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ABSTRACT

By recounting findings from three studies, it is shown that the ecological approach to education has the potential of promoting understanding of relationships between society, schooling, and life opportunities. The ecological approach means that one must attempt to see whether and how the organization of schools, school districts, or national systems of education may transform environmental inputs into aggregate outputs of cognitive attainment. The common assumption that cognitive learning is important in contemporary societies, both for persons and society, leads to an assumption that there are thresholds of learning below which there are very limited chances for a reasonably full share of the society's goods and participation in its institutions. Thus, if we want to foster equality of life chances in the United States, then at the very least we must maintain a system of schools in which the essential elements that affect opportunities to learn and to achieve academically are distributed as equally as possible. Because what transpires in the classroom may have substantial consequences for what and how much students learn, and consequently their positions in society, an ecological view of schooling is necessary. (Author/ND)

NATIONS, SCHOOL DISTRICTS, AND SCHOOLS: ARE THERE SCHOOLING EFFECTS ANYWHERE?

by

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NATIONS, SCHOOL DISTRICTS, AND SCHOOLS: ARE THERE SCHOOLING EFFECTS ANYWHERE?*

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I imagine that my topic seems pretty old hat. Everybody knows the Coleman Report (Coleman, et al., 1966) findings and their robustness. No matter how members of the Harvard Seminar (Mosteller and Moynihan, 1972) analyzed the Report's data, the principal findings were sustained: namely, the main predictors of the academic performance of individual students are not to be found in the school, rather they are in the family and neighborhood (or in the extension of these into the school in the guise of student body composition or friendship networks). We know equally well Jencks' (1972) conclusion that because the relationships between attributes of schools and presumed immediate and ultimate outcomes of schooling--among the latter individuals' income streams especially--are so weak, it makes little sense to think of them as means for equalizing life chances in society. Better to concentrate on making schools nice places to be and turn to other more potent tools to promote equality.

Just the same, I want to reopen the whole question this afternoon. There has been an unfortunate tendency--among social scientists, policymakers, the press and the public--to draw from these findings and arguments the conclusion that investment in education (whether it be money, people, or support) doesn't and can't count for very much. This conclusion was not drawn by either Coleman or Jencks and is fallacious in several ways. For example, if we found that people could learn to swim equally well in any kind of pool, it might make sense to build only simple swimming pools, but not to stop building them entirely.

But this, however valid, is not the issue I want to address. I begin with the assumption that what we nowadays call cognitive learning is important in

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contemporary societies, both for persons and for the society itself. I find it hard to argue against the proposition that one's life chances in a society like ours will be poor unless he has a pretty high level of literacy and numeracy and is pretty knowledgeable about the social, biological and physical processes in his world. Even if the relationships between amounts of cognitive learning and such things as life-time incomes, occupational attainment, or rates and levels of political and social participation aren't linear or monotonic (and I'm pretty sure most of them aren't), there undoubtedly are thresholds of learning below which there are very limited chances for a reasonably full share of the society's goods and reasonably full participation in its institutions.

To document this assertion a bit, Herbert Hyman, Charles Wright and John Reed in a forthcoming book called The Enduring Effects of Education, present convincing evidence (from an ingenious secondary analysis of pollsters' data) that Americans with less than a high school education lack many of the simple items of information (about the polity and the world of work, for example) that seem to be clearly requisite to effective social participation.

Even if one agrees with Randall Collins (1971) that the principal contribution of schooling to adult social destinations is only to certify and allocate, nevertheless within the education system itself, a student's record of academic performance opens or closes doors to the more advanced forms of training that in turn are doorways to occupational attainment and its status correlates.

My point is this--if we do want to foster equality of life chances in the United States, then at the very least we must maintain a system of schools in which the essential elements that affect opportunities to learn and to achieve academically are distributed as equally as possible. This is true even if one seeks equality of educational results--the minimum requisites of learning and achievement must be available to all, whatever may be added on for some.

Similarly for the society itself. Whether one reads, say, Robert Lane (1966) or Carlo Cipolla (1969), he cannot fail to be impressed by the close connections between the efficiency, adaptability and innovativeness of a society and the presence throughout its population of highly-literate, highly-numerate and well-informed persons. It is not just a matter of a sufficient concentration of the educated among elites; rather the requisite is a fairly high level of education, evenly-distributed.

Whether one's concern is for the collective or individual welfare, then, a high prevalence of learning is of no little importance. The question, however, is whether schools provide an effective means to bring about this pattern of attainment. Schooling may not be a potent tool for redistributing income, but is it a potent tool for equalizing even educational life-chances themselves?

On their face, the Coleman findings say no. Whether one alters the money spent, the quality of the teachers hired, the number of volumes in the school library, the availability of science laboratories, or whatever, students' rates of learning apparently are little affected. The principal tool for intervention seems to be the class and ethnic composition of the school's catchment area--a tool that has proved to be remarkably unwieldy.

Now measures of curriculum and teaching methods are notably absent from the array of variables in the Coleman Report equations. Consider, though, the recent work of John Carroll and Benjamin Bloom on Mastery Learning and of Michael and Lise Wallach on tutoring in basic reading skills. Especially when coupled with the findings of Wiley and Harnischfeger (1973) that adding a simple measure of amount of exposure to schooling to the Coleman Report equations markedly increases the variance in students' attainments attributable to school, the work of Carroll, Bloom, and the Wallachs gives pretty strong evidence, not only that students will not learn what they are not taught (whether by a schoolteacher or in some other way), but that they probably learn as a function of amount of exposure and opportunity-to-practice.

