Human Resources Development and Operations Policy

HRO

Working Papers

Concepts of Educational Efficiency and Effectiveness

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March 1994

HROWP 24

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Abstract

This paper provides a conceptual framework for addressing efficiency in education, considers how this concept compares to other related concerns and issues, and discusses constraints on improving efficiency. It argues that both the complexity of the educational process and the absence of relevant information hinder the use of efficiency measures for informing education policy decisions.

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Introduction

The term "efficiency" is used in many ways in educational discussions, and the general lack of a consistent definition at times produces very misleading discussions and policy recommendations. Here, we provide a conceptual framework for addressing efficiency in education, consider how this concept relates to other related concerns and issues, and discuss constraints on improving efficiency. A closely related concept — effectiveness — is also developed.

The rationale behind efficiency concepts is straightforward. When there are limited resources — as there always are -- those resources should be used to promote society's objectives as fully as possible. This is efficiency. The confusion over its application to education, has, however, led to less than complete acceptance of the concept. We take the position that efficiency, when properly applied, is a desirable and appropriate goal for educational systems.

Efficiency and Effectiveness Defined

Efficiency refers to a comparison of inputs and their related outputs. A more efficient system obtains more output for a given set of resource inputs, or achieves comparable levels of output for fewer inputs, other things being equal. (For technical discussions, see Hanushek 1986; Levin 1976, 1983; Pogrow 1983; Rossmiller and Geske 1976.) As a practical matter, if we are to compare the outputs produced by two different sets of inputs, we must measure the inputs in common units — and this implies that efficiency comparisons generally will rely upon

measuring inputs in monetary units since inputs can seldom be compared in other units.

Evaluation of efficiency in educational systems is, moreover, complicated by the fact that students not only learn in schools but also in their homes and on playgrounds. Therefore, the appropriate output for efficiency considerations is that portion of student growth or development that can be reasonably attributed to specific educational experiences — in other words, the marginal improvements that would not have occurred without the inputs of the educational system. These outputs might include the development of additional literacy and numeracy skills, positive attitudes toward work, civic responsibility, or a myriad of other specific skills, attitudes, and beliefs that exceed what otherwise would have been developed without the schooling in question.

Educational efficiency is frequently confused with educational effectiveness, and at times the two terms are (inappropriately) used interchangeably. Educational effectiveness is whether or not a specific set of resources has a positive effect on achievement and, if so, how large this effect is. Clearly, since effectiveness does not directly compare resource uses or costs, what is effective is not necessarily what is most efficient. (See, for example, Levin, Glass and Meister 1984 for comparisons of cost-effectiveness of alternative inputs.) This confusion is fostered in part by the frequent research finding that many traditional school resources in developed countries do not appear to be effective in raising student output (Hanushek 1986). Given this backdrop, many conclude that, if we find anything that appears effective, it would be appropriate to develop policies pursuing it. This, however, does not follow without some consideration of the costs of providing the input.

To complete our overall taxonomy, evaluation can be restricted to just the educational

system (internal) or can range into other sectors (external). The distinction is simply whether or not it is possible to make direct comparisons of resource usage in education and in other sectors, which in turn reflects whether or not there are ways to compare resource usage and outputs in different sectors.

These concepts allow a convenient classification based on the measurements of inputs and outputs. The inputs of the system determine whether the term "efficiency" or "effectiveness" is to be used. The outputs of the system determine whether the descriptors "internal" or "external" are applied to efficiency or effectiveness. The logic follows directly from the previous concepts. Since, for example, test score gains cannot generally be compared to child mortality rates, educational analyses considering the determinants of test score performance cannot easily be adapted to evaluating resource usage across the educational sector and other sectors. Similarly, without a direct way of comparing inputs, it is impossible to make efficiency judgments about policies related to alternative input bundles.[1] Table 1 provides a schematic representation of these distinctions, and the following sections amplify the ideas behind the taxonomy.

