IMPROVING THE EFFICIENCY OF EDUCATIONAL SYSTEMS

INDICATORS OF EDUCATIONAL EFFECTIVENESS AND EFFICIENCY

January 1988

IEES

Improving the Efficiency of Educational Systems

The Florida State University
Howard University
Institute for International Research
State University of New York at Albany

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PREFACE

When I was asked originally to prepare a monograph on indicators of educational efficiency, my initial response was negative. The excellent work done on the topic of educational efficiency over the last decade by such economists as Mary Jean Bowman, Eric Hanushek, and Henry Levin has recently been supplemented by two extensive World Bank survey papers by Bill Fuller and Marlaine Lockheed.* This raised a serious question both as to the need for and potential value-added of a monograph such as this one. The issue was reinforced by the fact that my own papers, Internal Efficiency and the African School (prepared for the World Bank) and--coauthored with David Chapman--the Evaluation of Efficiency in Educational Development Activities (prepared for the Improving the Efficiency of Educational Systems project), contained much of what I wished to say about the policy application of efficiency concepts to the evaluation of educational programs and projects.

However, in response to the entreaties of my IEES colleagues (most notably, David Sprague and Joan Claffey of the Agency for International Development and Robert Morgan of Florida State University) I agreed to accept the responsibility for preparing a paper on indicators of educational effectiveness and efficiency. The paper was to be designed as a companion piece to the Chapman/Windham evaluation monograph. There were four major justifications offered to me for preparing such a paper:

1. the opportunity to synthesize a large portion of the literature on educational efficiency in a form that would make it accessible and useful to a wide range of non-economist professionals;

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* Older researchers will remember that during previous incarnations of USAID interest in educational indicators, Selma Mushkin and her colleagues Fassil Kiros and Bradley Billings produced several reports on this topic. The most noteworthy are Kiros, Mushkin, and Billings, Educational Outcome Measurement in Developing Countries (1975) and Mushkin, Educational Outcomes and Nutrition (1977). The present effort recognizes the seminal nature of this early work and attempts to assure that the contributions of Mushkin, et. al., are not lost to the current generation of analysts and policymakers.

2. to distill from the varied experiences of the IEES project some of the lessons learned in terms of the opportunities and limitations encountered in promoting efficiency enhancement in a developing nation setting;

3. to detail how the products of efficiency analysis can inform the development of educational management information systems and data- based argument among educational administrators and policymakers; and

4. to create a basic text from which a set of management training manuals could be developed to promote the understanding and appropriate use of efficiency concepts in educational decisionmaking.

With these four justifications as goals, work on this monograph began in April, 1987. Two immediate problems were encountered. The first was the need to compromise between the level of detail and analytical sophistication that exists in the economic literature and the types of data and issues faced by educational decisionmakers in most developing nations. Because the large majority of decisionmakers in such settings are not formally trained in economics, there was a derived need to decide how much background in economic theory was required to present the efficiency concepts in a meaningful manner. Based on my personal experience in training and counterpart situations with colleagues in such settings, the material presented here has been designed to require no formal experience in economics but to rely heavily on the reader's intelligence, industriousness, and openness to new concepts. It was felt that some concepts might prove redundant to the experience or training of some decisionmakers; however, when these cases occur, it was felt that it is easier for these individuals to skip over a section than it would be for the other readers to understand the use of the concepts without some discussion the concept's assumptions and derivation.

The second compromise required was between a personal desire to advocate the increased use of efficiency concepts in educational planning and evaluation activities and a professional responsibility to couch such advocacy in terms of the constraints that exist in the application of efficiency concepts to the real world of educational decisionmaking. However, it should be stressed that many who express concern about the emerging emphasis on efficiency applications to education are confusing efficiency with fiscal reductions. This monograph tries to resolve this confusion and to distinguish self-interested objections to educational accountability from legitimate concerns over any excessively mechanistic approach to the crucial decisionmaking concerning the lives of students, teachers, and parents.

As has already been indicated by the comments of my colleagues who reviewed the first draft of the monograph, not everyone will agree with where I have drawn the line between the interests of economists and those of educational decisionmakers or the position I have taken between advocacy and the promotion of skepticism. My consolation lies in the fact that the reviewers disagreed as much among themselves as with me on these issues and that no solution existed to satisfy all of them.

Since this paper draws on my experiences in a variety of nations over the last fifteen years, any list of acknowledgements must be incomplete. I will begin by repeating my debt to Drs. Sprague, Claffey and Morgan for their encouragement that I undertake this project: I hope they have a minimum of regrets now that it is done. I owe a special debt to those colleagues who reviewed the draft version of the monograph in detail (Stephen Hoenack of the University of Minnesota, Donald Winkler of the University of Southern California, S. Thiagarajan of the Institute for International Research, Frank Farner of the World Bank, and Dan Levy, David Chapman, and Frances Kemmerer of the State University of New York at Albany). They, of course, are not responsible for any failures by me to incorporate their comments or to do justice to their many excellent suggestions.

In addition, I am very appreciative of the support provided by colleagues such as Gary Theisen, Mark Rilling, and Frank Method of the Agency for International Development; Stephen Heyneman, Marlaine Lockheed, and Jacques Hallak of the World Bank; Bikas Sanyal of the International Institute for Educational Planning; Jack Bock, Jerry Messec, Peter Easton, and Steven Klees of Florida State University; Willie Howard of Howard University; Victor Cieutat and Mary Pigozzi of the Institute for International Research; Valerie Janesick of the University of Hawaii; and all of my colleagues at the State University of New York but with special appreciation to Philip Foster, Warren Hehman, Robert Koff, Alan Purvis, Jerry Strudwick, and Frederick Dembowski. Also I wish to extend my strong appreciation to my international colleagues on the IEES project advisory committee: Minister Othello Gongar of Liberia, Deputy Minister Abdul Garada of the Yemen Arab Republic, Mr. Jakes Swartland of Botswana, Pak Moegiadi of the Republic of Indonesia, Mr. Ali Gaal of the Somali Democratic Republic; and to Mr. Ma Weixiang of the State Education Commission and Mr. Cai Pei-Yi of the Shanxi Province Education Department, People's Republic of China. Whether purposefully or inadvertently, all of these individuals have profoundly affected the manner in which I approach the economic analysis of education.