In short, what transpires in the classroom, between students and teachers, student and student, and student and curriculum may have substantial consequences for what and how much students learn; the Coleman Report and similar studies have not probed very much into classrooms and curricula.

To return to the theme of equality, is there any way to insure that exposure to favorable classroom environments and curricula is more than fortuitous--or to insure that good teaching and good curricula do not become, or remain, a mark of privilege? Can school organization by virtue of its effects on the probabilty that students will encounter fostering classrooms and curricula, be an effective instrument of policies for equality of educatonal life chances?

An interest in the organization of schooling and its relation to the distribution of educational life chances implies an ecological view of schooling--an attempt to see whether and how the organization of schools, school districts, or even national systems of education may transform environmental inputs into aggregate outputs of cognitive attainment, that is, certain levels or distributions of attainment within successive cohorts of students.

Neither Coleman and his collaborators nor any of the other investigators whose findings on school effects have been so consistently negative has taken an ecological approach. For Coleman <u>et al.</u>, for example, the concern is to explain the attainment of individual students. Moreover, they took the school as essentially a closed system, acting, as it were, without any constraints upon or stimuli to its operations except those imposed by its own properties (such as the racial or social class compostion of its student body or the average verbal ability of its teachers).

It seems strange to me that those of us who have been concerned with schooling as an instrument of social policy have been preoccupied with the antecedents of individual rather than aggregate academic performance. To foster students' life chances we must remove situational barriers to their performance. In the absence of a utopian wealth of resources, to do so requires that we structure school situations so that on the average for a given cohort of students, these barriers are low. In short, we must be interested in the situational (or social organizational) properties of schools, school districts, or national systems that are correlated most strongly with variation in the probabilities of attainment within student cohorts.

Social scientists, nevertheless, have been taught to be wary of ecological approaches, of the "ecological fallacy." While it is true that ecological correlations can underestimate individual variability (and lead us to erroneous conclusions about relationships between ecological properties and the behavior of individuals), it also is true that individual-level correlations can underestimate aggregate differences in rates or patterns of behavior. To fail to see and apply this principle is, in logical terms, a fallacy of composition.

It is hardly surprising that individual differences in behavior (such as academic achievement or learning) are more powerfully explained by individual differences in personally-intimate and more long-standing characteristics--for example, those associated with family and kin networks--than they are by more global and less enduring environmental properties. Nevertheless, in a sense such individual and aggregate phenomena form two separate and non-comparable classes; to judge one by the other seems inappropriate.

In the present case, our interest is not in explaining individual levels of achievement, though this is valuable knowledge for other purposes. We are after properties of educational organizations (schools, districts, or national systems) that have noticeable effects on probabilities of attainment and can be altered in the interest of social policy. Therefore, we must find out how the organization of schooling intervenes between environmental inputs from the school's catchment area, the district's community, or the nation and outputs of learning. In this way, we will learn how in the aggregate educational life-chances may be altered.

At the risk of being tiresome, let me stress that the question is not to explain as fully as possible (or to foster as much as possible) the learning of individual students. This question is of a different order than the one I am addressing here. To answer it requires individual-level analysis; to act on the knowledge obtained presumably would require individual attention to students within the classroom (such as the Wallachs' tutoring program for teaching basic reading reading skills) and some kind of intervention as well in the extra-school situations of these students.

Rather, the present question is to discern the ecological correlates of intra-cohort rates and distributions of learning, to interpret them as indicators of the consequences of school attendance on the probabilities of varieties of school learning for a student cohort, and then to use this knowledge to keep these probabilities as high as possible through organizational means.

This ecological approach need not regard entire student cohorts as undifferentiated. One can estimate the ecological correlations for the whole cohort or separately for any part of it--males and females, whites and non-whites, and so on. But, again, the phenomenon to be explained is not how sex or race, as individual traits, affect learning, but whether the ecological correlations and therefore the probabilities affecting rates and patterns of learning differ between the sub-cohorts of male and female or white and non-white students. The policy objective is to increase the precision of intervention into the organization of schooling.

Because ecological variables affect aggregated individuals, while an ecological variable may not have strong effects on individuals, these small effects nevertheless, may cumulate into relatively large effects at the aggregate level. So, for example, while having a well-trained or competent teacher may account for only a small proportion of the variance in an individual student's achievement (either absolutely or in comparison with other traits of individual students), nevertheless the cumulation of such small effects may result in stronger ecological correlations. This difference between individual and ecological correlations has substantive significance. It means that ecological correlations--in the present case correlations between properties of educational organizations and rates or distributions of learning--can indicate whether barriers to learning have been lowered for an entire cohort (e.g., a fairly even rate of learning right across the cohort) or differentially for some of it (e.g., more rapid gains near the top or bottom of the cohort distribution, or for white or non-white sub-cohorts). The bearing of this information on such issues as providing for threshold-equality in chances to learn or assuring a wide distribution of literacy, numeracy and knowledgeability in a population is obvious.

