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Cognitive Equality and Educational Policies: An Example from Pakistan

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An empirical study of distributions of examination scores within secondary schools in Karachi shows that intraschool inequalities are relatively large. The results of several analyses are consistent with the hypothesis that either schools in Karachi do not care about the equality of their students' cognitive achievement, or if they do care, current policies are ineffective at reducing or widening their distributions of scores.

Studies of cognitive achievement in public schools frequently focus on average levels of performance, as in the question, "What school variables affect a school's average reading score significantly, other things being equal?" However, investigators in the developed countries are beginning to look also at achievement *within* schools. Do some schools consistently have more equality of scores than others? Do certain school variables significantly affect the spread of a score within schools, other factors held constant?

These questions about the quality of achievement within schools are important for educational policy. Schools, like countries, may care not only about the per capita level of "goods" produced, but also about the distribution of those goods. For example, a school may try to have as many students as possible pass the matriculate examination, even if this approach means that fast learners may suffer. There may be a tradeoff between raising average scores and narrowing variability.

Jencks [2, p. 86] has noted that intraschool inequality is important in American schools:

> The range of variation for school means is less than half the range for individuals. In some ways this is the most important and most neglected single finding of the EEOS. It means that if our objective is to equalize the outcomes of schooling, efforts to reduce differences *between* schools connot possibly take us very far.

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Klitgaard [3 and 4] found evidence in the United States that (1) social background factors do not explain intraschool standard deviations very well, in contrast to such factors' well-known explanatory power for school means; and (2) year after year and for different tests, some schools consistently have "tighter" distributions than chance or their socioeconomic compositions would predict. Klitgaard speculates that such schools may be consciously aiming at more equality among their students. Brown and Saks [1] found that school variables were significantly related to the spread of scores. Linn and Burstein [6] review several more recent studies of the intraschool distribution of achievement.

To our knowledge, large-scale studies of equality within schools have not been carried out in developing countries. In this paper, we examine a new data set from Karachi, Pakistan. We find that intraschool inequality is large, that our variables for socioeconomic background and school policy do not explain variations in intrascho o equality across schools, and that a school that is particularly equal on one test is not particularly equal on the other.

DATA ON SECONDARY SCHOOL IN KARACHI

Data were laboriously gathered from a stratified random sample of 207 of Karachi's 348 secondary schools.

The bases of stratification were SES (region), management, and sexual composition. SES (region) is described below. According to management, the schools are of three types: government (schools always operated by the government), nationalized (formerly private schools taken over by the government in October 1972), and private. The sexual composition of schools was all boys, all girls, or mixed (coeducational). It is impossible to estimate from existing data what percentage of the age cohort in Karachi attend school; Pakistan-wide, the figure is 12 percent. Our best guess would be a third of the boys and a tenth of the girls.

Examination scores were gathered from the 1975 tenth-grade tests for humanities and science. These are separate tracks; students taking science do not take the humanities tests. For each subject, a standard essay test is given at every school in Karachi, and the results are graded by the Examination Board.

Our measures of cognitive equality were the standard deviations of science and humanities scores, both before and after adjusting them for non-school background variables like socioeconomic status [3, pp. 22-41]. We wished to investigate the amount of intraschool inequality, whether certain educational policy variables and student background factors explain variations in intraschool equality and whether some schools are consistently more (or less) equal. Because we only analyze cross-sectional data, our ability to estimate the effects of policies is necessarily limited, since trends over time cannot be assessed. A further problem: no commonly accepted theory specifies which attributes combine in which ways to affect student achievement, or how these variables might be measured.

Available data were limited. From each school we obtained the number of students in ninth and tenth grades; the number of teachers who teach in those grades; the numbers of such teachers holding different educational degrees (B.Ed., M.Ed. and others), having first-class degrees at the B.Ed. level, and having more than five years' experience; the percentage of male teachers; and the average salary of teachers. We used this information to calculate for each school the student/teacher ratio and the percentage of teachers having these characteristics of education and experience. From our original sample of 207 schools, 142 schools gave examinations to at least five students in both subjects and had information available on all other variables. These schools were the basis of our analyses.

We also collected two sorts of data on the socioeconomic characteristics of each school's students. In February 1972, the Karachi Development Authority's Master Plan created a detailed socioeconomic map of the blocks in the city. Each block was classified into one of eight socioeconomic categories, one being the lowest, according to an aggregation of four indices: median household income, literacy rate among adults, percentage of dwellings having water and sewerage, and percentage of dwellings with "pucca" and "semi-pucca" construction. We used this map to assign each school in our sample into an ordinal socioeconomic category, "SES (region)". School district officials assured us that most students attend schools in their immediate neighbourhoods, with only a few schools drawing students from broader areas of the city.

