Schools and the Disadvantaged

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The recent spate of federally financed education programs intended to improve the performance of racial minorities and other disadvantaged groups rests on a foundation of plausible assumptions and commendable intentions but with essentially no data to indicate their probable effectiveness. Will Head Start improve the school performance of deprived children? Will excellent teachers for the poor help break the "cycle of poverty"? Will Negro students learn more in integrated schools? Will the performance of middle-class children suffer if they attend school with predominantly lower-class children? Will increased expenditures for education result in greater student achievement? There are currently no firm answers to these questions.

Apparently as a reaction to the dearth of information, Section 402 of the Civil Rights Act of 1964 directed the Commissioner of Education to conduct a survey of inequalities in educational opportunities for all groups in the United States. What seemed to be called for was a tabulation of the physical facilities, teachers, and expenditures in schools attended by various minority groups; but at a more fundamental level answers to such questions as those posed above are necessary, since equality of educational opportunity is ultimately defined not by dollars, teachers, and buildings, but by the effects of these facilities on student achievement. Fortunately, the congressional directive was interpreted as including the more basic questions.

Several studies were initiated by the U.S. Office of Education's National Center for Educational Statistics, directed by Assistant Commissioner Alexander M. Mood, a statistician of some note and author of *Introduction to the Theory of Statistics*. The studies were directed by two consultants: James S. Coleman, professor of social relations at Johns Hopkins and author of *The Adolescent Society* and *Introduction to Mathematical Sociology*, among other books; and Ernest Q. Campbell, chairman of the Department of Sociology and Anthropology at Vanderbilt and author of *Christians in Racial Crisis*.

The results of these studies are reported by Coleman, Campbell, Mood, and four USOE staff members—Carol J. Hobson, James McPartland, Frederic D. Weinfeld, and Robert L. York—in **Equality of Educational Opportunity** (Government Printing Office, Washington, D.C. 1966. 743 pp. $4.25), a thick, paperbound volume filled with tables and charts and accompanied by a separately bound **Supplemental Appendix** ($3) containing 548 pages of computer-printed correlations. The report shows signs of being hastily put together to meet the two-year congressional deadline. The major findings are imbedded in a mass of trivial detail, and the summary (available as a separate 33-page booklet, $0.30), which appears to have been guided by a desire to avoid disturbing public opinion, is actually misleading. The survey itself, however, was carefully planned and skillfully analyzed. Conducted at a cost of $1.25 million—about half the cost of an F-4 Phantom Jet—it is one of the largest studies yet completed in the field of education, and its startling findings assure it the status of a landmark in educational research.

The principal study was a survey of over 600,000 children enrolled in grades 1, 3, 6, 9, and 12 of about 4000 schools generally representative of all U.S. public schools, but with some intentional overrepresentation of schools enrolling minority children. The children answered questionnaires about their attitudes and home backgrounds and took tests of educational achievement and verbal and nonverbal ability. Teachers, principals, and superintendents also answered questionnaires, and the teachers took a brief verbal-ability test. A survey of such scope would have been nearly impossible just 15 years ago; but, through the magic of optical scanners, computers, and probably Benzedrine, the current report was released an unbelievable ten months after data collection was started. The survey was met with suspicion and slander in many communities, and school systems in several major cities refused to participate. Complete data were available for only 59 percent of the sampled schools, which shortcoming detracts from the survey's value as a census.

Analyses of the data were concerned with four major questions:

1) *Are minority groups segregated in public schools*? To no one's surprise, it was found that segregation prevails. Nationwide, 65 percent of Negroes attended schools in which over 90 percent of the students were Negro, and 80 percent of whites attended schools in which over 90 percent of the students were white. There was greater segregation in the South than in the North. Mexican Americans, American Indians, Puerto Ricans, and Oriental Americans were also segregated, but to a lesser extent than Negroes and whites.

2) *Are the school facilities for minority children inferior to those for the majority*? On the basis of such indicators of school quality as class size, educational programs, physical facilities, and teacher qualifications, no consistent advantage was found for any one group, and the differences in the quality of education available to the various racial and ethnic groups were small when compared with differences between regions of the country and between metropolitan and nonmetropolitan areas. In terms of these indicators, the educationally deprived groups in the U.S. are not racial or ethnic minorities, but children—regardless of race—living in the South and in the nonmetropolitan North.

3) *Do the various racial and ethnic groups perform differently from each other on tests of school achievement and of verbal and nonverbal ability*? The substantial differences between the average test scores of the different racial and ethnic groups were quite similar on the various tests and at the various grade levels. Whites obtained the highest average scores, followed, in order, by Oriental Americans, American Indians, Mexican Americans, Puerto Ricans, and Negroes. "The Negroes' averages tend to be about one standard deviation below those of the whites, which means that about 85 percent of the Negro scores are below the white average" (p. 219). The differences between regions for Negroes followed the pattern for whites, but the regional

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variation tended to be greater for Negroes. The highest scores were obtained in the metropolitan North and the lowest in the nonmetropolitan South. The highest regional average score for Negroes was below the lowest for whites.

