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## ***The Effects Of Schooling In The Input-output Approach: Problems, Issues And Trends***

In an open system (Burns and Stalker, 1961; Katz and Kahn, 1966; Thompson, 1967) allocative strategies of resources are influenced not only by the dynamics internal to the school system but also by the dynamics of environmental factors within and outside of the school system as an organization. The above suggests organizational adaptiveness or the need for adaptiveness for survival and effective goal attainment, and taken together with the conception that organizations tend toward an equilibrium in which structure and function harmonise for the attainment of goals in an on-going environmental setting, provide the impetus for research into the variables that make for organizational effectiveness. If the above proposition holds, then, it follows that allocative and organizational strategies vis-a-vis school systems and staff composition are a function of both internal dynamics and external pressure. This point of view seems consistent with the social-ecological theory of adjustment and accommodation in the face of environmental factors (Park, 1936; Hollingshead, 1947; Gettys, 1940). The question of interest is, therefore, the way school systems and staff composition respond to the environmental inputs of the school-going population and the community, and how effective that response is in terms of expected outputs.

Another question of interest is the way individual schools, given the resources in the short run, allocate resources in response to pressures and perceived needs among the different "sectors" within each school. Of more recent vintage is the interest in the allocative processes within each school, class and among individuals within the class. All the above notions are predicated on the assumption that resources make a difference in outcomes, however defined by the functioning unit, whether it be the school system, a school, a class or an individual. Indeed in the United States, since the time of Ellwood P. Cubberley in 1906 to the present, numerous resource or power equalisation formulae, such as the Strayer-Haig formula,

are predicated upon the assumption that resources make a difference in school effects (Benson, 1968; McDermott and Klein, 1974). In Singapore, the restructuring of the school system and the decision to build bigger and better equipped schools, to replace non-graduates with graduates at the secondary level, to inject funds for the purchase of audio-visual aids and to set up a curriculum development institute to produce new and presumably effective curricular programmes are predicated upon the assumption that the injection of resources into these areas of activities would make a difference to educational outcomes. Unlike industries, the educational enterprise does not have firm guidelines on the kinds of inputs that would make a difference to schooling outcomes and the kinds of inputs that are tractable to policy manipulation.

Theoretically, when applied to educational production, the input-output model of production, derived from the field of economics, should yield the kinds of answers required by policy makers. Economists are perhaps better placed than other social scientists in specifying a production function for education (the acronym is EPF) but few have entered the field of educational research. Sociologists and educationists have used the input-output model to answer questions that pertain to educational and status attainments but few have addressed themselves specifically to the questions of efficient resource allocation. So far no one has used the EPF to discover the full range and contribution of inputs that are optimal for the production of schooling outputs. When the model is carefully specified, it could be made to yield information on the relative impact of schooling inputs on outputs, the relative cost of inputs to a unit of output and the substitution rate of inputs to produce the same or a projected output. Such information would enable policy makers to make rational choices in school resource allocation.

The research carried out during the past decade using the input-output model, however,

has been disappointing to decision makers. Findings on school-specific antecedents of pupil achievement have either been inconsistent or negative. Averch *et al.* (1974), in reviewing the findings of studies on school effectiveness, aver that the findings of the research effort seem to point to one conclusion: the failure to identify one or more school factors consistently associated with pupil achievement. Factors which consistently show strong influences on student achievement belong to the cluster of variables coming under the socio-economic status of the student's family, e.g. his parents' education, income and occupation. Literally hundreds of research studies come to one pessimistic conclusion: that schools make no difference: that resources make no difference to schooling outcomes. A severe criticism against research on school effectiveness which had been conducted up to recently, especially those based on the input-output model, has been the lack of well-grounded theory (Richer, 1975).

#### School Effects Study in Developing Countries

Meanwhile, school effects studies have been extended to developing countries and an excellent review of these studies has been undertaken in "The Determinants of School Achievement in Developing Countries: The Education Production Function" (Alexander and Simons, 1975). Findings are not always consistent over the effects of the school inputs which enter into the EPF model. Inputs which show consistent and positive impact on achievement are highly motivated teachers, textbooks, access to reading materials and homework.