In the remainder of this address, I should like to draw on some of my own research and that of two economists, Byron Brown and Daniel Saks, to illustrate the ecological approach to the study of the effects of schooling. During the past year, working with a sociologist-colleague, John Kasarda, I completed a study of the educational effectiveness, for the school year 1969-1970, of the 178 K-12 school districts in Colorado (Bidwell and Kasarda, 1975). Kasarda and

I began with the simple notion that any organization (including an educational organization) can be viewed as an arrangement of human activity to transform environmental inputs into outputs (goods or services of whatever kind). If so, the particular organizational forms that one observes in school districts should vary with the inputs that they receive from their environments. These forms also should interpret observed correlations between these inputs and the districts' outputs (e.g., rates and distributions of academic achievement).

As I have said, this ecological approach can be applied to any level of educational organization. The Coleman Report and the subsequent studies of schooling effects have been concerned with the properties of schools, treated in the analyses, however, as if they were properties of students themselves. We chose the district, believing that the local school may not be an especially productive unit for ecological analysis.

There are several reasons for this belief. First, there is little variation between schools in the morphology of administrative control (e.g., its relative centralization), more between school districts. Second, budget-making, which affects such things as the differential allocation of resources between functions or between schools, is a central-office and school board responsibility. Third, the supervision of teaching and the work of such specialists as counsellors or therapists often is conducted district-wide. Fourth, one important component of the specialization of instruction--the specialization of schools--pertains to the district.

In point of fact, preoccupation with the school, as well as with the correlates of individual differences in learning, may have resulted in the neglect of the ecological approach (and dependencies among environmental and organizational variables) so characteristic of school effects studies. For example, the very fact that fiscal resources are initially received and allocated at the district level may have led investigators to ignore imparities in the allocation of resources across schools within a district and ways in which this budgeting may affect variation in the staffing, structure and activities of schools, measured as district properties.

Nevertheless, the more important shortcoming of the earlier work, we thought, was the failure to explore ways in which the organization of schooling may intervene between inputs and aggregate outcomes. We required a specific model of this organizational mediation, and the model we used is shown in this figure. The model is a simple one, partly because our ideas are not complicated, partly because of limitations in the data available to us from the Colorado State Department of Education.

Notable among these limitations is the fact that our data are cross-sectional, while a full-scale ecological analysis would be concerned with change: in the environment, in organizational patterns and within and between cohorts, in rates and distributions of students' attainment. Another important limitation is the absence of data about inputs of student ability to the Colorado districts, a limitation we hope is partly overcome by data about the socio-economic and educational levels of the parental risk populations of the districts' communities.

The relationships shown in our model follow from certain assumptions about the characteristics of instructional technology, the goals of schooling and the legal and policy framework of public education in the United States. We assume that instructional technology is primitive, uncodified and labor intensive, with the teacher at the focal point of the work process. Moreover, school districts must enroll all students who present themselves, while in the short-run they can do little to alter tax rates, property valuation, or the amount of state aid. Hence the principal means available to a school district to adapt to varying amounts or qualities of student input is to raise or lower the ratio of teachers to students (within the limits of union contracts and beliefs about optimal class sizes). As enrollments grow, school districts in the short-run must move fairly quickly to ration their teachers.

We assume that the goals of public education are vague and often subject to a good deal of disagreement within a school district's community. There is no clear or widely-accepted evidence of relationships between students' attainment and either curricular or teaching methods. Consequently, school districts are highly vulnerable to parental and community preferences about, for example, teacher qualifications, the availability of student services or curricular "innovations." So, too, as school district income grows, it is likely to be invested relatively heavily in such things as numerous, well-trained teachers or support specialists, independently of the size or quality of student input. The vagueness of educational goals also implies that when a school district judges that its student input will be difficult to teach, it is likely to respond by hiring the best-qualified teachers it can find, by adding to its staff of professional specialists (e.g., remedial reading teachers), and by adding instructional "innovations" thought to promise more effective teaching. (If it does not do these things, our model suggests, the constraining factors will be the availability of revenues, the perceived need to add sheer numbers of teachers, or the lack of community support for such efforts.)

Looking now at the figure, we had available four measures of school district organization: PTRATIO, the ratio of the total number of students in average daily attendance to the total number of classroom teachers (in full-time equivalents)" QUALIF, the proportion of all certificated personnel with at least the Master's degree (a rough measure of the aggregate professional qualifications of the teaching staff); PROF, the ratio of all professional support staff (e.g., remedial reading teachers and counsellors) to the number of classroom teachers (in FTE); and ADMIN, the ratio of the total number of administrators (excluding clerical staff) to classroom teachers (in FTE).

There also were five environmental variables for which data were available: SIZE (the total average daily student attendance); RESOURCES, fiscal resources (the total annual district revenue per ADA); DISAD, the proportion of all school-age children from families that were below the Census-defined poverty line; and EDUC, the proportion of males 20-49 years old and females 15-44 years old residing in the district (the parent risk population) with at least four years of high school education. (The fifth variable, PNONW, the percent of the district's resident population classified by the Census as non-white, served as a disturbance term rather than an exogenous variable because Census category, "white," includes Spanish-speaking persons, who in Colorado contribute a large proportion of the pupils in the public schools of low measured ability and from low-income families.)

