04$ for Levene's test of equality of error variance). The univariate analysis of covariance also failed to find significance differences among the math scores for the five levels of school enrollment ($p = .19$).

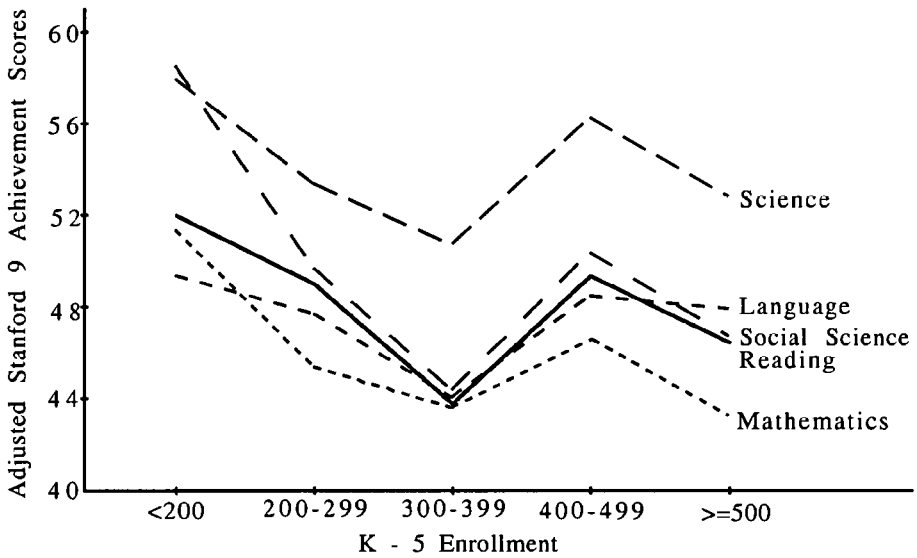

Figure 2 . Adjusted Fifth Grade Standford 9 Achievement Scores By School Size

DISCUSSION

With socioeconomic status held constant, the findings of this study imply that small schools appear to have an academic achievement advantage. This was more evident for schools in relatively impoverished areas than for schools from affluent areas. The small sample size and that the three smallest enrollment groups of schools tend to contain older inter-city schools while the two largest enrollment groups tend to contain newer suburban schools are limitations in this study. Attendance area characteristics and school size are confounded in the study. Results of the confounding

of school size and attendance area characteristics are evident in the patterns of achievement in both Figures 1 and 2. The use of percent free/reduced lunch as a covariate may not have been adequate to account for the older inter-city versus newer suburban school characteristics. The study by Fredkin and Necochea (1988), including both elementary and secondary schools in California, found that students in low-SES communities performed much better in small schools, whereas students in high-SES communities performed somewhat better in larger schools. The findings of Fredkin and Necochea (1988) may be reflected in the pattern of achievement illustrated in Figures 1 and 2. Generally speaking the findings of this study are consistent with the findings of Hung & Howley (1993) and Howley (1996).

The differences among the five academic areas measured by the Stanford 9 and the significant interaction between school size and academic areas may be a reflection of the curriculum implementation within the district.

Considering a wide range of educational inputs and educational outcomes the research of Irmsher (1997), Raywid (1999) and Howley (2000) suggest an enrollment of 350 as the

upper limit for elementary schools to achieve optimal educational goals. The research by Howley (1992, 1994 & 1996) implies that a school enrollment of less than 350 is preferred for low SES students. Sergiovanni (1993) has radically claimed a school enrollment of 300 as the largest size to sustain a true educational community for the betterment of school children. The suggested enrollment of under 200 from this study may be reflected in the short K-5 grade span of the sample schools. Howley, Strange & Bickel (2000) found that high schools can have larger enrollments than elementary schools and still have desirable academic outcomes.

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