Our second socioeconomic variable was based on interviews in 1976 with knowledgeable school district officials from Karachi. We asked these officials to classify each school according to the median income of the households of its students. There were five categories. Officials ranking the same schools were in close agreement about the classifications, but, as in the case of our first SES variable, "SES (income)" is an aggregated proxy variable rather than a pupil-level, direct measurement.

ISSUES FOR ANALYSIS

Is intraschool variation large, compared to the variation in examination scores across all schools? The Examination Board does not calculate the Karachi-wide average or standard deviation for student scores. (The standard deviations of school means in our sample were: Science, 73.6; Humanities, 69.9.) We drew two random samples of 1000 student scores from the schools in our study, one sample for the science test and one sample for the humanities. We computed the mean, standard deviation, and skewness of each sample (Table 1).

We compared these results with the distributions of scores within schools. Figures 1 and 2 given histograms of schools' standard deviations on the two tests. Much of the variability in standard deviations among schools can be attributed to sampling error. Figure 3 shows how standard deviations have less variability

Table 1

Estimates of Interstudent Means, Standard Deviation, and Skewness

Test	Mean	Standard Deviation	Skewness
Science	429.8	126.5	−0.14
Humanities	385.6	102.8	0.15

Note: For large samples from a normal population, the standard error of the standard deviation is $\sigma/\sqrt{2n}$; for n = 1000, about 0.0224σ. Thus, 95 percent confidence intervals for the standard deviation are: Science, 120.9 to 132.0; Humanities, 98.3 to 107.3.

for schools with larger numbers of students tested, as one would expect if in fact all students were samples from a single normal population. To illustrate

STD. DEV.	NUMBER OF SCHOOLS	
50 o	4	****
60 o	8	********
70 o	12	************
80 o	18	******************
90 o	36	************************************
100 o	31	*******************************
110 o	26	**************************
120 o	16	****************
130 o	12	************
140 o	5	*****
150 o	2	**

Avg. = 97.00
s.d. = 21.23

Figure 1
Histogram of Science X Standard Deviations
(n = 170)

STD. DEV.	NUMBER OF SCHOOLS	
20 o	1	*
30 o	0	
40 o	4	****
50 o	9	*********
60 o	21	*********************
70 o	33	*********************************
80 o	41	***
90 o	29	*****************************
100 o	12	************
110 o	8	********
120 o	4	****
130 o	1	*
140 o	1	*
150 o	1	*

Avg. = 79.28
s.d. = 19.69

Figure 2
Histogram of Humanities X Standard Deviations
(n = 165)

this point further, 167 random samples of different sizes roughly corresponding to the actual distribution of the number of students tested in Science were drawn from a normal distribution with $\mu = 429.77$ and $\sigma = 126.48$. The plot