My colleague, Dr. Kemmerer, deserves special commendation in another respect as well; as Institutional Coordinator for the IEES project at the State University of New York at Albany she has organized the administrative office in such a manner that the

logistics of this volume were handled expeditiously even though I was away from Albany during most of the period of the volume's preparation. The two most valuable persons involved in this whole production process were [redacted], [redacted] IEES Project Administrative Assistant, and Ms. Catherine Wightman, Project Secretary. Their work on this activity was exceptional in every way--which for them is an unexceptional occurrence.

Finally, I must acknowledge the debt owed to Ms. Jeannette Windham. Her editing skills are sorely tested in attempts to control my abhorent spelling, convoluted sentence structure, and perverse preference for alliteration. However, more important than these efforts are her continued patience, support, and affection without which neither this paper nor any other meaningful task could be accomplished.

CHAPTER ONE

THE CONCEPT OF EDUCATIONAL EFFICIENCY: AN INTRODUCTION

The purpose of this monograph is to identify appropriate quantitative indicators of educational effectiveness and efficiency and to discuss how such indicators should be used in assessing education at multiple levels of the educational system. These statistical indicators of educational effectiveness and efficiency are required to document the present status of educational activities, to establish alternative goals for the education and human resources (EHR) system in terms of how it should appear at some future time, and to operate as benchmarks to define systemic progress toward better utilization of existing resources by the educational system or by individual educational organizations.

The primary audiences for whom this monograph was written are the mid-level planners and evaluators in developing nations responsible for educational decisionmaking as well as the university, government, and other advisors who assist these personnel. For some, the volume may serve as a self-instructional text; for others, it will prove more useful as a reference work. To increase the potential contribution of this volume, educational management training modules will be developed from this monograph. These modules will be designed for use in both group-instruction and self-instruction settings.

The secondary audience for this volume is much wider and is inclusive, specifically, of education and evaluation professionals concerned with resource allocation in education and education's relationship to personal and national development and, generally, of any educationalists, social scientists, or other parties interested in the status of the application of economic concepts to educational analysis. Because of these multiple audiences, some sections of the volume may be in excessive detail for some readers already familiar with the material while in other sections, readers may wish to refer to the cited literature for a more detailed introduction to concepts with which they are unfamiliar. However, the volume is designed for use as a self-contained presentation of the issues of educational effectiveness and efficiency since many readers may not have the time or access to other resources required to supplement this volume. It is hoped that, while any individual reader may desire less of some discussions and/or more of others, the large majority of readers will find the volume useful and adaptable to their own training, experience, and professional needs.

This monograph is designed as a companion volume to Chapman and Windham, The Evaluation of Efficiency in Educational Development Activities (1986). That monograph examined issues related to the design and conduct of program and project

evaluation of activities that have the enhancement of educational efficiency as a goal. While it dealt extensively with the context, techniques, and processes of efficiency evaluation, the prior monograph did not deal in detail with the alternative means of operationalizing effectiveness or efficiency concepts. While this monograph is designed to be of benefit as an independent volume, greater value will be derived by those familiar with the concepts and issues treated in the Chapman and Windham monograph.

In the last decade there has been a great increase in the attention paid to efficiency issues in regard to the role education can play in development (e.g., Windham, 1982B; Psacharopoulos and Woodhall, 1985; Windham and Wang, 1986). This increased attention has been brought about by the constrained fiscal conditions under which most developing nations are forced to operate and the heightened demand in these nations for resources from the EHR sector itself, from other social service sectors, and from the infrastructure sectors (e.g., transport and communications). Within this fiscal environment, the debate over efficiency issues has evolved into three forms of discussion: (1) rhetorical, (2) conceptual, and (3) practical.

The rhetorical discussion of educational efficiency is best characterized by the treatments found in most national planning documents and the policy papers of the international donor agencies. Here, "efficiency" is rarely operationalized and even when used as a general concept, it is often unclear whether efficiency is meant to exist as a goal in and of itself or as a means to some other end. However, "efficiency" normally is assumed to be an inherently good thing and efficiency enhancement activities often are cited as a means of increasing the availability of funds required to improve educational access and/or quality.

Within the rhetorical discussion of efficiency there is a minority view that is less supportive of the concept. The "efficiency movement" is viewed with suspicion by those who fear that educational efficiency will manifest itself primarily in the forms of lower fiscal allocations and reduced unit costs. Again, the "efficiency" standard is rarely defined by these critics who tend generally to oppose most encroachments by economists and financial analysts into the educational domains of pedagogues, administrators, and policymakers.

While much of the policy debate over educational efficiency has been conducted at this first level of abstraction, economists in the last decade often have concentrated on equally abstract conceptual and definitional distinctions at the expense of pragmatic issues of relevance to administrators and policymakers. The economists' focus on taxonomic issues (internal versus external efficiency, private versus social costs and effects, technological versus economic efficiency) has been useful to those noneconomists who have taken the time to master the terminology; unfortunately, few have been persuaded to do so because most educational administrators and policymakers

operate in an environment that does not always allow for the fine distinctions and deliberations called for by the economic literature.

Thus, in the last decade the discussion of educational efficiency has been balanced between these polar forms of abstraction: the practitioners' undefined use of efficiency as a totem-word and the economists' multiple use of efficiency as a context-specific concept. Inadequate attention has been paid by both groups to practical applications of the efficiency concept to educational activities. Practitioners often are uncomfortable in discussing these issues because they feel they are at a disadvantage relative to economists in specifying operational measures of efficiency and in understanding the interpretive biases inherent to any such practical definitions. Similarly, economists have manifested a reluctance to abandon the purity of their conceptual definitions to deal with issues of practical specification and quantification. As will be explained later in this monograph, any operational definition of educational efficiency is subject to legitimate questioning. Any economists who advocate or appear to advocate particular efficiency measures are open to criticism from their colleagues for the conceptual inadequacy of a particular measure or the inadequacy of the form of its quantification.