Internal Effectiveness. When outputs are measured in purely educational values such as test scores, policy deliberations are generally restricted to alternative uses of resources within the educational sector. The inputs of education include both material and non-material resources, with the latter term used to encompass pedagogical practices and the organizational

[1] This classification scheme does have some exceptions. For example, programs of school lunches and of food stamps for families could both lead to improved health of children, and an analysis of external effectiveness could be conducted even though it would "violate" the rules in the table.

Table 1: Internal and External Effectiveness and Efficiency of Educational Systems

	Outputs measured in non-monetary terms (#) Example: learning achievement	*Outputs measured in monetary terms ($) Example: earnings*
Inputs measured in non-monetary terms (#) Examples: number of textbooks, classroom organization, years of teaching experience	INTERNAL EFFECTIVENESS[a] (technical efficiency: #/#)	EXTERNAL EFFECTIVENESS ($/#)
Inputs measured in monetary terms ($) Examples: cost of textbooks, teacher salaries	INTERNAL EFFICIENCY[b] (effectiveness-cost: #/$)	EXTERNAL EFFICIENCY (benefit-cost: $/$)

Note: All ratios refer to the ratio of outputs to inputs, expressed in either non-monetary (#) or monetary ($) terms.

[a] A system is more internally effective (technically efficient) than another if, to produce the same level of output, fewer of at least one input are used.

[b] A system is more internally efficient than another if, to produce the same level of output, it is less costly.

structure of schools and school systems, as well as such items as teacher time and ability. Material inputs include such items as textbooks, instructional materials, desks and classrooms. Thus, the term "inputs" is not restricted in this discussion to only those inputs which can be expressed as physical quantities or in monetary terms.[2] In fact, we specifically include the complex interactions of students and teachers as elements of input, even though they are best expressed as processes rather than inputs. Internal effectiveness is also closely linked to what economists call "technical efficiency." The organization of available resources in such a way

[2] Economic theory traditionally distinguishes between physical inputs and descriptions of the process. For discussions of education, these distinctions are difficult to make and do not help in policy deliberations, as long as the costs and effectiveness of "soft" inputs are adequately evaluated.

that the maximum feasible output is produced is technically efficient (Levin 1976), and would be equivalent to "maximum internal effectiveness" for a set of inputs.

Internal Efficiency. The term "internal efficiency" of education refers to a comparison of learning (a non-monetary outcome of education) to the costs of educational inputs; the analysis typically employed is cost-effectiveness. Internal efficiency addresses the question of how funds within the educational sector should be best allocated. It is concerned with obtaining the greatest educational outputs for any given level of spending. Economists have a simple conceptual rule to determine how resources should be allocated among alternative educational activities: the improvement in educational performance that results from the last amount of funds spent on an educational activity should be equal across each possible activity. For example, consider a school that is deciding between buying new workbooks for students and hiring a part-time teacher to tutor individual students. Clearly, the school should spend the funds on the one that increases performance the most -- say workbooks in this example. In fact it should continue spending money on workbooks until the educational value of the two choices is the same. (After the initial purchase of workbooks, the value of added workbooks is probably lessened so that at some level of spending the appropriate decision is to purchase a tutor instead of more workbooks.) The same logic holds for all of the inputs that a school purchases, leading to the previously stated rule. Internal efficiency is also sometimes referred to as "allocative efficiency" or "price efficiency" (Levin 1976).

External Effectiveness. External effectiveness has to do with the relationship between

non-monetary inputs and monetary outputs. In education, this could refer to the degree to which certain pedagogical practices or school tracks affect student post-graduate salaries, other things equal. Studies contrasting the earnings of technical-vocational track graduates with the earnings of students graduating from academic tracks are examples (e.g., Psacharopoulos and Loxley 1985).

By measuring outputs in monetary values, it is possible to compare educational programs directly to other potential uses of society's resources. For example, the income gain from a vocational education program could be compared to the income gain from an on-the-job training program. However, by itself, this type of analysis does not provide much policy guidance because the resources required to achieve the gain are not specified. Such analyses are usually conducted as a first step to a "cost-benefit" analysis.