One consistent finding of EPF studies in developed and less developed societies is the differential impact of socio-economic status variables on student achievement. Unlike more industrialized societies where school inputs have less and social antecedent variables have more impact on achievement, school input variables have more impact than socio-economic status (SES) variables in developing societies (Heyneman, 1975). This may not imply that developing societies have more effective schools as such vis-a-vis schools in industrialized societies. The weak relationship between SES variables and achievement in developing societies may point to the important fact that status crystallization has not emerged yet to influence child-rearing practices, crucial in developing habits, values and attitudes that are con-

comitants for school achievement. It has been hypothesized that there are fewer differences in child rearing practices among emergent social classes in developing societies. Alternatively, it can point to the inadequacy or inappropriateness of the SES measures conceived in Western terms when applied to developing societies, that is, the measures of objective SES membership do not capture the essential differences of social classes in developing societies. It may also imply that school inputs are crucial in student achievement when these are in such short supply. There are obviously threshold effects in operation here; beyond the threshold, additional inputs of facilities or teacher qualities do not account for such differences in achievement. Another point, worthy of note, is that the community outside the school may be highly "educational" and is an important source of learning. What it teaches may not be much different from what schools are teaching in industrialized societies. In developing societies, the out-of-school environment does not complement what the school does and hence school achievement is peculiarly the work of the school. It is also conceivable that in developing societies where education is not compulsory and school places are limited, few of the lower SES children enrol in schools and those who do are exceptionally bright, which accounts for their being able to out-perform children from the higher SES group. The implication is that these children are atypical of the social class from which they are drawn. When all children from the lower SES are in schools with compulsory education, then the full range of abilities will be represented. When this happens, then SES will emerge as the dominant determinant of school success as in industrialized societies. The foregoing discussion is meant to highlight the complexities of situational factors that EPFs are dealing with but which are often left out leading to misleading findings and interpretations.

Leaving aside studies dealing with EPFs in developing societies, we now turn our attention to the Coleman "Equality of Educational Opportunity" (EEO) study which provides the benchmark from which other studies take their cues and forms the springboard from which many new attempts are made to fit a production function to schooling. Consideration of the many problems and issues of the EEO study best illustrates the numerous pitfalls of EPF studies, and represents the starting point for many subsequent studies aimed at improving the state of the arts in the study of school effectiveness.

## The Coleman EEO Report

The first massive study and therefore the one with the most intense impact came with the publication of Coleman's EEO Report in 1966 (Coleman *et al.*, 1966) followed by an equally shattering "Inequality" (Jencks *et al.*, 1972). Both studies show that resources make very little difference to student achievement defined in cognitive terms. The general conclusion of "Inequality" points to non-school factors as being more important determinants of educational outcomes than school factors, with the devastating and somewhat careless statement that "additional school expenditures are unlikely to increase achievements, and redistributing resources will not reduce test score inequality".

Coleman's "Equality of Educational Opportunity" in substance denies any significant impact of the school's resources and facilities on pupil grades. His findings do show, however, that there is a correlation between achievement and the quality of the peers the pupils go to school with as well as certain teacher characteristics. He finds not only variance in attainment between schools but also greater variance within schools which presumably enjoy the same resource inputs, and attributes the within school variance, by and large, to outside school factors.

In any case, Coleman's work has been subjected to a great deal of criticism and re-analysis on the grounds that the study has serious flaws: misspecification of the variables under study, serious weaknesses in methodology and measurement, and working in a conceptual and theoretical vacuum. (Bowles and Levin, 1968; Spady, 1973; Cohen and Garet, 1975; Mosteller and Moynihan, 1972).

## Some Theoretical, Conceptual and Methodological Weaknesses

Coleman's model operates in a theoretical vacuum. The choice of variables has not been informed by theory. Neither are the ordering of the variables and the linkage between them made explicit. On why and how the variables influence one another the Coleman report is silent. The reader is presented with a series of statistical relationships but is left in a quandary as to how he is to interpret the relationships in the absence of an explicit theoretical framework (Richer, 1975). How is one to interpret the presence of volumes of library books or science laboratories and their relationship to the impact or lack of impact on verbal achievement?

In the first place the nexus between science laboratories and verbal achievement is tenuous at best. Second, the availability of library books is merely an indicator of opportunity to use such books but is certainly not synonymous with actual use and frequency of use which are likely to be better predictors of verbal achievement or acuity than the mere presence of books.