This monograph will focus on the practical aspects of introducing effectiveness and efficiency concepts and measures into the deliberations of educational practitioners -- especially administrators, planners, and policymakers. While the discussion will originate from and be based upon the conceptual definitions taken from economics, the proposed indicators and their uses will be judged primarily in terms of their appropriateness in the settings in which most educational decisions are made. Decisionmakers must recognize that they never have all of the information they need or all of the time they want: decisionmaking in educational efficiency requires a forced trade off of the quantity and quality of information versus the timeliness and effectiveness of decisions.

The remainder of this monograph is arranged in four major parts. The immediately succeeding section will deal with the conceptual and definitional issues related to the measurement of educational effectiveness and efficiency. The appropriateness of the application of the efficiency metaphor to education will be reviewed and specific definitions for common terms will be proposed. The second major section of the monograph will deal with indicators of educational effectiveness; one chapter will deal with input and process measures and a second with output and outcome measures. In the discussion, the various indicators will include both those that are specifiable in financial terms and those that can be expressed in quantifiable but not financial terms. Also, the role for qualitative indicators in efficiency analysis will be discussed. The third major section of the monograph will present a review of basic cost issues and will demonstrate how efficiency analysis is conducted under four alternative forms: benefit-cost analysis, cost-effectiveness analysis, least-cost analysis, and cost-utility analysis.

The final major section of the monograph will attempt to assess the policy relevance of indicators of educational effectiveness and efficiency as they relate to the development and use of educational management information systems. The discussion will focus upon the use of these indicators in policy decisions, the constraints and facilitators in the use of efficiency data, and the prospects for increased and/or improved use of effectiveness or efficiency data in the planning and operation of educational and human resources development activities. The monograph will conclude with a brief review and a set of recommendations of actions needed to improve the practical relevance of efficiency considerations to educational systems and institutions.

Before proceeding to the main text of the monograph, it is necessary to clarify some of the assumptions and emphases that have structured this presentation. There are seven main statements that should help with this clarification:

1. There is an emphasis upon collective and public decisionmaking in regard to education but attention also will be given to the use of indicators in the support of individual decisionmaking;

2. There is an emphasis on applications of educational efficiency indicators within developing nations (especially those in Africa and Asia) but the preponderance of the discussion has equal relevance to developed nations;

3. The focus of the discussion and the preponderance of examples will be on primary and secondary education (including vocational/technical/ commercial alternatives) but, except where noted, the discussion also would apply to pre-primary, post-secondary, and both formal and nonformal adult education and training activities;

4. Efficiency indicators will be dealt with within the context of the need to create and utilize comprehensive educational management information systems within developing nations;

5. There will be a full discussion of the responsibility for efficiency indicators specifically and educational management information systems generally themselves to be cost-effective and responsive to the fiscal conditions of the nation;

6. The monograph's emphasis will be on the application of lesson's learned from the experiences of the Improving the Efficiency of Educational System's (IEES) project with a major secondary focus on the larger educational development literature; and

7. All discussion will have as its goal the practical and operational aspects of efficiency assessment within the context of the efficiency concept's advantages and limitations.

CHAPTER TWO

DEFINITIONAL AND METHODOLOGICAL ISSUES RELATED TO THE CONCEPT OF EDUCATIONAL EFFICIENCY

The purpose of this chapter is to provide an introduction to the nature of the concept of efficiency, as currently used by most economists, and the advantages and disadvantages one encounters in applying the concept to an activity as internally complex and contextually diverse as education. In this chapter, a set of definitions will be established that will serve as the basic terminology used in the subsequent discussion of specific indicators of educational effectiveness and efficiency. The discussion will introduce the four major forms of efficiency analysis applied to education: benefit-cost, cost-effectiveness, cost-utility, and least-cost models will be presented. The chapter will conclude with a review of five major limitations that exist in attempts to apply the economists' models of cost and productivity to education.

It is surprising to most non-economists to learn that the concept of efficiency is, in fact, a relatively new emphasis within the lexicon of economics. Schumpeter's History of Economic Analysis (1966), the standard for the treatment of the development of Western economic thought, has not a single index reference to efficiency. Part of the reason for this earlier lack of overt attention was that the efficiency concept was implicit to the market models developed by Western economists from the late 1700s up to the 1930s. Only in the last fifty years has great attention been directed toward issues of measurement and empirical testing of the deductively derived theories of neoclassical economics (Jonnson, 1975).* The result of this new emphasis on quantification has been to raise the issues of the operationalization and measurement of the economic variables. The economist no longer can be satisfied simply to state that under a given budget, efficiency exists, for a producer when the marginal cost of an output from a production process equals the output's marginal revenue product or for a consumer when the ratio of the marginal costs of all consumption items to their marginal utility are equal. Without debating the contribution that these abstract models (and the neoclassical insistence upon defining equilibria as optima) have had for understanding social and market phenomena, there has been a recognized need to produce a practical and adaptable form of efficiency that can advance the management of private and social enterprise.

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* Schwartz and Berney (1977) offer an excellent set of discussions dealing with the neoclassical economists' approach to the efficiency concept.

Chapter 2

The economic concept of efficiency is a metaphor borrowed from engineering relationships. In any technical process efficiency is defined as existing where the desired mix of outputs (effectiveness) is maximized for a given level of inputs (cost) or where inputs are minimized for a desired mix of outputs. It is important to recognize from these definitions that the concept of effectiveness (how well or to what extent the desired outputs are achieved) is subsumed in the concept of efficiency (effectiveness relative to cost). In the following sections of this monograph, the term effectiveness will be used when indicators represent outputs or output proxies (input or process variables and outcomes) and efficiency when the indicators represent a comparison of effectiveness with costs. In all cases efficiency is a more inclusive term and implies both effectiveness and cost considerations.