Most of the predicted relationships between the environmental and school district variables follow directly from the assumptions that I have just outlined: the rationing of teachers given high enrollment, the responsiveness of teachers' qualifications and the relative size of professional support staff to fiscal resources, perceived difficulties of instruction and parent/community demand (the second of these variables presumably indexed by DISAP, the third by EDUC).

In addition, in view of the simple organization of teaching in most school districts (the low interdependence of schools, classrooms and, in the high school, subject-specialized teachers), we expected school districts to accomodate increasing enrollments without notable increases in coordinative problems, even lowering the intensity of instructional supervision without immediately visible results. Hence the predicted negative effect of district enrollment on administrative intensity: We also expected that larger communities (for the most part those with large enrollments, given Colorado's K-12 districts), having larger teacher recruitment pools and better inducements to offer teachers, would attract more highly-qualified teachers than smaller districts. Thus the positive relationship between teacher qualifications and district enrollment.

As measures of school district output, we were able to use median grade-standardized achievement test scores in reading and mathematics for high school students, RACH and MACH. If our ecological approach were valid, none of the environmental variables (except for the disturbance term, PNONW) should have a direct effect on either of these median scores.

Though our ecological notions said otherwise, intuitively we were not at all sure that any of the school district variables would have more than trivial direct effects on these scores. If any were observed, however, we expected them to be those shown in the figure. Given the labor-intensive, uncodified, technically primitive character of teaching we expected teachers' own instructional skills, roughly measured by teachers' qualifications and the per-pupil shares of teachers' time, to be positively related to students' achievement. (To be sure, classroom skills and qualifications are very imperfectly related and, given our assumptions, are likely to reflect idiosyncratic elements in teachers' work.)

As for the relative size of the professional support staff, we expected only weak positive effects given that many of these staff do not work directly with students or with any large propotions of them, may not be used effectively by teachers, and do not perform services directly pertinent to academic achievement (e.g., school nurses or vocational counsellors).

Finally, from the low interdependence of academic units within school districts, it follows that the principal contributions of administration to school district effectiveness will occur in non-academic areas, with the possible (and in our study untestable) exception of the supervision of instruction. So, given the short-run inelasticity of school district revenues, administration should divert resources from instruction at a rate not overcome by its contribution to instructional effectiveness. Hence the predicted negative effect of administrative intensity on students' achievement.

In our data analysis, we used the Simon-Blalock method, supplemented by path-analytic decomposition of the zero-order relationships between the environmental variables and the two median achievement test scores. The results were encouraging, in almost all cases consistent with our model. Table 1 shows the pattern of environment-school district organization relationships that we had predicted, except for the weak correlations between non-fiscal inputs to the Colorado districts and the proportionate size of professional support staff. In short, while socio-economic characteristics of a school district's population influence staff qualifications, they have no significant direct effects on the formal structure of the districts. Structure is responsive only to enrollment and revenues. (As we had expected the percent of non-white population influenced none of the district variables. Indeed it was not even moderately correlated with the other environmental variables).

Table 2 shows the standardized partial coefficients for the regression of each of the two median achievement test scores on the four school district variables and the disturbance term. Again our predictions are generally confirmed; the exceptions are the non-significant effects of qualifications on mathematics achievement and of staff support on both achievement measures.

Next we regressed the reading and mathematics scores on each environmental variable, controlling for the four district variables. If there were no measurement error and our predictions were correct, the partial regression coefficients should be zero. Table 3 shows that indeed none of the coefficients is statistically significant and all except for the relationship between parental education and mathematics achievement approach zero.

As a final step we computed the effect parameters, using the full model, and decomposed the pertinent correlations into direct and indirect effects and joint associations. Table 4 shows the results. This table reveals the strong indirect influence of fiscal resources on achievement levels. While attention only to the direct effects would lead one to infer that resources had little impact on achievement, the indirect effects show that by influencing the structure and staff qualifications of the school districts, resources did have a substantial impact. The indirect effect of this variable results primarily because it lowered the number of pupils per teacher and raised staff qualifications.

School district size, on the other hand, has virtually no net effect on reading or mathematics achievement levels. Not only are its direct effects fairly small, but size has opposing indirect effects on achievement. While it improved achievement especially by decreasing administrative intensity and raising staff qualifications, large size lowered achievement levels by increasing pupil-teacher ratios.

Median school district scores for neither reading achievement nor mathematics achievement were independently influenced by the proportion of students from economically disadvantaged families. Note that both the direct and indirect effects of this variable are negligible. The negative zero-order correlations between the proportion of disadvantaged students and reading and mathematics achievement resulted primarily from the association of this variable with other environmental conditions that influenced achievement.

While the total effects of the educational attainment of the parent risk population on reading and mathematics achievement are of similar magnitude, the causal patterns differ. This variable had only a slight direct effect on reading achievement but a much stronger direct effect on mathematics achievement. Conversely, parental education affected reading achievement positively through its influence on staff qualifications, while this indirect effect was negligible for mathematics achievement.