## The Use of Proxies

The tendency to use proxies also deserves comment. Most studies use proxies rather than get at the attributes which are theoretically postulated to have an impact on students (learning – cognitive or non-cognitive) outcomes. For student's background variables, either father's or parents' education or some index of SES is used as proxies for attributes such as child-rearing practices which reflect value orientation towards achievement in school and status attainment in the adult world. Undoubtedly some of their attributes are captured by the SES index or other proxies since SES and value orientation are likely to be correlated but variance in each SES group is ignored. The preference for proxies is perhaps dictated by the difficulty of access to the attributes of cultural characteristics or problems of measurement. This is the issue of the trade-off. Often enough, the trade-off leads to greater costs than benefits in that the findings are vitiated by the use of proxies which are not definitive enough to permit meaningful interpretation and the planning of policy-relevant actions. To know that SES or father's education or other proxies are important determinants of school achievement does not allow meaningful policies to be formulated which can bring about change in student input and make a difference in schooling. It is true that home background factors are often deemed to be beyond policy control but this may not be the case. For example, if the background factor is malnutrition or poor health which is responsible for school absenteeism or poor attention span, then it is amenable to policy control. Unfortunately, these variables are seldom entered into the equation. Neither are child-rearing practices entered as inputs in the antecedent variables. These are presumed to be adequately represented by some index of SES or father's education which is too global and all-embracing to enable one to pinpoint the inputs that really matter.

Teacher experience is a proxy for attributes thought to have an impact on student achievement. These attributes are seldom explicitly stated and

measured directly. Experience may be a proxy for increased pedagogical competence, familiarity with content area, increased skill in interpersonal interaction or perhaps greater psychological maturity – a very mixed bag of attributes which may in fact be absent from teachers classified as “experienced” whatever the criterion of years of teaching that is used to categorize experience. In fact, there may be greater variance among teachers of the same years of teaching experience than among teachers with different years of experience. The proxy, therefore, has little to recommend itself as a measure of teacher input. What is needed is an attempt to measure the attribute conceptualised as an input expected to have an impact on certain kinds of achievement however difficult it may be to measure it. A major problem here is the lack of theoretical guidelines on the sort of teacher characteristics that do make a difference. A reading of the literature, however, should provide some tentative selection of teacher inputs such as teacher competence in the subject that is taught (Anderson, 1950), teacher personality type (Hoil, Powell and Feifer, 1960) or teacher explanatory facility (Gagne, 1968). These will have greater policy relevance than a vague all-embracing proxy, teacher experience.

#### Measurement Errors

A number of measurement errors which bias the Coleman findings are obvious (Bowles and Levin, 1968). First there is the confounding effect of differences in the levels of measurement which guarantee the dampening of the proportion of variance in achievement explained. Some of the variables are measured at the individual level (the characteristics of pupils), some at the school level (volumes of books and science laboratories) while others are measured at the district level (expenditure per pupil). Yet irregardless of the levels of measurement, these characteristics measured at the school or district level are attributed to individuals. In brief, the fallacy is one of attributing group properties to individuals. A clear case is the measure of per pupil expenditure at the district level and attributing this expenditure as a resource to the individual student. The per pupil expenditure is an average measure for the whole district and by matching it to individuals, the Coleman study ignores the variance of per pupil expenditure between schools within a single district thereby overestimating the resource available to low SES schools and underestimating it for rich schools.

The net effect is to underestimate the impact of per pupil expenditure on achievement. Incidentally, it also ignores differences in resource availability between elementary and secondary schools.

#### Historical Measurement Error

The measurement of resources at one point in time and the impact of such resources on school outcomes rest on the unrealistic assumption that past resources do not have an impact on current learning and outcomes. Learning is cumulative, and initial learning, which is also a function of ability or IQ, is a function of past learning. Current resources, therefore, have differential impact on different students depending upon both initial ability and learning up to the present. This is the historical measurement error. What has been overlooked in the Coleman model are measures of relevant resources, whether they be school or home based, cumulative to the present time. Such an omission, however, has been corrected in recent formulations of the school effects paradigm in EPF studies taking the form of:

$$A_{it} = s(F_i(t), P_i(t), O_i(t), I_i(t), U)$$

The  $i$  subscript refers to the  $i$  student; the  $t$  subscript in parenthesis ( $t$ ) refers to an input that is cumulative to time  $t$ ; where

$A_i(t)$  = a vector of educational outcomes for the  $i$ th student at time  $t$

$F_i(t)$  = a vector of individual and family background characteristics cumulative to time  $t$

$S_i(t)$  = a vector of school inputs relevant to the  $i$ th student cumulative to time  $t$