If the definition of efficiency is specified in terms of physical quantities only, one has a definition of technological efficiency. If one modifies the concept to take into account utility* or monetary measures, a definition of economic efficiency is derived. Economic efficiency is defined as existing when the value of all outputs is maximized for a given cost of all inputs or where the cost of all inputs for a given value of all inputs. Both of the efficiency concepts, technological and economic, appear both rational and intuitively obvious. What is less obvious is how to measure inputs and outputs so one may know when efficiency exists and, in the case of economic efficiency, to know what values (costs or prices) to assign to inputs and outputs to avoid biasing the identification of efficiency.

In a competitive market situation all firms must strive to achieve efficiency because the inability or unwillingness to do so will mean that their competitors can charge lower prices and drive the "inefficient" firms out of the market. Efficiency in a competitive market is therefore a self-monitoring and self-equilibriating process. Since firms in a competitive market are, by definition, small relative to the total market, the individual firms have no effect on the cost of inputs or the prices of their products. Thus, economic efficiency can be defined in a non-arbitrary manner.

Unfortunately for those who prefer objective, mechanistic decision processes, the conditions of the competitive market are increasingly rare in general and simply do not exist in regard to the education and training systems of most nations. As will be developed here, the abandonment of the competitive assumptions does not reduce the importance of the efficiency concept; however, it does force those who wish to use it to

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* The economic concept of utility is dealt with at a later point. For the moment it is necessary to understand only that utility refers to perceived satisfaction or happiness.

deal with less than ideal proxies for their conceptual variables and to accept subjective responsibility for judgments concerning the values of inputs and outputs.*

In almost all situations, education in developing nations is either a monopoly function of government or else government exists as a major financier and regulator of the educational activity. In shifting from the model of a competitive market to one of a bureaucratic management or regulatory system, one loses the self-monitoring and self-equilibriating characteristics that assured efficiency in the competitive situation. To replace them one must turn either to legal rules or bureaucratic incentives that are designed to achieve an approximation of efficiency.

Some economists and many non-economists have questioned the propriety of transposing the efficiency concept from a technical setting to a social or behavioral one (Klees, 1984). A more appropriate question might have been whether it is possible and justified to transpose the concept of competitive efficiency to a non-competitive context. It is clear, however, that regardless of the philosophical uncertainty over the propriety of this transposition, the last ten years have seen a rapid escalation in attention paid to efficiency issues related to educational finance and management; and this increased attention has occurred in both socialist and market economies.

If the result of this increased attention to efficiency is that more and or better educational benefits are obtained for a given level of expenditure then the use of the efficiency concept will be justified. If the result is hat educational planners and managers use economic models and jargon as a shield for their biases and subjective judgments, then the use of the efficiency concept will not have served a legitimate purpose. It is important to understand that the efficiency concept is a neutral device; it is the definition and valuation of its components (inputs, processes, outputs, and outcomes) that will determine whether the current attention focused on efficiency is a positive or negative contribution to educational development.

In proceeding to establish a basic glossary of efficiency terminology, it is useful to discuss the concepts of production and utility that underly the practical discussion that follows. This discussion of theory is presented as a foundation for the later practical discussions. While it is possible for one to benefit from the subsequent practical discourse without an understanding of this theoretical foundation, one cannot claim to

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* Klees (1984) asserts that the requirement that market prices reflect efficiency is similar to the econometric condition that regression coefficients represent causal impact. He notes that "... both necessitate the fulfillment of relatively few, but totally unattainable, conditions and both have little practical guidance to offer on how inaccurate these indicators are when the necessary conditions do not hold..."

understand the efficiency issue fully without an appreciation of the concepts of production and utility.

The production process for education, for which the major factors are depicted in simplified form in Figure One, consists of four main parts: inputs, process, outputs, and outcomes. In Figure One examples are given of the types of observable and measurable variables that may be classified as belonging within each stage. Inputs are the resources used in the production activity; for educational production, inputs may be divided into the general categories of student characteristics, school characteristics, teacher characteristics, instructional material and equipment characteristics, and facilities characteristics. In each case the term "characteristics" refers to the availability of a resource, its nature and quality, and its manner and rate of utilization.

For example, an important teacher characteristic would be the teacher's mastery of the subject matter (e.g., mathematics) for which the teacher is responsible. The effect of teacher subject matter competence on the education production process will depend on the existence of some measurable level of competence; its nature (the areas of mathematics skill mastered) and quality (the degree of competence); and its manner and rate of utilization (the means by which a unit of teacher time or effort is combined with other resources including student time and effort).

The process stage of educational production refers to the means by which educational inputs are transformed into educational outputs. Often the term educational technology is used to refer to a specific process for promoting educational outputs; examples of educational technologies are classroom lecture/discussion, small group instruction, individual student-teacher tutorial, self-study with traditional textbook or textbook-derived materials, and self-study with programmed instruction. Recently, these traditional technologies have been supplemented by radio or television instruction within the classroom, more sophisticated audio-visual equipment, and computers. These latter teaching-learning processes are the ones that are more "technological" but the term "technology" may refer to all forms of the educational process.

The interaction of inputs and process determine educational costs. Ideally, educational managers should be able to design the instruction/ learning system by considering alternative inputs and processes simultaneously. However, the reality is that in most developing nations serious limitations exist in terms of the availability and quality of inputs and over the range of practical and affordable technologies (Thiagarajan, 1984; Cummings, 1986).