Education of the parental risk population is very likely a proxy for a variety of family and community attributes that influence academic achievement (for example, the proportion of families providing high levels of cognitive stimulation to children or the availability of books in public libraries). That this variable had only a slight direct effect on reading achievement, therefore, is unusually strong evidence of the association between the staff qualifications and the academic output of the Colorado school districts--the more so since the level of qualifications of the certificated staff is no more than an approximate indicator of teachers' competence. The findings for mathematics achievement are more what one might have realistically expected a relatively strong direct effect of education of parents and a modest direct effect of staff qualifications.

Decomposition of the correlation coefficients supports our prediction that percent nonwhite should affect achievement levels independently of other variables in the model. Controlling for the other eight independent variables, the standardized partial regression coefficients between percent non-white and median reading and mathematics achievement scores are of essentially the same magnitude as the zero-order correlations.

To sum up, Kasarda and I believe that these findings should encourage use of the ecological approach to analysis of the effects of schooling. Our

Colorado findings suggest that school districts display structural and staffing properties that are responsive (in the short-run at least) to the inputs of resources, students and demand that they receive from their immediate community environments. There is no reason to suppose that a different order of results would have obtained had we broadened the definition of environment that we used (for example, to include national or regional networks for the diffusion of educational R & D).

These school district properties in turn mediate the effects of inputs on outputs of student achievement. It is not what kinds or amounts of resources school districts have but how they allocate and order them that makes the difference in students' aggregate achievement, though resource input constrains the organizational responses that districts make. Other constraints and stimuli to district adaptation came from population characteristics that probably indicate varieties of student inputs and the political environments of districts (which demands of a district's local constituencies are expressed, with what force and unanimity). When large numbers of students are to be taught, we observe the rationing response, moderated only when revenues are sufficient to allow additional teachers to be hired. Here a constraint not included in our model is the pervasive one-teacher-one-classroom organization of teaching. Truly effective curricular or other technological innovation in instruction might provide very different responses to varying enrollments.

Finally, the direct and indirect effects that we found were not trivial. They suggest that when aggregate rates of student achievement are at issue, school district organization may indeed have notable consequences for the educational life chances of student cohorts--effects that are separate from the out-of-school environments from which the students come.

Now we need reliable, replicated findings.. Our Colarado study is, indeed preliminary. We had no over-time data, no data about inputs of student ability, no estimated parameters for sub-cohorts of students and information only about rates of achievement, not its distribution.

Still and all, findings similar to ours (though with output measured much earlier in the school grades) have been produced by another study and extended to show effects of school district attributes on the distribution of students' achievement. Two economists, Byron Brown and Daniel Saks, using 1970-71 school district data from the Michigan Educational Assessment Program, estimated the parameters of a model roughly like ours, employing both the means and standard deviations of a composite 4th-grade achievement test score to estimate district effects--hence effects on the pattern as well as the level of students' attainment (Brown and Saks, 1974). (The composite score is based on reading, language, and mathematics tests administered annually in all Michigan public schools to all students in attendance on the testing day.) The study includes all the K-12/grade 4 and grade 7 school districts that were in the state in 1970-71. Moreover, in contrast to my study with Kasarda, Brown and Saks estimated the effect parameters in their model separately for city, suburban and rural and small-town districts.

Brown and Saks found very interesting distributional effects of certain school district attributes. To quote from their report: "...it seems true that experienced teachers have particularly strong effects everywhere. [They included average years of experience in addition to student-teacher ratios and the proportion of teachers with the Master's degree as the district variables in their model.] Since they both raise the mean and lower the standard deviation everywhere, their net effect is to improve the worst students. The same effect holds, but less powerfully, for teachers with masters degrees and for teacher/student ratios in town and rural areas and in cities. Masters degrees and better teacher/student ratios increase the standard deviation in suburbs, but the mean is relatively unaffected, so it is hard to conclude that the better students are more improved unless the worst students are actively hurt (or make less than normal progress)." (p. 19)

These effects, moreover, were net effects, after Brown and Saks had controlled for the socio-economic status of the 4th grade cohorts in the Michigan districts and for their racial composition. They did find large direct effects of these variables on the test score means and standard deviations for the Michigan districts, in contrast to our Colorado finding for parental socio-economic status. (This difference may be the result of any of several variations in the design of the two studies--especially the different school grades at which achievement was tested and different bases for computing the socio-economic variables.) Nevertheless, the direct effects of socio-economic and racial composition and those of the three district attributes, were additive; Brown and Saks found no significant interactions between either socio-economic or racial composition and any of the school district variables. Evidently the properties of the school districts that Brown and Saks measured did indeed contribute to 4th grade attainment independently of the composition of these 4th grade cohorts. Brown and Saks did not investigate the bearing of environment on school district organization, but I suspect that had they done so the findings would have been similar to ours for Colarado.

Their success in using school district variables to predict distributional outcomes of schooling raises two important issues. The first is the apparent impact of school district organization on the equalization of educational life chances. With the exception of the suburban districts, the more experienced the teachers, the better their qualifications and the more favorable the student-teacher ratios, the more likely were poorer students to do better, but without marked effects on the attainment of better students. The suburban exception underscores the importance of further work to reveal the processes underlying these ecological relationships and here we may find a fruitful complementarity of the ecological and individual approaches.