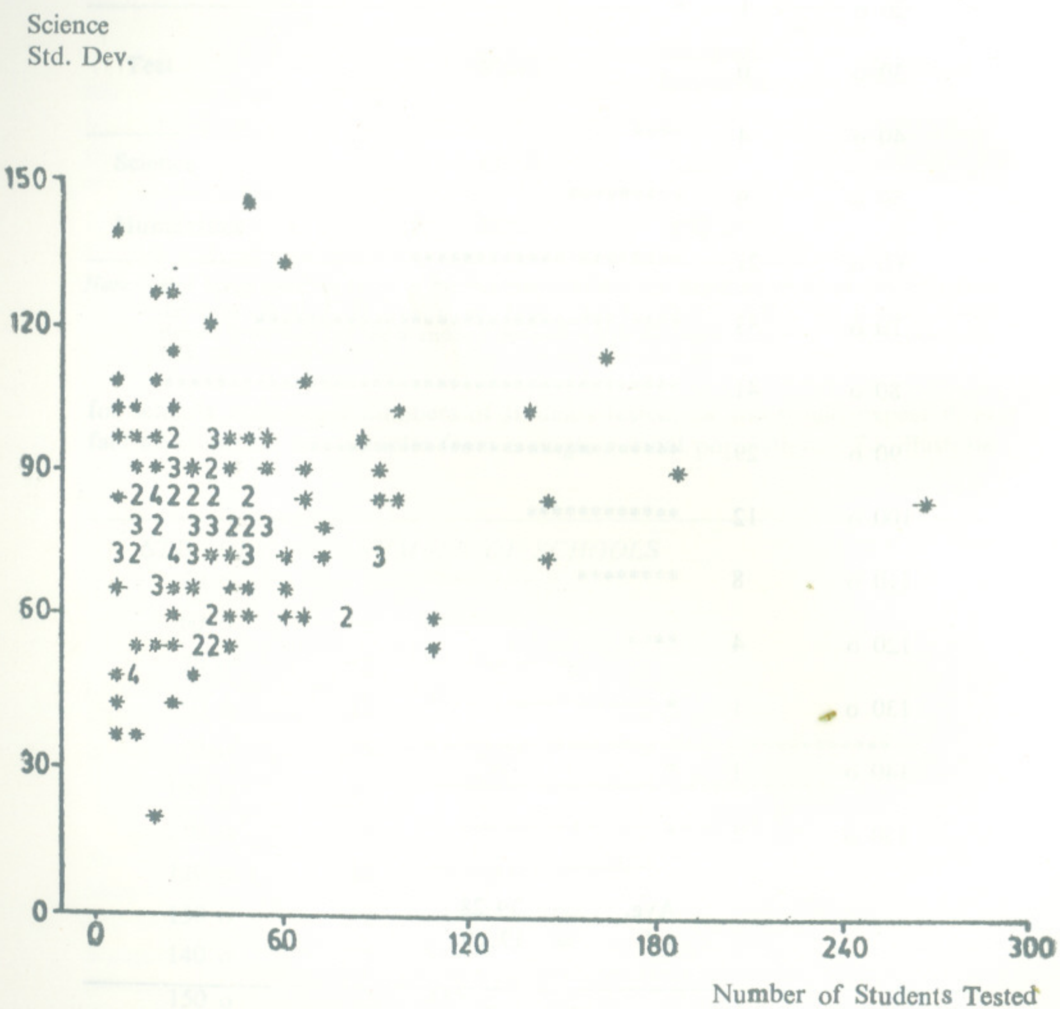

Figure 3

Plot of School Standard Deviations Versus Number Tested, Science

of sample standard deviations against sample size had the same pattern as Figure 3, except the samples had on average larger standard deviations than the actual schools did, and the standard deviation of the sample standard deviations in the simulation was 20.65, compared to 21.23 for the actual schools.

The average standard deviation within Schools for Science was 97.7. This is 77 percent as large as the estimated standard deviation for *all* Karachi students taking the test. For Humanities, the situation was almost identical: the average standard deviation within schools was again 77 percent of the interstudent standard deviation.

Intraschool inequality is therefore relatively large. This finding surprised us: we anticipated that most inequality would be between schools. But as Jencks notes for America, the problem of cognitive inequality is to a large extent within schools, not just between them.

Do school policy variables or aggregate socioeconomic variables explain differences among schools in their standard deviations? Our variables did not. We performed extensive multiple regression analyses with Science and Humanities standard deviations as the dependent variables, using techniques of exploratory data analysis [5, 7 and 8]. We experimented with various combinations of regressors, transformations, and interaction terms, paying particular attention to residual plots in looking for useful models. In effect, we gave these variables every chance to display their explanatory power. No matter which equation we tried, we found only one regressor that was statistically significant beyond the $\alpha = 0.10$ level. (In the model where this variable was significant there was no evidence of multicollinearity, heteroscedasticity, or other statistical problems.)

The only significant variable in any of the regressions was the management of the school. A visual inspection of Table 2 shows that private schools had less variability in Science scores. However, the management variable was not significant in regressions on Humanities standard deviations. Apart from this mild difference between private and public schools on Science tests, we find no support for the idea that our variables for school policies or socioeconomic background are consistently and importantly effective in equalizing (or widening) scores within schools.

Do certain schools consistently have more (or less) equality among their students' scores? If a school is effective in pursuing equality (or in widening scores), we might expect that its standard deviations for the two different tests would tend to be narrower (wider) than those of other schools. We might anticipate a positive correlation between schools' standard deviations on the two tests.

In these data, however, no such phenomenon was observed. Figure 4 depicts the situation. The correlation between the standard deviations was only 0.02, statistically insignificant; the rank correlation was 0.00. (In contrast, the correlation of school average scores on the two tests was 0.78.)

Table 2

One-way Analysis of Variance: Scores of Science Students by Management of School

School Management	Average Score	Standard Deviation of Scores
Government	103.2	21.0
Nationalized	97.9	21.0
Private	84.7	18.2

$F_{2,142} = 6.27$ significant at $\alpha = 0.01$.