$P_i(t)$  = a vector of peer or fellow student characteristics cumulative to time  $t$

$O_i(t)$  = a vector of other external influences (the community, for example) relevant to the  $i$ th student cumulative to time  $t$

$I_{it}$  = a vector of initial or innate endowments of the  $i$ th student cumulative to time  $t$

$U$  = an error term

### Range of Resources Measured

A number of other limitations has also been highlighted. The range of school resources measured is limited: the number of volumes of library books per pupil in elementary schools and, for secondary school, the additional resource of science laboratories. A whole host of other resources has been omitted, for example, access to counsellors and other supportive staff, programmed learning technology, allocation of teacher time, and others. No less important are the qualitative dimensions of resources which are more likely to be left unmeasured than the quantitative aspect.

### Mishandling of Non-response

Other weaknesses in the Coleman Report stem from the poor sample response. Only 59 per cent of the high schools in the original sample responded and among the non-responses, were the many big city schools where many of the low SES schools were located. The manner in which Coleman handled the non-response to the many items in his questionnaire also contributes to measurement errors. For example, many of the non-responses were for items eliciting father's and mother's education and other background variables. The non-response items were simply given the arithmetic mean of the whole sample. This leads to biases in his estimates; there is reason to believe that the non-response to his many items is non-random. Comparison of the mean of the achievement scores of those who did not respond to parents' educational background with the mean of the whole sample shows that the mean of the non-responses is much lower. Non-whites are over-represented in the returned questionnaires that have non-responses to these background variables.

### Inappropriate Proxy

Another serious error is the use of educational background as a proxy for SES. For Blacks, education, income and occupation do not correlate as closely as they do for Whites. Therefore parental education is a poor indicator of Black's SES. It has also been pointed out that the higher achievement of Blacks in schools with a higher proportion of whites could be attributed to Blacks' own social class rather than white peer influence. An interesting point which emerges from this Report is the finding that 23 per cent of the variance in

achievement for grade one children is accounted for in school with a higher proportion of whites, yet these scores were taken during the first days of the school year before peers have had time to interact and influence each other.

### The Linear Model

The most widely used model for school effects study uses the linear regression of the form:

$$Q = a + b_1x_1 + b_2x_2 \dots b_n x_n$$

It has been pointed out all too often that such a linear model is not isomorphic to the impact of resource input on achievement or other non-cognitive output.

The additivity principle of the linear model is predicated upon the assumption that a unit increase in resource input (the independent variables) will lead to a proportionate increase in the outcome (the dependent variables). The linearity relationship implies a constant return whereas social reality or production reality would imply that, at least for some of the inputs, the multiplicative term would be more appropriate and a better predictor of school outcome. For example, teacher resource, whether it be time or competence, devoted to an individual student is likely to be multiplicative: initial ability or the initial achievement score interacts with teacher or material resource multiplicatively. If initial ability is  $x_1$  and teacher resource is  $x_2$ , then the multiplicative term  $(x_1)(x_2)$  for the individual student is hypothesised to be a better predictor of that student's outcome because initial ability interacts with resource input to produce a certain quantum of outcome.

Most formulations assume that a certain quantum of resource input will yield the same outcome for all students within a class, which simply does not square with reality. Secondly, there is no reason to believe that all students within the same class receive the same resource input with regards to teacher time and level of expertise available to students. The teacher is a decision making unit and how much of the resources he devotes to particular students or groups of students will be based on the criteria used by the teacher within the constraints of the over-all school policy. It depends on whether the teacher is maximising the mean or the variance of achievement. What is true at the class level must also be true at the school or district level, that is, decisions to maximise the mean or variance of achievement scores (Brown and Saks, 1975).

Often enough no attempt has been made to ascertain whether the input-output relationship is linear or curvilinear. Forcing a regression line onto a non-linear relationship results in a bad “goodness of fit” line where the variances of the means of the independent variables are so large that the estimates derived from the regression coefficients are severely biased and inaccurate. For illustration, we can use a two-variable model which yields a relationship as shown by the curve in the diagram below:

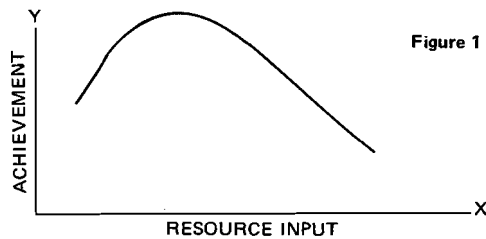


Figure 1

Forcing a linear regression line onto this relationship (Figure 1) would result in the line AB (Figure 2).