The second issue, which Brown and Saks themselves raise, is the need to disentangle the results of what they call "technology and taste," or what I would call technology and policy. In the Michigan data there is an apparent trade-off between effects on the mean and on the standard deviation in the allocation of experienced teachers. But there is no way with the Brown-Saks data to tell the extent to which this trade-off reflects the efficiency of experienced teachers with the poorer students or preferences by school districts for allocating them to these students. In the model that Kasarda and I used, we intermixed technology and policy (e.g., our assumptions that well-trained teachers would be effective and that districts with high proportions of students of low ability would try to hire teachers with high qualifications).

Probably the school district effects that Brown and Saks observed in Michigan and that Kasarda and I found in Colorado reflect both technology and policy. The important problem is to disentangle the productivity of the various "factors" of the organization of schooling from the way these factors are allocated--and to do so for specific sub-cohorts. For example, are well qualified or experienced teachers as productive with non-whites as with whites or with older as with younger pupils? How productive in each case? At given levels of productivity, are these factors allocated so that they are more or less available to those students more (or less) able to profit from them? Clearly there may be interesting interactions of factor productivity and allocation as they affect the aggregate outputs of school districts. Once we know about these things, policy can be a more deliberate instrument of preference--for equality of educational life chances, for maximizing the chances of the most able, or whatever.

I have suggested that the ecological approach is potentially applicable to the several levels of schooling organization. I also have suggested why I think it less likely to be useful with schools, as they are organized in the United States, than with school districts. But what about national systems? The questions that I have raised about relationships between the organization of schooling and the educational life chances of student cohorts surely are central to the comparative analysis of national systems of education.

Another sociologist-colleague, William Cummings, and I now are trying a first probe to see whether a model similar to the one Kasarda and I used in the Colorado study also is useful with cross-national data. I would like to share some of the first findings with you. They are encouraging.

The data we used came from the International Study of Educational Achievement. In this carefully-designed study, specially constructed tests of achievement in reading, mathematics, science, foreign language, literature and civics were administered in the late '60's and early '70's to students in from 12 to 18 countries. (Some of the tests were administered in more countries than others.) These tests were given to samples of students, stratified by school type, selected at up to three pupil age levels (again there were variations depending on the test): 10, 14, and in the last year of full-time secondary school.

In addition to the tests, data were collected about the students; their families; the organization, curriculum and staffing of their schools; and about the sampled countries. The student, family and school data can be aggregated to form country-level measures, and these and other data about these countries supplemented from published censuses and surveys.

To date we have limited ourselves to the science test scores as measures of learning, using the middle-school score as the measure of output and the primary-grade score as a measure of inputs of student ability and achievement. We chose the middle school score means as our output measures because school-leaving tends to be fairly low in the sampled countries up to this school level. Of course, the sample size severely constrained the degrees of freedom in our analysis; the N for the science data is 18.

We were able to obtain measures of several attributes of the 18 national systems of education (limited to attributes of the middle schools): the mean student-teacher ratio, the ratio of auxiliary personnel in science (e.g., laboratory assistants) to teachers in this area, the proportion of science teachers holding a university degree in a scientific field, and an index of the emphasis given to science in the middle school curriculum.

We tried a number of measures of national attributes, though only a few could be entered in any one equation: the per capita GNP, the proportion of the total labor force in non-agricultural employment, the proportion of the total population living in urban places, the mean years of mothers' education, the mean prestige scores of fathers' occupations, the proportion of the pertinent age cohorts in school, the proportion of the GNP invested annually in education, the total middle school enrollment, and the rate of growth in this enrollment for the five years preceeding the administration of the science tests.

Our working hypothesis paralleled the Colorado study: that attributes of the educational systems would interpret zero-order correlations between national attributes and science achievement scores. In other words, we expected the educational system to transform inputs of resources, pupils, and correlates of the socio-economic characteristics of the middle-school parent population into outputs of science achievement.

The results that we have obtained so far have been more favorable than we realistically had anticipated. Our analysis is a little complicated because of the constraints of sample size, but I can describe the main findings. No matter what combination of national characteristics and educational system variables we used (never more than six in one equation, always including the primary school science mean), three of the four system variables have strong effects on the middle-school science means: the student-teacher ratio, curriculum emphasis on science, and teacher qualifications. The effects of the first two are particularly strong. (Because of the small sample size, we decided to regard only standardized regression weights of .3 or more as worth attention. In most of our equations, the coefficients of these three system variables were a good deal larger than .3.)

In contrast to the Colorado district findings several of the exogeneous variables, here the measures of national attributes, continued to have strong direct effects on the science test means when the educational system variables were controlled, but these effects were substantially smaller than their net effects when the system variables were not in the equations. Per capita GNP, the proportion of non-agricultural employment, the level of maternal education, and enrollment growth were especially potent predictors among these variables. To be on the safe side, we ran two sets of equations, in one set forcing the national attributes to enter first, in the other, forcing the system variables to enter first. The differences between the two sets of estimates were slight.

There was an unexpected finding that led us to discover still other unanticipated, but quite interesting patterns in the data. The coefficients for student-teacher ratios were positive, rather than negative as we had predicted. Was it in fact true that the more teachers per student, the poorer the country's middle-school science mean? I won't bore you with all of the dead-ends we encountered, but we did find that the relationship between student-teacher ratio and the science score means (adjusted for the other more powerful variables in our model) was curvilinear. When we plotted this curvilinear trend, we found that among the less-developed countries in the sample, the relationship between student-teacher ratio and achievement was indeed negative. But it was positive for the economically-developed nations. Pursuing this lead, we found for the latter countries a strong statistical interaction between student-teacher ratio and curricular emphasis on science. When this emphasis was great, students performed better if the ratio of students to teachers was high than if it was low. When emphasis on science was less, they did better if the ratio was low, but the difference was not as marked.