4) *To what extent are differences in average performance of racial and ethnic groups the result of different educational opportunities?* This, the most important question of all, could not be answered unequivocally, but several results of the survey are relevant to it. These results also have implications for the broader issue of the extent to which differences in ability of students in general are dependent on differences in educational experiences.

The first line of evidence concerning the effects of schools comes from a comparison of the scores of the various groups at different grade levels. If the schools attended by minority children contribute to their poor performance, the decrement in performance of these groups should increase with increasing grade level. Such an increasing decrement was found for Negroes in the South and Southwest, but it was absent or minimal for other regions and other minority groups. The authors seem to prefer interpretations of their data that attribute the poor performance of minority children to the effects of the schools, and their interpretation of the present result is a good example of this tendency. They say, "For example, Negroes in the metropolitan Northeast are about 1.1 standard deviations below whites in the same region at grades 6, 9, and 12. But at grade 6 this represents 1.6 years behind; at grade 9, 2.4 years; and at grade 12, 3.3 years. Thus, by this measure, the deficiency in achievement is progressively greater for the minority pupils at progressively higher grade levels" (p. 21). Actually this apparently increasing deficiency is entirely an artifact of the unequal intervals of an age scale. Mental growth follows a negatively accelerated curve, as do growth in height and many other characteristics, so that the variance of scores increases with age when the scores are expressed as normative age equivalents. Thus, this result suggests that the role of the schools in increasing or decreasing differences between racial and ethnic groups is quite small.

A second line of evidence comes from an elegant regression analysis in which the variation among students in test score was divided into variance between school means and variance between students within schools. The between-school variance, which represents an upper limit to the proportion of the total variation in test scores that might be attributable to differences in school quality, was between 10 and 20 percent of the total variance for Negroes and whites and slightly more for the other minority groups. If differences between schools in mean test score were due to differential effectiveness of the schools, the between-school variance should become an increasing proportion of the total variance at increasing grade levels as the result of increasing exposure of the students to the influence of the school. No such increase in the between-school variance with increasing grade level was observed for any of the groups studied. Again, by this second line of evidence, school effects appear minimal.

Socioeconomic Background

After statistical control for a number of student socioeconomic indicators, the between-school variation showed little association with indicators of school or teacher quality, but instead was associated with the average socioeconomic level of the students at the school. The authors conclude: "The data suggest that variations in school quality are not highly related to variations in achievement of pupils. . . . The school appears unable to exert independent influences to make achievement levels less dependent on the child's background—and this is true within each ethnic group, just as it is between groups" (p. 297).

Two additional results of the regression analysis are relevant to the question of the effects of school segregation on student performance. First, the performance of minority children, after statistical control for socioeconomic background, was better where the proportion of white children in their schools was higher, but this result was attributable to the higher socioeconomic level of the student body in integrated schools rather than to racial balance per se. Second, the performance of minority children (again controlled for socioeconomic background) was more highly related to the socioeconomic level of the other children in their school than was the performance of white children. These two findings lead the authors to say that "if a white pupil from a home that is strongly and effectively supportive of education is put in a school where most pupils do not come from such homes, his achievement will be little different than if he were in a school composed of others like himself. But if a minority pupil from a home without much educational strength is put with schoolmates with strong educational backgrounds, his achievement is likely to increase" (p. 22).

This conclusion, which Commissioner of Education Howe appears to have accepted at face value (*Science*, 14 October 1966, p. 242), is a beautiful example of interpreting correlation as indicating causation. Moreover, the findings on which it is based might also be attributed to inadequate control for the preschool characteristics of the students. Differences in average performance of students attending different schools can be due either to differential effects of the schools and associated environmental influences or to differences in initial ability of the students attending the different schools. To study the effects of schools, differences in initial ability must be controlled. Ideally, students should either be assigned to schools randomly or they should be tested before school entry so that the effects of initial ability can be separated statistically. Regrettably, the time required for these longitudinal approaches ruled them out for the present survey. Lacking measures of the initial ability of the students, the authors controlled instead for several family-background factors, primarily socioeconomic indicators. Family socioeconomic status obviously does not account for all differences in initial ability of students. It might nevertheless be argued that control for socioeconomic status does account for most of the differences between schools in the initial ability of their students, since most nonrandom assignment of students to schools is along socioeconomic lines. But does it, really? Parents of a given socioeconomic level probably exert a different degree of effort to get their bright children into "good" schools than they do for their dull children. Parents living in high-socioeconomic school districts are probably more intelligent than parents with the same standing on the relatively superficial socioeconomic indicators who are living in low-socioeconomic school districts. Errors in the child's report of his family background would tend to be in a direction causing one to underestimate the socioeconomic level of families living in high-socioeconomic school districts and to overestimate the socioeconomic level

of families living in low-socioeconomic school districts. The same bias would result from the practice of substituting the mean for missing data that was followed in constructing the background indices. Socioeconomic status is probably a better substitute for initial ability of majority students than it is for that of minority students, whose family social mobility is limited by various forms of discrimination.