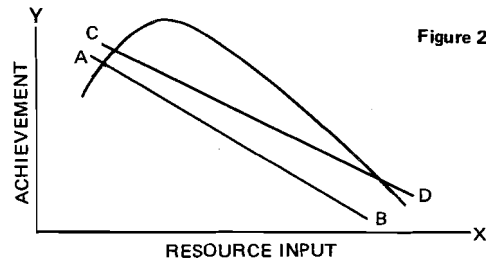


Figure 2

However, it is possible to obtain a better “line of fit” by using one of the polynomial transformations by squaring the resource input to yield the line CD. Other techniques such as the use of the log of the independent variables will also result in a “line of better fit”. Theoretically it seems realistic that with additional applications of the same resource, other things being equal, diminishing returns are bound to set in as in economic production.

A common problem is that of multicollinearity among the independent variables which create problems in specifying the unique effect of each independent variable (Fuller, 1972). For example, if  $x_1$ ,  $x_2$  are highly correlated, then if  $x_1$  is entered first into the equation, it captures a larger proportion of the variance explained, leaving  $x_2$  with very little to explain. The explanatory power of the first variable will be overestimated while the second variable will be underestimated. No statistical techniques are available for separating the joint influences of clusters of variables that are correlated. If we sum the squares of the standardized betas of each independent variable, we will find that this sum will be less than  $R^2$ , the variance explained for the whole equation. The

difference between the  $R^2$  and the sum of the squares of the betas can only be attributed to the joint influences of the independent variables and cannot be attributed to each independent variable uniquely. This limitation of an otherwise powerful statistical technique, the multiple regression, has to be kept in mind when interpreting the regression coefficients.

### The Appropriate Unit of Analysis

Another issue which has come to the fore revolves around controversies regarding the appropriate unit of analysis. Coleman’s unit of analysis is the school which, while it is equivalent to the plant in the industrial sector, is not the nerve centre in decision making in the allocation of resources, so it has been argued. It has been pointed out that the school is not a conceptually and empirically appropriate unit for determining the relationship between resource inputs, including pupil background inputs, and outputs, “if we view organizational phenomena as a means for transforming environmental inputs,” which makes the school district rather than the individual school, “the principal locus of these phenomena” (Bidwell and Kasarda, 1975). The argument advanced is based on the logic that schools within a district is an organic whole controlled by the central office in such important matters as “differential allocation of resources between functions or between schools”. The differences between school districts in terms of command over resources available for education and population characteristics make analysis at the district level more meaningful than at the school level especially when organizational attributes are to enter as independent variables having potential impact on pupil achievement. After all, resource inputs can be transformed into a variety of organizational attributes, which can have varying impacts on pupil outcomes, given the pupil inputs. It is the nature of the organizational attributes and staff composition, which represent the transformed resources, which act upon pupil inputs that we have to investigate to ascertain the impact of a given level and kind of resources. The social-ecological approach points to the significance of the transformation of environmental inputs by social organizational means in achieving organizational effectiveness vis-a-vis the goals of the organization.

“School District Organization and Student Achievement” (Bidwell and Kasarda, 1975) is the answer to the badly needed “empirical studies . . .

that use well-defined models of the link between input and output". Such an approach and the findings come as a welcome change from recent research which has become largely bogged down in the quagmire of hopelessness that "nothing matters in school". Some of the major findings of the Colorado study are summarized below:

- (a) High pupil-teacher ratio and administrative intensity depress median levels of achievement. The converse is also true.
- (b) Of environmental conditions, only percent non-white has consistently significant negative effect on median achievement.
- (c) Other environmental conditions, resources especially, have important indirect effects (positive) on achievement via their direct effects on school district structure and staff qualification.

The implication of the findings points to the importance of investment in teachers to reduce the pupil-teacher ratio and provide better qualified certificated staff vis-a-vis pupil achievement in reading and mathematics. Increasing administrative staff disproportionately to front line teaching staff results in lower median scores. The authors, therefore, conclude that it is premature to assert that "little can be done through the formal organization of schooling to affect students' academic attainment". At the same time, the authors add a caveat that their findings in terms of educational policy are to be taken as "tentative, since the coefficients that we have reported are modest". Further studies along the same lines are called for.