External Efficiency. By external efficiency, we refer to what is often the topic of cost-benefit analyses: that is, the ratio of monetary outcomes to monetary inputs. Extensive consideration has been given to the issue of "external efficiency," or how the overall use of money for schooling compares to other potential public and private uses. If a country received $1 million, should it channel this to education or to some other expenditures? The answer depends crucially upon a comparison of the benefits of the alternatives. In perhaps the simplest consideration, one can calculate the rate of return to an investment in education and then compare this with an alternative investment. The analysis of returns to schooling (e.g. Psacharopoulos 1973, 1981) is an example. This is complicated — in large part because the calculation of benefits is frequently difficult — but it has proven to be a very useful approach

for policy considerations.

The analysis of external efficiency provides information that is useful in deciding upon the right level of educational spending for a country, or in deciding upon the allocation of funds across different sub sectors such as primary education or vocational training. It does not, however, provide guidance about the specific policies that should be pursued within the educational sector. This guidance is provided through analysis of internal efficiency.

Efficiency Related to Alternative Criteria

Five issues are indirectly related to the measurement of effectiveness and efficiency. These are: the broader consequences of education, equity considerations, specification of quantitative versus qualitative outputs, and cost minimization.

Broader Consequences. The rationale for investing in education often has to do with its indirect effects on desirable social goals — that is, it improves individual productivity, nutrition, and health; it aids in achieving other societal goals, such as fertility objectives; it relates to income distribution concerns; and so forth. These objectives are mediated by different direct outputs of the education system: cognitive skills, attitudes and behaviors. A direct implication of this is that different conclusions regarding effectiveness and efficiency will be drawn, according to the particular outcome criteria that is chosen.

It is not difficult to develop effectiveness and efficiency analyses when there are means of directly comparing benefits in different dimensions, such as by placing a monetary value on

each output. The required weights for such alternative outputs as literacy, numeracy and civic responsibility, however, do not generally exist, and hence effectiveness and efficiency analyses typically address single outputs only.

Equity. A second and more fundamental issue in analyzing effectiveness and efficiency is the general neglect of any distributional matters, since both effectiveness and efficiency considerations gloss over who benefits. If, however, there is a systematic distributional component that differs across policies, the most "effective" or "efficient" policy may not always be the optimal policy for society. (Typically, economic analysis would presume that resources should be employed in their most productive use, maximizing the total amount of output. Then, if redistribution is a separate goal, other policies should be pursued to attack that area directly. Various political or cultural constraints might, however, make these latter policies difficult.)

Measuring Outcomes: Quantitative Comparisons. The most common "output" measure used in research in developing countries is counts of students: enrollment rates by ages, grades, or level of schooling; continuation rates or dropout rates at specific ages or grades; and repetition or completion rates by grade or level. Each measures some aspect of the flow of students through schools.

None of these measures is appropriate for judging the internal effectiveness or efficiency of schools. While measures of the quantity of schooling received by children can provide some aggregate descriptive comparisons, say across countries or across regions within a country, they are not very useful for policy purposes unless there is a precise standard of the knowledge

acquired, say for any grade comparison.

Moreover, it is very possible to develop policies that, for example, increase the continuation rates in schools but do so at the expense of children's learning. The quantity of schooling is obviously related to the amount children learn, but the relationship is not consistent across children, schools, and countries. All available evidence suggests clearly that policies to increase the amount of primary schooling, and thereafter secondary schooling, are desirable. This does not, however, mean that all "improvements" in quantity mark "educational" improvement, since some might not be warranted if learning declines as a result. For example, repetition rates in primary grades can be changed by direct governmental policy; yet lowering repetition rates in a mechanical way might reduce the amount students learn.