CONCLUSIONS

A surprisingly large amount of the cognitive inequality among all secondary students in Karachi was within schools, not between them. To equalize average scores across schools would therefore not mitigate the disparities observed in student learning. In itself, this finding has important implications for educational policy. If one cares about cognitive equality, one cannot simply focus on raising the quality of the poorest schools.

But if inequality within schools is important, do school policies affect it? Our evidence is consistent with, but does not prove conclusively, a negative answer—in the particular context of Karachi's secondary schools in 1975. Not only does none of our variables for socioeconomic background or school policies explain variations in intraschool equality, but no school seems more (or less) likely to provide equality across different tests. A number of explanations may be offered for these results. We hypothesize that either secondary schools in Karachi do not care much about the equality of learning among their students or they do not currently have effective means for narrowing (or widening) differences in achievement among students. Future research, particularly with long tudina data and more precise measures, will be required to verify our conjectures.

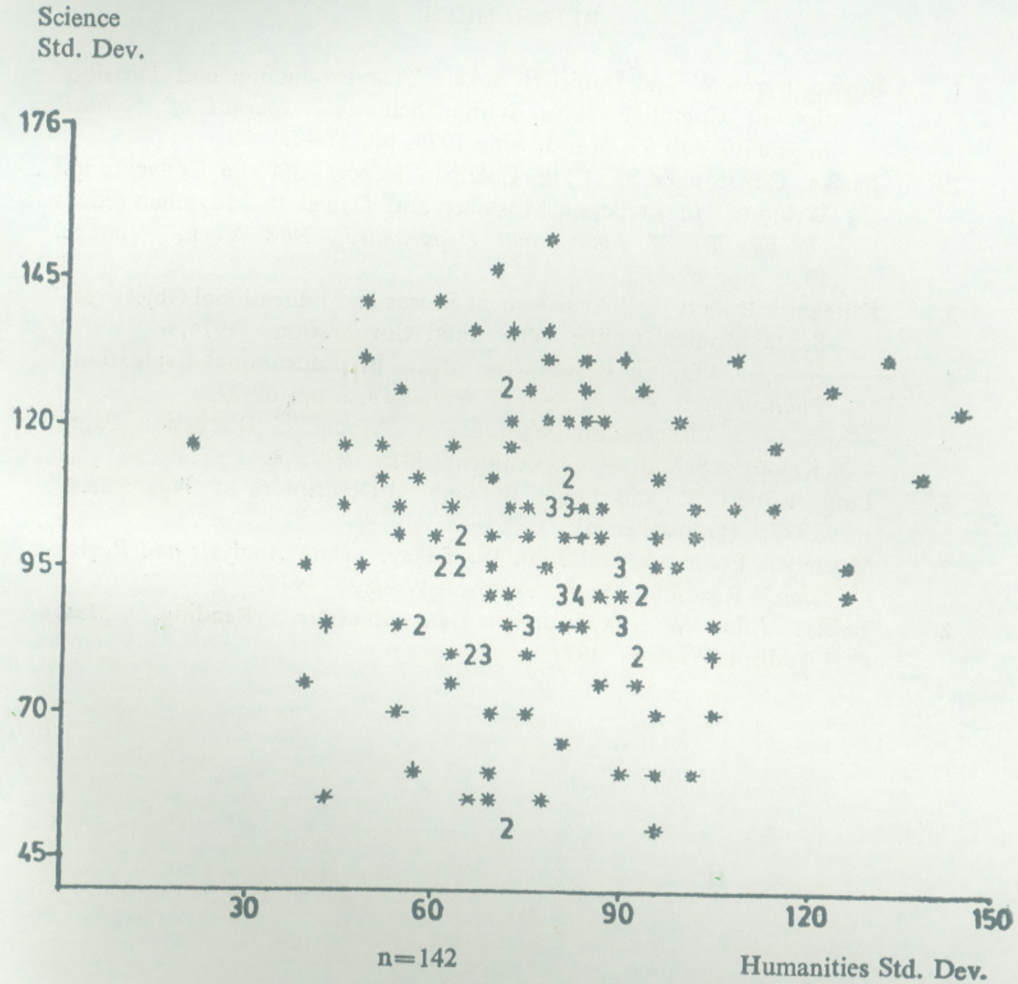

Figure 4

Plot Showing lack of Consistency in School's Standard Deviations for Different Tests

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