### **The Colorado Study and Grounded Theory**

A very serious criticism of research on school effects or the EPF which had been carried out until recently, especially those based on the input-output model, has been the lack of well grounded theory (Richer, 1975). Without the theoretical framework, the models presented tell us nothing beyond the statistical relationships; without theory, the selection of variables for the model cannot be anything but random and the findings do not hang together as it were, in a meaningful and coherent frame of theoretical reference. "The role of a variable in affecting objectives can only take on meaning and be interpretable in the context of a carefully specified and theoretically justified model" (Cain and Watts, 1970). The Bidwell and Kasarda study on Colorado school districts redresses this lack, and this study stands out as one

of the very few studies that make explicit the theoretical justification and relationship of the variables in the model.

The model presented in the Bidwell-Kasarda study is grounded in the social-ecological principles and organizational theories which yield certain key propositions vis-a-vis the effectiveness of the school district organization in delivering the stated goods. The input-output approach which treats the school as an unknown "black box" is less satisfactory and powerful in explaining the relationships between the input-output nexus. In the Bidwell-Kasarda model, some of the elements in the black box are identified and specified, however imperfectly, in the intervening variables of organizational attributes of the school district. Such a proposition postulates that fiscal inputs are transformed into organizational variables which provide certain experiences yielding outcomes of varying amounts and levels. Pupil inputs, bearing certain characteristics, some unique to themselves and some common to the population attributes of the community in which the district is located, are acted upon by the organizational attributes, which are postulated to be responsive to the environmental inputs.

The omission of the processes themselves in the school may constitute a weakness in the model, which is best looked upon as a segment in a possibly larger and more complete formulation in the achievement attainment model. The use of achievement scores rather than achievement gains as the dependent variable may constitute another weakness. The use of achievement gain, which speaks to the notion of value-added as a result of additional resource inputs, would be able to demonstrate the input-output relationship better. The value-added concept, however, is not without its own problems. This came to light with the Thai data brought to Chicago for a seminar course by Professor Fuller. When aggregated to the level of the region or for the sample as a whole, the value-added turned out to be a negative value. Another problem stems from the ceiling effect: the value added for a student who scores say 80 may be 10; for another student whose initial score is 40, the value added may be 15. Which of these represents more value added? Should the 10 added to the initial score of 80 be equated to a gain score of 10 for an initial score of 50? These are the unresolved problems. The ceiling effect will ensure that those who score high initially will have a lower gain score than those who score low initially. Perhaps a system of weighting could be used but a theoretical justification would be necessary before weighting



could be used. Barr and Dreeben (mimeographed) sum up the Colorado study thus:

Except for the fact that the school (as a firm) is conceptualized as an active agency transforming inputs into outputs, this study takes us little further empirically than previous studies in understanding the process by which schools transform inputs into outputs. How, after all, are pupil-teacher ratio, teacher qualifications, and professional support translated into achievement? Conceptually, however, this study does go beyond others in speculating plausibly about what might be going on in classrooms.

According to Bidwell and Kasarda, schools transform input into student output (achievement) at the level of the classroom through "instructional technology". But the black box still remains a close mystery.

#### **A Shift of Interest to Variables Accounting for Within School Variance**

Complementary to the school effects study using the school or the school district as the unit of analysis is the recent movement to get into schools to study within school variances, which are largely ignored in earlier studies in achievement and resource allocation. Two such studies, one by Barbara Heyns (1974) and the other by Alexander and McDill (1976) will be briefly reviewed. Both studies attempt to get at the social differentiation and stratification within high schools and its impact on achievement and non-cognitive outcomes. This represents an attempt to look at the social structural variables within schools commonly known as tracking which results in differential curriculum placement and influences the resource allocation process.

One crucial mechanism for academic differentiation and selection is the high school curriculum. Tracking and assignment policies typically segregate students within schools and define an academic hierarchy through which certain rewards may be allocated. The general conclusion that resources do not determine achievement differentials between schools (Coleman *et al.*, 1966; Jencks *et al.*, 1972) ignores stratification patterns and access to resources within schools and necessarily understates the effects of such resources. If access to better teachers, counselling, and highly motivated, academically oriented peers affects achievement to any degree, such resources should operate between curricula within schools as well (Heyns, p. 1435).