What can we make of this finding? In the less-developed countries student-teacher ratios are consistently high, higher than in all but one of the developed nations. It seems likely that there is a threshold above which student-teacher ratios erode students' chances to achieve (at least in science), no matter how much stress the curriculum gives to science or how well-trained the teachers are (though the meaning of our teacher qualifications measure obviously varies a great deal across countries).

In the developed countries, perhaps a relatively heavy investment in teachers, which generally would occur below this postulated threshold, is a drain on the resources of educational systems when the curriculum gives sufficient opportunity to learn. In other words, the returns from this investment in teaching, net of the returns from curricular emphasis, may not be great enough to offset the returns foregone from alternative uses of the amounts invested--just as we postulated insufficient returns to instruction from investment in administration among the Colorado school districts.

Finally, I should note that the observed relationships between national attributes and the educational system variables were those most of us, I think, would have expected. Among the stronger of these, countries with higher levels of economic development, had more highly-educated populations, lower student-teacher ratios and better-trained teachers, gave more emphasis to science, and hired proportionately more auxilliary instructional staff. Countries that had experienced more rapid enrollment growth had higher student-teacher ratios and tended to employ less-qualified teachers. They also tended to use proportionately larger numbers of auxiliary staff.

These are not definitive findings. The analysis necessarily was constrained by the sample size, and we have more work to do--both with the science score data set (including an analysis of correlates of test score distributions) and to extend our analysis to other of the measures of student achievement. As in the Colorado study and the Brown-Saks Michigan Study, our national data are cross-sectional and, with the exception of enrollment growth, do not allow us to consider interrelations of change in national attributes, educational systems, and rates or patterns of academic achievement. But again they point to the usefulness of the ecological approach. I think we see in these data certain indications of the effects on students' educational life chances of the ways in which national systems of education are structured and the kinds of teachers they employ. We see evidence of the strong constraints on these systems imposed by the economic and demographic attributes of the nations they serve.

Even more, we see that such national attributes as economic development may have less-than-obvious consequences for students' educational chances because of the action of educational systems. To take just one example, countries with more highly-developed economies, compared with those with lower GNP's or a more heavily agricultural labor force, tend to give science stronger emphasis in their middle-school curricula, but they also employ more teachers per student and invest more heavily in auxiliary instructional staff. We have seen that among the developed countries science emphasis fostered aggregate achievement, while this effect was reduced by apparent over-investment in teachers. Furthermore investment in auxiliary staff had little effect, positive or negative, on the science means. As a result, the more-developed countries are simultaneously raising and lowering the opportunities of their students for science achievement--through these several investments in schooling, each of which on its face would appear to be good.

We also see in these cross-national data the strong constraints imposed by demographic change on systems of education. Those nations in our sample that had encountered rapidly-growing enrollment were concentrated among the poorer countries (not only the LDC's). Our findings suggest that if such countries wish to maximize the aggregate academic effectiveness of their schools, it makes better sense to move toward a centralized curriculum that will ensure adequate exposure to the preferred subject-matters than to increase the proportionate investment in teachers. If there is to be heavier investment in teachers apparently it is better made in training than in numbers.

I hope that by recounting some of the findings from these three studies I have convinced you of the potential that the ecological approach holds--for understanding connections between society, schooling, and life chances. Much work, as I have said, is still to be done. Until then, judgments about the impotence of schooling and about its irrelevance to major issues of social policy are clearly premature.