The popularity of quantitative measures is clearly related to their availability, not their conceptual desirability. While they may be useful for aggregate and cross-national comparisons, they cannot provide real guidance to the efficiency discussions here. The important issue is the different kinds of policy discussions and deliberations that are being considered. For a country that does not have universal primary education, expanding exposure -- almost regardless of quality considerations -- is likely to be an appealing policy. But once general exposure, which can be justified on equity grounds, is reached, educational policies switch from purely quantity considerations to differential quality.

Measuring Outcomes: Standardized Tests. The most commonly used measures of school performance are scores on standardized achievement tests.[3] By standardized tests we refer to

[3] Standardized tests include both fixed response (e.g. multiple choice) and constructed response (e.g. essay, performance) questions.

tests that are constructed, administered, scored, reported and interpreted in a consistent fashion to provide for the measurement of individual differences in as unambiguous ways as possible (Anderson, Ball and Murphy 1975). Properly treated, standardized tests provide consistent information across schools, as well as indications of performance differences among children within the same school. Although studies linking performance on standardized tests and subsequent outcomes are few, when tested, there is a strong positive relationship between test scores and subsequent labor market earnings (see Boissiere, Knight and Sabot 1985).

At primary levels, standardized tests provide good indicators regarding student attainment of principal educational objectives: functional literacy and numeracy. In later grades, where other objectives of schooling increase in importance, standardized tests covering the entire curriculum are more difficult to construct. In higher education there are very few cases in which learning outcomes have been successfully measured.

Cost Minimization. Efficiency considerations in educational policy has received a bad name in part because some equate it to cost minimization. Clearly, however, the idea of efficiency is gaining the most output from a given expenditure on inputs or resources. Similarly, the pure maximization of students' future incomes for any given school expenditure may not be the efficient solution when there are other outputs valued by society. Standardized tests include both fixed response (e.g. multiple choice), and constructed response (e.g. essays and performance tasks) questions. Importantly, it is necessary to distinguish between the conceptual goals and potentially faulty applications.

Constraints on Improving Internal Efficienc

Efficient use of resources is especially important in the case of education in developing countries. Most countries make education a priority spending item, and education tends to consume large portions of governmental budgets. Yet education must compete with other uses of funds, both public and private. In times of fiscal pressures on governmental budgets — whether these arise from poor performance of the economy or from the competition of other governmental programs — education spending comes under intense scrutiny. If it appears that funds allocated to schooling are being wasted — that is, inefficiently used — arguments for cutting back expenditures are strengthened.

Internal efficiency of education can be improved in two ways: (a) by reallocating resources from inputs that have smaller effects on learning to those than have larger effects on learning, that is, by increasing outputs associated with given levels of resources, and (b) by reducing overall resources while maintaining existing levels of learning.

Improving efficiency has obvious appeal, particularly in the face of the fiscal pressures facing most school systems. But there are many reasons why it might not be achieved; this discussion identifies three of the more important ones: (a) inadequate knowledge about internal effectiveness, (b) inadequate knowledge about costs of inputs, and (c) difficulty in obtaining appropriate information.

Effectiveness of Inputs. Informed policy making requires information about the effect on educational outcomes of adding (or subtracting) every possible educational input (that is,

knowing the internal effectiveness of all resources). These informational requirements are obviously very large. Such information can come from many sources: educational experiments, research into scholastic performance, or experience and observation. Each source has its advantages and disadvantages, but none is likely to provide a complete picture.

Educational administrators, policy makers, and researchers must each be able to separate the influences of the different inputs to the educational process in order to judge their effectiveness. This is frequently very difficult to do because inputs tend to be related to each other. For example, well educated parents are likely to provide learning in the home and send their children to schools having more resources and better trained teachers. Similarly, illiterate parents in developing countries are likely to send their children to schools having few material resources and poorly educated teachers. In both cases, it is difficult to separate the influence of specific school inputs from each other or from that of parents. Other examples pointing to the difficulty in separating the distinct inputs to education are easy to develop.