While pointing to the not unimportant determinant of SES in verbal achievement, grades, curriculum placement, and aspirations, Heyns comes to the major conclusion that ascriptive factors are overshadowed by achievement criteria used by schools for curriculum placement. Those placed in the college track have greater access to counsellors, teachers and other resources which point to important differentials in resource allocation within schools, a point which has often been masked in studies which aggregate inputs to the school or district level. Like all school effects studies, the conclusions of Heyns and Alexander and McDill are not always consistent. Alexander and McDill find that SES as measured has a major impact on curriculum placement.

Both articles are interesting theoretically in that they point to social differentiation and stratification within schools as a determinant of differential allocation of resources. Theoretically, however, both articles are rather thin. Heyns points to the common practice of ability grouping within schools and other empirical studies which show a link between college preparatory curriculum placement and subsequent attendance at college (Flanagan *et al.*, 1966; Jencks *et al.*, 1972). Alexander and McDill made a cursory reference to Parson's theory of curriculum differentiation as a major mechanism by which secondary schools perform their functions of "selecting and allocating" youths to adult roles. Many references are made to particular empirical studies on the relationship between curriculum placement and status origin but scant attention is paid to the rich theoretical literature on stratification, division of labour, honorific evaluations and their linkages to differential allocation of resources, reward systems and their isomorphism with stratification in society at large. Neither is there reference to the economic theory of investment of resources and returns in terms of cognitive and non-cognitive outcomes. Theoretically and empirically it seems reasonable to assume that more scarce resources are likely to be applied to those inputs that give the greatest yield. Neither is there reference to structural-functional and conflict theories (Collins, 1971; Nelson, 1975; Gintis, 1971) as theoretical constructs in viewing social stratification within schools.

The work of Summers and Wolfe (1976), "Equality of Educational Opportunity Quantified: A Production Function Approach" represents the continuing interest in taking the individual as the unit of analysis. The approach and the statistical technique employed are sophisticated and exhibit

none of the weaknesses characteristic of the Coleman study: an indication of the advance in the state of the arts in school effects study. Careful specification of the variables and measurement coupled with the use of dummy variables, piecewise linear fitting and other non-linear specifications have produced some interesting findings. The general conclusions suggest that

student achievement is increased when school resources are applied differentially to low income vs. high income students, Black vs. non-Black students, and, most clearly, to low achieving vs. high achieving students. This raises the question whether educational output should be regarded as a multi-product activity. Alternatively, perhaps the empirical work of this paper is best thought of as an estimation of a number of separate production functions for these different types of students which has been handled in one equation for reasons of statistical convenience and efficiency.

It suggests that there may not be a single, monolithic production function for a school or a school district, that there may be a series of production functions corresponding to certain recognizable characteristics of student inputs. It further suggests that differential application of resources would be necessary for different categories of student inputs to achieve maximum increase in achievement gains. What it is saying is that the same resource input, whether it be length of teacher experience, or class size, "bright" or "less bright" teachers can have differential impact on different categories of students at different levels in the school structure as different achievement outcomes.

#### **Problems and Issues in the Specification and Measurement of Outcomes**

The most common outcome of schooling used in the study of school effects or EPF is some measure of cognitive achievement for subjects like Mathematics, Science, reading or verbal skills, while affective and psychomotor outcomes such as citizenship, self concept, maturity and preferences are omitted (McDermott and Klein, 1974). But the school is a multi-product firm producing both cognitive and non-cognitive outcomes (Bowles, 1970; Katzman, 1971). Resources that enter into the school production function often yield joint products and in many instances it is not possible to separate the resources that go into the improvement of, say, Geography, History and even Mathematics and those that go into the production of certain attitudes, values or patterns of conduct. The

production of one also yields products of another kind. Joint product analysis in economics is not very helpful in school production function because the joint products of the school are not in certain fixed proportions as in such joint products as wool and mutton, or beef and hide. They are produced in unknown proportions irrespective of the resources devoted to cognitive or non-cognitive outcomes.

Even in the simple measure of cognitive outcomes, there is the issue of whether the mean or the variance of any cognitive measure is the appropriate one because some schools maximize the mean while others maximise the variance (Brown and Saks, 1975). Hence the common use of the mean score as the measure of some cognitive outcomes in EPF may in fact be an inappropriate measure. Even where the appropriate measure has been decided upon, the problem of the selection of inputs relevant to the selected output remains. Expenditure per pupil whether it be at the school or district level is too gross a measure in relating fiscal input to outcomes. The fiscal resources can be spent on numerous items and programmes and may have nothing to do with the outcome that is measured. Attributing resources to one group of students when they are in fact spent on another group leads to gross measurement error and biased findings.