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FIGURE 1

A MODEL OF SCHOOL DISTRICT ORGANIZATION AND STUDENT ACHIEVEMENT

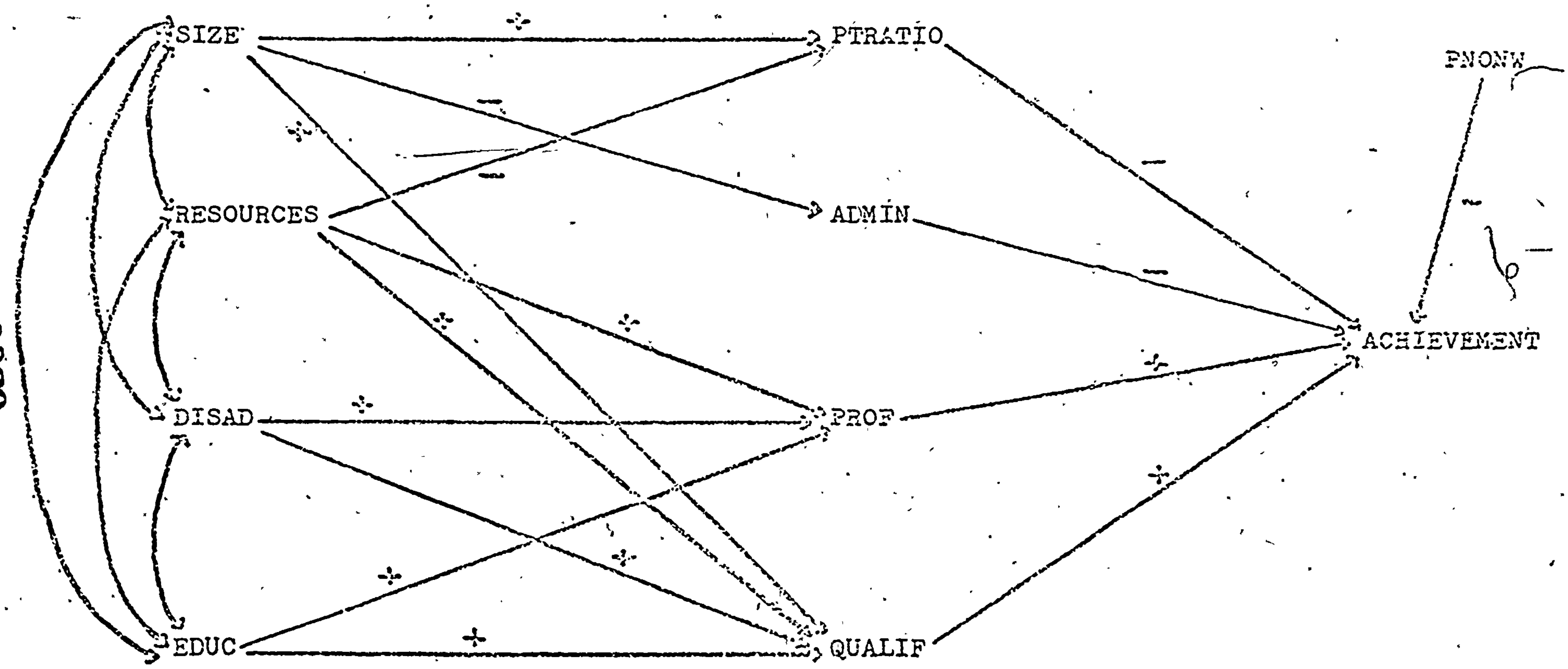

Table 1

Standardized Partial Regression Coefficients from Regression of Each Structural Condition of School Districts on Organizational Parameters and Other Structural Conditions

Independent Variables	Dependent Variables ADMIN	PROF	PTRATIO	QUALIF
SIZE	-.400**	.225	.300**	.307**
RESOURCES	.056	.380*	-.681*	.293*
EDUC	-.228	.063	.063	.420*
DISAD	.104	.038	-.140	.201*
PNONW	-.137	.004	-.004	.031
QUALIF	.114	-.005	.136	----
PTRATIO	.153	.200	-----	.262
PROF	.100	----	.073	-.003
ADMIN	-----	.108	.062	.089
Multiple R	.489	.385	.832	.637

* coefficient is twice its standard error
** coefficient is three times its standard error

Table 2

Standardized Partial Regression Coefficients for Variables

Expected to Affect Achievement Directly

Independent Variables	Reading Achievement	Math Achievement
PTRATIO	-.284**	-.296**
ADMIN	-.242*	-.268*
QUALIF	.286**	.145
PROF	.125	.087
PNONW	-.201*	-.255*
Multiple R	.487	.458

* regression coefficient is twice its standard error
** regression coefficient is three times its standard error

Table 3

Standardized Partial Regression Coefficients Between Four Organizational Parameters and Achievement Controlling for Structural Conditions and Percent Non-White

Organizational Parameters	Reading Achievement	Math Achievement
SIZE	-.091	-.110
RESOURCES	.092	.043
DISAD	-.025	-.087
EDUC	.065	.188

Table 4

Decomposition of Zero-Order Correlations Between Independent Variables and Average Achievement Levels

	Reading Achievement				Mathematics Achievement			
	Total Effect	Direct Effect	Indirect Effect	Joint Assoc.	Total Effect	Direct Effect	Indirect Effect	Joint Assoc.
RESOURCES	.301	.074	.221	.006	.268	-.053	.212	.109
SIZE	.031	-.105	.155	-.019	-.053	-.152	.069	.030
DISAD	-.137	.006	.059	-.202	-.165	-.037	.037	-.165
EDUC	.272	.059	.166	.049	.280	.201	.088	-.009
PNONW	-.179	-.189	----	.010	-.231	-.227	----	-.004
ADMIN	-.217	-.250	----	.033	-.214	-.250	----	.036
PROF	.172	.117	----	.055	.105	.087	----	.018
PTRATIO	-.177	-.178	----	.001	-.227	-.265	----	.038
QUALIF	.269	.268	----	.001	.121	.104	----	.017

Multiple R = .497

Multiple R = .494

Decomposition of Indirect (Causal) Effects

	Reading Achievement				Mathematics Achievement			
	Via QUALIF	Via PTRATIO	Via PROF	Via ADMIN	Via QUALIF	Via PTRATIO	Via PROF	Via ADMIN
RESOURCES	.070	.121	.046	-.014	.030	.186	.016	-.014
SIZE	.082	-.053	.022	.100	.032	-.079	.016	.100
DISAD	.054	.025	.006	-.026	.021	.037	.005	-.026
EDUC	.113	-.011	.005	.057	.044	-.017	.004	.057