FIGURE ONE

MAJOR FACTORS IN THE EDUCATION PRODUCTION PROCESS

DETERMINANTS

INPUTS	PROCESS
Student Characteristics	Forms of Instructional Organization
Teacher Characteristics	Alternative Technologies
School Characteristics	Use of Teacher and Student Time
Instructional Materials and Equipment Characteristics	
Facilities Characteristics	

EFFECTS

OUTPUTS	OUTCOMES
Cognitive Achievement	Employment
Improved Manual Skills	Earnings
Attitudinal Changes	Status
Behavioral Changes	Attitudinal Changes
	Behavioral Changes

The predominance of teacher-centered lecture/discussion as the means of educational technology is neither an accident nor a result of unfettered choice. Rather, this mode of classroom instruction has emerged because, first, many educational budgets must allocate 80% or more of expenditures to teacher salaries (with a substantial portion of the remainder used for system administration) and, second, because teacher-student ratios are such that a lecture format is seen by most teachers as the only means by which the teacher can deal (in terms of instruction and discipline) with the large number of students for whom they are responsible. While most teacher training systems advocate greater use of small group and individual instruction, the teacher's own classroom experiences as a student and the reality of classroom management demands often dictate against all but the most highly structured, teacher- centered forms of classroom organization. Also, given the high rate of incidence of unqualified or underqualified teachers in some educational systems, reform of the teacher-centered instructional process, which may threaten the security of the existing teacher corps, is unlikely to occur without substantial external pressure.

A danger of the economic production metaphor is that it tends to imply that the technology used is rigid and constant and that the inputs are standardized and independent. Because the education process deals with human factors, all of these implications are unfulfilled to some degree. It is not just that variety (perhaps extensive variety) exists among the inputs of teachers, students, schools, and materials, and the way they are combined; the individual human and material inputs also may vary over time. The motivation and effort of the teacher may fluctuate day to day or even within a given day; the attentiveness and effort of students is a notoriously variable commodity. The interdependence of the variables is indicated by the fact that one of the explicit responsibilities given to teachers is to monitor and motivate the behavior of the students; a similar indication of interdependence of inputs is the finding, common to the research literature, that student peer influences have a substantial moderating impact on student behavior and accomplishment (Winkler, 1975; Webb, 1982; and Nielsen, 1982). At least in part, these interaction effects can be controlled for by the introduction of interaction terms in the quantitative specification of an education production function.

Thus, this abstraction of reality from the conceptual form of production must be recognized but it does not destroy the value of the production metaphor for understanding educational behavior. For example, in some classrooms it will be the practice of the teacher to spend extra time with the slower learning students while allowing the faster students to work on their own with textbooks or other materials. This is a decision that potentially is supportable from the economic theory of production. The teacher is operating on the belief that the marginal value of a unit of his or her time is more valuable to the slower learning student than to the more advanced student. Even if the advanced students would learn more from the teacher than from study on their own, the

greatest relative productivity advantage lies from combining the teacher input with the inputs of the disadvantaged students.

Unfortunately, detailed microeducational analyses to support such teacher decisionmaking are almost never done. Classroom observation studies are the only practical means for developing the appropriate data for such analyses and such ecological studies of the school are time and labor intensive and suffer from their own set of serious methodological limitations as well as the obvious question as to generalizability. However, if classroom-level studies face serious limitations, as to method and relevance, the same can be said for the survey approach to analysis of educational production and efficiency. The survey collection of data on inputs and outputs from a large number of schools assumes implicitly that the individual classrooms are using the same instructional technology when classroom observation studies often suggest this simply is not so (Thomas and Kemmerer, 1983). The survey approach may be more acceptable in developing nations where, as noted above, variation in formal classroom organization and process often is more constrained. However, in this setting the problem of proper specification and measurement of the variables, and internal variation within a defined variable, may be even more of a problem than in a developed nation setting.

To this point, the discussion of educational production has emphasized only inputs and processes (technologies). These two factors will determine the cost of education since total cost is equal to input unit costs (cost per teacher-year or textbook) multiplied by input quantity (number of teachers or of textbooks).

One of the major confusions concerning the efficiency concept is the belief that it is synonymous to lower costs. In a case where excessive expenditures and waste exist the two may be achievable simultaneously. However, where more costly inputs exist that have proportionally even higher productivity, the achievement of efficiency could be used to justify greater unit costs. In every case, cost considerations are only one part of the efficiency calculation.

As indicated earlier in Figure One, the effects side of the efficiency equation involves both outputs and outcomes. Outputs are the direct and immediate effects of the educational process. They include cognitive achievement, manual skill development, attitudinal changes, and behavioral changes. In aggregate measurement one is concerned not just with measures of the central tendency but also distributive parameters. The latter are used in judging the equity or fairness of the educational system. Comparisons of such measures as student means and standard deviations among socioeconomic, ethnic, locational, or other classifications and between the gender groups is another method used to judge whether education has an ameliorating, neutral, or reinforcing effect on initial social disadvantages of given groups.

Ideally, cognitive, manipulative, attitudinal, and behavioral measures of outputs should be highly differentiated by specific subject areas, skills, attitudes, and behaviors. The common situation is that these measures are available only for certain general cognitive areas (verbal and mathematics) and often not available at all in the areas of manual skills, attitudes, and behaviors.

In addition to the differences noted above, outputs tend to be less subjectively measured than are outcomes. The types of cognition, manual dexterity, attitudes, and behaviors purposefully promoted by the school are generally a product of governmental if not public consensus. The larger social outputs are more controversial both because they are less directed in their production and because they often involve the manifestation of unauthorized if not unacceptable views and behaviors.

The difference in the degree of subjectivity is not absolute since considerable debate can and does exist about what the school produces, whether the production is "purposeful," and how to value it. The tendency to value educational outputs in terms of how they promote desired economic development outcomes has been one of the most controversial areas. Whether these development outcomes occur within market or statist economic systems, there is a legitimate question of whether other outcomes of education have not been unduly neglected in favor of this single indicator of educational effectiveness.

Outputs, when compared to educational costs, can be used in measuring internal efficiency is a measure of how well the educational institution or system achieves its stated goals; it is calculated by the ratio of output to cost. If both output and cost can be quantified in monetary terms a benefit/cost ratio can be derived. To be efficient the benefits must exceed the cost (i.e., the benefit/cost ratio must be greater than 1.0). In comparing educational activities in the absence of practical budget constraints, the activity with the higher ratio of benefits to cost is preferred.