The "school effects" that were found are precisely the effects that would be expected to result from such incomplete control of student input. "School effects" were greater for general ability measures than for measures of school-related achievement; they were associated with the average socioeconomic level of the student body rather than with measures of school quality; and their correlation with student-body characteristics was greater for minority than for majority children.

The result of all this is to reinforce the two preceding lines of evidence in indicating that the effects of variations in school quality on student achievement are minimal, even less than the authors admit.

This survey suffers from problems common to all nonexperimental studies in attempting to assess the effects of natural experiments, which are so messy that one can never be certain that all relevant variables have been taken into account or that the correlations observed in the natural setting would continue to hold if the variables were artificially manipulated. Two uncontrolled variables that come to mind as possible distorting influences in this study are student dropout and migration. If there are differential dropout rates for the various groups, loss of the less able minority students at higher grades may obscure an increasing decrement in group performance. Because of student migration, the student's present school may not be a good indicator of the quality of education to which he has been exposed, and this clouding of the independent variable may make the regression analysis less sensitive to whatever school effects may exist.

It is unfortunate that the sensitivity of the racial issue made it necessary to collect the data from the students anonymously. If each student's name could have been associated with his test scores, a retesting of the same grades in the same schools three years later would have yielded data for a longitudinal study in four segments stretching from the first through the 12th grade.

The study would also have been improved if Jews and possibly Catholics had been identified as additional minority groups, since both are probably subject to some *de facto* segregation in public schools. The higher average performance usually found among Jews would have provided a useful contrast in the attempt to understand the lower average performance of the other minorities.

In view of these shortcomings it is obvious that this is not a good study of the effects of education on minority-group performance; it is just the best that has ever been done. Moreover, it provides the best evidence available concerning the differential effects—or rather the lack of such effects—of schools. AAAS members may find it hard to believe that the $28-billion-a-year public education industry has not produced abundant evidence to show the differential effects of different kinds of schools, but it has not. That students learn more in "good" schools than in "poor" schools has long been accepted as a self-evident fact not requiring verification. Thus, the finding that schools with widely varying characteristics differ very little in their effects is literally of revolutionary significance.

It is not customary for educational practice in the U.S. to be based on research, and these results will likely have little influence on educational policy. The conservatism may be adaptive in this instance, because the findings are too astonishing to be accepted on the basis of one imperfect study. What seems to be required is additional study of differential school effects with better controls for input. However, until these findings are clarified by further research they stand like a spear pointed at the heart of the cherished American belief that equality of educational opportunity will increase the equality of intellectual achievement.

Molecular Orbital Theory for Organic Chemists

When the purpose of a book is to acquaint the organic chemist with the basic principles of the molecular orbital theory and its application to organic chemistry, then the authors have set themselves a difficult but important task. The task is important because the practitioners of molecular orbital theory have been prolific and even successful. The task is difficult because molecular orbital theory, disinherited by quantum mechanics, is practiced as an odd mixture of theory and empiricism, algebra and guesswork—a black art which must be dissected if it is to be intelligently used. The simplest form of molecular orbital theory, in which wave functions for a molecule are constructed as linear combinations of atomic wave functions and obtained as solutions to a one-electron wave equation, is very easy to use, but the validity of the results is often difficult to assess.

In **Quantum Organic Chemistry** [Interscience (Wiley), New York, 1965. 366 pp., illus. $13], Kenite Higasi, Hinoaki Baba, and Alan Rembaum introduce the reader thoroughly and concisely to the manipulations of the simple molecular orbital theory. They present a number of examples and an excellent list of references which should enable any scientist to perform his own calculations. The well-written chapters on the applications of the method to the prediction and interpretation of physical properties of molecules and chemical reactivity will suggest many possibilities for applications of molecular orbital theory to new problems.

One looks, in a presentation of molecular orbital theory to the uninitiated, for a warning on the side of the package—*Use carefully*. The present authors are concerned with imparting proficiency and they pay little attention to the pitfalls. There is much comparison of various calculations, but the empirical basis of the method is seldom emphasized. The inherent limitations of the simple molecular orbital theory are briefly mentioned. There is a tendency to jump from a molecular orbital description to a valence bond description and back again. Readers would benefit from a clearer distinction between the two theories and between physical properties of a molecule, such as bond lengths, and properties of the model, such as free valence.

Quantum Organic Chemistry conveys a body of knowledge well, as does a good teacher. The judgment required to prevent the misuse of molecular orbital theory must be developed on one's own.

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