There is the further problem and issue of what the school is maximising. Indeed, it is conceivable that different schools seek to maximise different outcomes. One school may decide to maximise Mathematics or Science or the cognitive aspects of schooling while another may seek to maximise athletic prowess or football skills. Yet another may maximise good citizenship behaviour. To select an outcome a priori without reference to the actual maximising behaviour of schools is to specify a production function that is non-isomorphic to the diversity of decision making with respect to school outcomes.

Even when the outcomes are known, the measurement problem remains. For cognitive outcomes, the usual instrument is the Standardised Achievement Test. Apart from the validity and reliability of the instrument, test situations are stressful ones and the score may not reflect the amount of knowledge gained.

Some of the problems related to the use of Standardized Achievement Tests are:

- (1) They are designed to test content though the course programme of each school may vary. Is this then a valid test of school output?

- (2) Poor test design, poor, confusing instructions, and the lack of uniformity in test administration may render the test non valid.
- (3) Another problem is that some tests test more than what they purport to test. For example, a reading test includes a test of reasoning ability which is influenced by home background.

Another issue is whether the Standardized Achievement Test is really the appropriate instrument for measuring cognitive outcomes. Standardized tests were constructed to rank individuals with respect to norms despite curricular variation across schools and districts. Items with little variation are dropped. Perhaps instruments designed in this way are inappropriate for studies which assess and compare different schools and curricula. Perhaps different school tests would be the more appropriate instruments for outcome measures (Cohen and Garet, 1975; McDermott and Klein, 1974).

In spite of some reservations regarding the measurement of cognitive outcomes, it is decidedly less problematic than the measurement of affective outcomes. Conceptually, there is the definitional problem of delineating mutually exclusive affects, of disentangling values from attitudes and attitudes from their cognitive component. The second problem refers to the validity and reliability of the instruments to achieve such measures. Measurements of attitudes and values or perceptions of significant others by students are fraught with instability and vulnerability to change. Different wordings of the questions would elicit different responses and the measure obtained may not represent the "objective" attitude of the respondent. There is also the notorious lack of isomorphism between expressed attitudes and actual behaviour or conduct. The murkiness of the social-psychological variables, which are theoretically interesting and relevant, has induced many a researcher to omit them in favour of more stable measures in cognitive outcomes. Of the 22 research studies reviewed in "How Effective is Schooling?" (Averch *et al.*, 1974), 21 use cognitive measures as the dependent variable. Only one study uses the student's and parent's attitude and grade expectation (and the fourth is the student's verbal score) as the dependent variables. "The measurement of educational output is in a primitive state, and educational decision makers should be extremely cautious in formulating substantive educational

policies on the basis of present productivity studies" (Alexander and Jordon, 1976).

### Concluding Remark

Since Coleman's EEO Report, the school effects or EPF literature has proliferated. Controversy over theoretical positions and appropriate statistical techniques has led to new efforts and innovations resulting in more sophisticated designs and techniques. As research designs become more complex, techniques have been developed to handle non-recursive models. Controversy over the appropriate unit of analysis has led to advance in our knowledge and understanding of operational links and relationships at the district, school, class and individual levels. The next stage is the development of an overarching theoretical framework within which all levels may be included in a grand model which seeks to articulate what happens to individuals within the constraints of a particular class embedded in a particular school and district. But the basic processes of what happens in the classroom and the mechanisms of achievement still remain relatively unexplored. The black box in input-output studies still remains a closed book. Clearly then, the line of inquiry that seeks to shed some light on what goes on in the black box deserves close attention. The second need is to search for higher order theoretical concepts from which causal relationships may be articulated. The third need is for a theory of schooling without which further research on school effects may still take on a groping in the dark. But the last decade has seen school effects study reach a new height of maturity.

This paper does not speak to the social-psychological processes that mediate between the structural factors and achievement. The sociological viewpoint that much behaviour can be interpreted in terms of structural factors may be defensible considering the murkiness of the social-psychological variables that are theoretically interesting and relevant to the achievement process but are subject to instability of measures. There is also the notorious lack of isomorphism between expressed attitudes and actual behaviour.

Recent advances in theoretical conceptualization of factors which make for effective schooling have stimulated new research into educational productivity by the Centre for Educational Finance and Productivity located in the University of Chicago. ☞

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