If the effects of an activity cannot be stated in monetary terms, it is possible to derive a cost-effectiveness ratio; however, the measure of effectiveness must still be quantifiable (even if only in an ordinal form). For example, a study might show that an additional five dollar per-student expenditure on instructional materials will increase measured achievement by ten percent while a similar expenditure on instructional radio increases achievement by only seven percent. In this example, the instructional materials alternative would be the more cost-effective.

One weakness in many educational innovation projects is that the efficiency comparison is made only between the individual innovation (additional educational materials or radio instruction, for example) and the traditional classroom practice (lecture/discussion without instructional support materials or radio instruction). In the

example presented above, both systems might be judged cost-effective compared to the traditional classroom; however, the relatively less cost-effective radio alternative might be selected for implementation if it were the only instructional alternative to the traditional classroom for which a cost-effectiveness comparison were made. Thus, the usefulness of cost-effectiveness analysis may be seen as a function of the analyst's thoroughness in selecting options for evaluation.

A second methodological problem is that some cost-effectiveness comparisons fail to consider the consequences of expending an equivalent additional sum per-student on the traditional classroom alternative. Legitimately, no objective comparison of cost-effectiveness can be made unless either the cost or effectiveness standard is fixed. For example, one can compare the efficiency of the traditional classroom with an instructional innovation if one has the same cost for both; in this case the difference in measured effectiveness alone will determine the more efficient alternative. Similarly, if the effectiveness standard is fixed (e.g., a five percent gain in measured achievement), it is possible to compare the costs to see which instructional system requires the least expense to generate the identified level of effectiveness.

However, if neither costs nor effectiveness can be fixed for the two alternatives, it is not possible to use the mechanistic criterion of cost- effectiveness. Rather, a cost-utility comparison must be made. An example would be where there are two innovations with data available as indicated below:

	Additional Cost Per Student	Average Percentage Increase in Achievement
Innovation A	$10	7%
Innovation B	$15	10%

In this example, it would be fallacious to consider the relative cost-effectiveness ratios of $10/7% and $15/10%. The fallacy exists because the fractions do not contain a common numeric (unit of expression in quantitative terms) and because one cannot assume that the cardinal value of $1 per student is either equivalent or consistently proportional to the value of a 1% increase in achievement.

Judgment in such a case must be made based on the subjective valuation that the decisionmaker assigns to the measures of costs versus the measures of effectiveness. One person may feel that it is worth the additional $5 per student to gain another 3% in achievement and thus would favor Innovation B; a second person might disagree and feel

that Innovation A is preferred and the additional cost of $5 per student is not justified to produce "only" another three percentage point gain in achievement. Of course, it is also possible that a third person may feel both innovations are too expensive and would oppose the adoption of either one. The argument would be that the subjective value of increased achievement is simply not worth the additional expenditure.

When one considers the fiscal effect of multiplying a small increase per student times all of the students in an educational system, it is easier to understand why educational innovations have such a history of disappointment in terms of system-wide adoption or adaptation within developing nations. The advocates of specific innovations, in addition to being guilty of certain evangelical excesses in ignoring other innovative alternatives, often fail to collect the data or institute the social marketing practices (Middleton, 1986)--including incentives--that will convince parents, practitioners, and policymakers that the positive effects of the innovation are worth the financial expense (and the non-monetary costs that may be incurred in terms of the disruption of traditional classroom and bureaucratic practices).

The final form of efficiency analysis is least cost analysis. It involves the lowest level of conceptual sophistication of any of the analytical models for measuring educational efficiency. It assumes that the desired outputs are fixed (but not necessarily quantifiable) and requires only that evidence be presented that the proposed means of producing the outputs is the least costly alternative available. The most common use of least cost analysis is in the determination of the feasibility of project designs. In such a situation, a judgment must be made that the probable effects of the project will justify the educational intervention and the probable costs of the intervention are the least expensive means of producing the desired effects.

All of the approaches to efficiency evaluation mentioned here are generic to project or program analysis and are not limited to the evaluation of educational activities.* The application of these approaches to the appraisal or evaluation of educational activities has been more controversial than in such areas as transportation or infrastructive development. Health and population activities are an exception in that efficiency analysis has been at least as controversial there as in education. Education, health, and population activities share an immediacy in their effect on human lives and an inherent subjectivity in terms of external and collective judgments of their benefits and costs. The controversy has been aggravated by a tendency of some efficiency proponents to misrepresent the degree of objectivity implied by the use of efficiency criteria such as benefit/cost ratios and cost-effectiveness comparisons. The fact remains that as long as

* More extended discussion of these issues may be found in Donohue, 1980; Levin, 1983; Ray, 1984; and Woo and Sanders, 1986.

educational demands exceed available resources, rationing of educational opportunity in access and quality terms will be required. Increased efficiency, therefore, will remain the only means of expanding access and/or quality without new resources and the best means of assuring that new resources that are made available are used to maximize their impact on access opportunity and quality enhancement. The efficiency analyst can help provide the most current and accurate information obtainable to assist the decisionmaker in promoting access, equity, and quality enhancement goals.

A special aspect of the efficiency controversy is the difficulty of shifting from the analysis of internal efficiency to the analysis of external efficiency. While disagreement may and does exist over the degree of determinacy of educational inputs for educational outputs, the difficulty of relating the immediate effects to the investments made in education are much less than in attempting to relate the more distant educational outcomes. The long term effects that one normally considers as educational outcomes are such things as lifetime earnings, the probability of employment, occupational attainment, social status, political participation, consumption and savings patterns, and a variety of attitudes and behaviors.

Two main difficulties exist in relating educational inputs to such educational outcomes (that is, in the measurement of external efficiency). The first difficulty is determinacy (imputing the causal effect of education) and the second is discounting for time preferences. The latter problem exists because educational expenditures that are investments in future outcomes require an immediate financial sacrifice in return for a future benefit that may be delayed for a considerable time.