Current knowledge of the educational process both in developing countries (Fuller 1987; Harbison and Hanushek 1992; Lockheed and Verspoor 1991) and developed countries (Hanushek 1986, 1989) is actually quite primitive. The effectiveness of some inputs is known, but the evidence is not very precise. The result is that inefficiency can be very large simply because there is insufficient information upon which to base policies.

Costs of Inputs. A second element needed for policy and analysis into the internal efficiency of the educational system is the cost of separate inputs into the process. If there are several inputs known to be beneficial to education, the efficiency criterion would dictate

allocating resources in a way that also considered costs. Specifically, more expensive inputs should be more effective in order to compensate costs.

The estimation of costs of inputs, while apparently quite straightforward, can be very difficult, and current knowledge of costs in conjunction with effectiveness is extremely limited (Lockheed and Hanushek 1988; Harbison and Hanushek 1992). Costs must be directly linked to the inputs identified in the effectiveness discussion. If attempts are made to describe inputs in great detail -- perhaps linking process choices of teachers and the like -- the costs must relate to providing inputs of such a description. This rapidly exceeds our abilities, because little is known about the supply of many of the inputs. For example, the supply of teachers with a given level of schooling has been estimated as a function of salaries; the supply of teachers with a given schooling and verbal ability level, with a pedagogical style emphasizing student questioning, with a fluency in several languages, and so forth has never been systematically studied. Most cost estimates, therefore, are very general.

Difficulty of Obtaining Information. The difficulty in developing better information about the educational process reflects several factors. First, the complexity of the problem means that any research/information gathering effort must be quite sophisticated, utilizing multiple instruments to measure both inputs and outputs and employing complex research designs. To identify relationships fully, experimental designs with effects traced over several years are desirable. Such projects are rarely undertaken anywhere.

Second, systematic analysis of the type needed to support large policy initiatives is costly, thereby making it an appealing target in times of fiscal stringency. It is noteworthy that, while

the World Bank has invested over $10 billion in education projects, research necessary to answer questions about the internal efficiency of education has been conducted in around 10 instances (see Lockheed and Rodd 1990). A similar story holds in the United States and other developed countries.

Third, and perhaps most fundamentally, the nature of schooling in the countries where studies have been undertaken may obscure any basic relationships. If identified inputs into the educational process do not have a consistent relationship with educational outcomes, observations of the inputs by different people at different times could yield mixed findings. Such could be the case if the educational system exhibited a noticeable degree of technical inefficiency (internal ineffectiveness); that is, if inputs were not used in such a manner as to achieve the maximum feasible output. For example, a textbook in the wrong language or a teacher improperly prepared for a specific subject would almost certainly be worse than if these were appropriately arranged. In some schools (those using the correct books) it might appear that textbooks were a very effective educational input, while the experiences of other schools (those using the wrong books) might suggest no impact of textbooks. Technical inefficiency, which is essentially the wastage of specific resources, makes it difficult to predict or evaluate the potential advantages of different policies.

Technical inefficiency can exist for a wide variety of reasons. It might reflect historical but outdated policies; overt and knowing waste; or simple mismanagement. But it might also reflect the complexity of the educational process and the difficulty of properly identifying effectiveness in both research and policy analysis. In the simple example above, it could be that properly measured inputs of textbooks (such as an appropriate arithmetic book in the correct

language used immediately after the previous text in the same series) has a consistent effect on achievement, even though simply measuring the presence of any book in the school has no consistent effect. The case of teachers is much more complicated because the possible identifying characteristics make up a very long list -- one far exceeding any available analysis.

The underlying requirement in measuring effectiveness and in evaluating potential policies is the identification of a given set of inputs that have a homogeneous relationship to student outcomes. Doing this might involve specifying complicated interactions among teachers, the various process choices they make in the classroom, and the environment of the schools and macro process choices. The more complicated this is, the less likely any research is to be successful and the less likely it is that fully articulated policies can be developed.

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