The concept of time preference is well established in behavioral psychology and economics. Two primary reasons are given for a preference for immediate versus postponed benefits: the first is the risk that a benefit delayed may not be received or not received in full and the second is the demonstrated preference of individuals for immediate over delayed (but otherwise assured) consumption. Mortality, changes in educational qualification requirements,and other changes in the labor market relating to salaries and job security make it exceedingly difficult to predict the future earnings, employment probability, or status for any given level and type of education graduate.

When dealing only with financial outcomes such as earnings it is possible, through discounting, to compare monetary values across time. A unit of currency at any future time may be equated to a current unit of currency values by the following formula:

$$PV = \frac{FV}{(1 + i)^t}$$

where: PV = present value
FV = future value
i = rate of discount;
and t = number of time periods

Thus, if the future value is $100 and the rate of discount is .10 (10 percent) per time period and the future value is received five time periods into the future the formula becomes:

$$PV = \frac{\$100}{(1+.10)^5} = \$62.09$$

Thus, $100 received in five years is equivalent to receiving $62.09 today if the rate of discount is ten percent. The rate of discount incorporates the effect of anticipated inflation plus other calculable risks involved in postponing receipt of funds. Because of psychological and other differences among persons, individuals' subjective rates of discount may differ substantially. The present value of benefit/cost then is exactly the same criteria as the normal benefit/cost criteria but with the important exception that the values of benefits and costs have been adjusted by discounting to take into account when the benefits and costs occur over time. An alternative to the present value of benefit/cost criteria is the rate of return approach that will be discussed in detail in the later section on efficiency criteria. The present value formula may be modified to calculate the sum of the present values of a series of different future values that occur over a number of time periods (for example, expected annual earnings over a period of years):

$$PV = \sum_{t=1}^{N} \frac{FV_t}{(1+i)^t}$$

where n = the total number of time periods.

While the discounting process is apparently objective, its mechanistic nature disguises the problem of obtaining the appropriate estimates of the future values and the difficulty of selecting the appropriate rate of discount. The future earnings for a certain type of educational graduate may be forecast based on current earnings patterns and expected labor market changes--this is a process fraught with the opportunity for substantial error. Also, fifty years ago, the rate of discount was considered relatively uncontroversial because lending rates for "riskless" government bonds (the normal basis for determining the opportunity cost of the time delay) were relatively standardized and tended to be stable over time. In the current capital markets of most nations a plentitude of rates may exist without clear criteria (such as varying maturities or risks) to justify selection of a single discount rate and, more importantly, the fluctuation in rates over time may be expected to be much more substantial due to variations in the expected rates of inflation.

These difficulties make the calculation of present values of educational outputs difficult but still feasible if done on a relatively frequent basis and if one can avoid making substantial fixed investments on the basis of present values that may change significantly over time. The latter caveat is important but often ignored in educational planning decisions. Where possible, educational investments should be of a type where fixed facilities and equipment are avoided or minimized and, again, where possible, subject to alternative uses if future conditions no longer justify continuing a project or program.

The areas of secondary and post-secondary vocational training or technical education are excellent examples of where this logic can be applied. The demand for vocational skills may fluctuate greatly over time and, within a single economy, specific skills may be subject to saturation of supply in a relatively short period of time. For example, if there is a need to produce a total of 1,000 electricians over the next five years one might create a training program that would produce 200 graduates per year. The problem is that at the end of the fifth year the demand for electricians may be satisfied but the training program will still exist. Educational systems have had little success in closing programs once they are initiated. Ideally, the original program plan should have presented efficiency data to justify the production of the 1,000 graduates but also should have provided an analysis of how the program could be phased down, converted, or terminated once the justified number of graduates were produced.

An important reason for the growing emphasis on the use of industrial sites for training activities is that, in addition to providing access to more current technology, the main cost of equipment is for the purposes of production, not training. Therefore, the efficiency analysis requires only that there be sufficient benefits to justify the proportion of equipment and facilities costs allocatable to the training activity rather than the total of such costs.

The preceding discussion has concentrated on the issue of production. Because both outputs and outcomes of education are multiple, and even some individual outputs and outcomes must be valued subjectively, the economic concept of utility must be discussed. Consumer utility may be defined as the pleasure or satisfaction a consumer expects to receive from consumption of a product or service. When the "consumer" is in fact a bureaucrat or other policymaker, then utility ideally should be inclusive of judgments about the probability of consumer satisfaction on the part of the individuals affected by their judgment. For example, an educational planner's decision will be based upon his or her personal utility but also on the degree of responsiveness of the planner to perceptions of the utility of the parents, teachers, students, and others affected by the decisions made.

In the simplest case, where only two outputs exist, utility maximization will be achieved by considering the value of the two outputs and the resource constraint on output production. While mathematically the problem of maximization of utility increases as the number of output choices is expanded, the fact is that the human mind (and now, computers) can handle the optimization process quickly. The main constraints the educational decisionmaker faces are the paucity of knowledge about alternative costs, about the nature of relationships among outputs, and about the time preferences of those affected by the decisions made. Some outputs--such as verbal ability and certain forms of disciplinary behavior or obedient attitudes--may be joint outputs. This means that the process of producing one output can produce the other output at no additional cost. Other outputs may be mutually exclusive at the margin. That is, one can produce more of either output but not more of both. An example would be that one may not be able to produce greater achievement by the most advantaged students and increase achievement equality for the class at the same time.

The task of educational managers (in fact, of all managers) is to understand the production process well enough to be able to identify which outputs are independent, which are joint outputs, and which are mutually exclusive outputs. Then, the educational utility decision requires combination of this knowledge of the production process with an understanding of the appropriate values to be assigned to the outputs so that a decision can be made that will maximize the utility to be derived from the mix of outputs that are to be produced.

There is an unfortunate tendency for politicians and even some senior educational administrators to act as if the educational production process can be expanded (in terms of the number of outputs and/or the amount of the individual outputs produced) without providing new resources or incurring any sacrifice in existing output production. Implicitly, they are assuming that the current educational process is inefficient (probably true) and can be changed by administrative fiat (probably false). Unfortunately, even if

the administrators were fully correct, administrative decrees rarely produce new outputs without reducing others. The demand for new or better outputs may be achieved by sacrificing some existing outputs that could be more highly valued. In addition, the new demands may overburden the process (especially the teacher's class management skills) in such a manner that overall production of outputs is reduced. Too often ignored, both in economic theory and administrative procedures, is the fact that those directing the educational production process at the classroom, school, and even system level are individuals who rarely have received management training concomitant with their management responsibilities.

A final item of terminology needs to be reviewed before proceeding from this discussion of the concepts of production and utility to their application to effectiveness and efficiency analysis in schools and school systems. A critically important term is that of the "margin." Frequent references refer to marginal cost or marginal productivity and it is common for economists to say that a certain condition (e.g., equilibrium or efficiency) exists "at the margin." The concept of margin is taken from the calculus and refers to a single incremental unit. For example, the marginal productivity of teacher time could refer to the increase in productivity that would result from one more hour of teacher effort. Similarly the marginal cost of teacher time could be defined as the expense of using the additional hour of teacher time. In theory, marginal units are assumed to be extremely small; in practice, one often is forced to work with units of substantial size (a person-month or person year, for example). One can even consider the idea of a marginal school or marginal university if one is analyzing the effect of adding an additional institution to an existing system.

Five limitations exist in regard to application of basic productivity and cost relationships to education:

1. multiple inputs that must be determined simultaneously;
2. multiple output/outcome measures of productivity;
3. lack of information on costs and productivity;
4. fixed input quantities or relationships; and
5. variable input quality.

The problem of multiple inputs is one faced in almost all production situations but poses special problems in education. While economic theory stipulates productivity relationships under ceteris paribus conditions, the educational decisionmaker must determine the mix of inputs simultaneously. Teacher quality and quantity, availability and use of materials, equipment and facilities, and means for motivating student, parent, and community effort are some of the major input categories with which the decisionmaker must deal. One reason for the conservatism of educational systems relative to instructional change is that the decisionmaker always has to justify any new

input mix when, in fact, there are few data or experiences to support the purported effectiveness of the new input types or quantities. In addition, economic theory presents the productivity concepts in terms of a given technology. If the new input mix also involves a change in technology, it will be even more difficult to justify the instructional change on the basis of a priori quantitative data.

The second problem the educational decisionmaker faces is the valuation of marginal product. In addition to the basic problem of value judgment, the decisionmaker must identify and value the effect of the individual inputs on multiple outputs and outcomes. As discussed above in the description of utility analysis, multiple products can be dealt with but they add complexity to the analysis and heighten the implicit subjectivity of the valuation process. The decisionmakers need to know both the cost of inputs and the relationship (independent, jointly produced, or mutually exclusive) among the inputs and the mix of outputs and outcomes. In addition they must be able to assign a value to alternative output/outcome mixes. Obviously, most educational production decisions are made without all of this information; the goal of efficiency advocates is to increase the amount, quality, and timeliness of such information and to make the valuation process more explicit.

The third constraint on educational decisionmaking about production is the availability of information. Given the quantity of educational research of the last thirty years it is surprising how little is "known", let alone how little can be "proven" concerning educational production and efficiency. The next section of this monograph will discuss the various individual inputs, processes, outputs, and outcomes that commonly are proposed for education. Each will be reviewed in terms of what research has revealed, what deductive logic and experience can tell decisionmakers, and what can be done to increase the informational base for efficiency decisions.

The fourth specific constraint of educational decisionmaking concerning efficiency is the fixed nature of relationships that exist within the educational production process. These rigidities are not always technologically determined but rather are often a product of tradition, law, regulation, or contractual agreement. The most dominant of these rigidities is the central role for the teacher. The teacher's dominance in the classroom is an interesting example of tradition becoming institutionalized by law, regulation, and contract. Further, because of the low level of resources normally available for the classroom instructional budget, there is little ability in the poorer countries even to provide significant complementary inputs to reinforce the teachers' effectiveness, let alone to consider replacing the teacher as the major input.

The fifth major limitation on the use of economic production and cost concepts in educational management is the variability in the nature of the inputs. The major cause of this variability is the need to conduct management decisionmaking at an excessively

high level of aggregation (and often at a physically distant level of administration). The "teacher" input is an example of a variable that often contains substantial internal variation; in such a case the modal or mean characteristics of a group of teachers may not be a useful base for decisionmaking because of the large range and substantial variation that exist around these measures of central tendency. Even if one divides the excessively aggregated concept of the teacher input into its component parts--subject knowledge, experience, pedagogical skills, motivation, attitudes, and behavior--the problem of internal variation within the multiple teacher-input definitions still may be considerable.

This problem is at the center of the long standing debate over survey versus observational collection of data with which to analyze education production relationships. While observational techniques provide more depth and detail in terms of measurement of the variables and their interaction, the observational approach itself has three major methodological disadvantages. First, observational measurement techniques are still in the process of development and controversy still exists over the specification and measurement of educational variables at the classroom and school level. Second, there is an unavoidable and explicit acceptance of subjectivity and variability in the measurement of inputs. An observer measuring time-on-task of students is forced constantly to make judgments of student behaviors as to whether certain actions are learning relevant or not. In addition, there is the fact that observed values will differ not just among observers but that the values of inputs assigned by a single observer can vary from situation to situation depending on the observer's attentiveness and diligence. And third, because classroom and school observational studies involve substantial cost in time and money, this methodology allows results of only limited immediate generalizability because the research budget rarely allows a statistically representative coverage of classroom or school settings.

The weaknesses of the observational methodology for analysis of educational production are no greater than those that exist for the survey methodology; however, because the weaknesses are more obvious (and the survey approach has tradition as an advantage) the observational methodology has been marginalized. The point must be made, however, that some educational production issues are researchable only by ethnographic methods including classroom observation. A major need is for economists and others interested in educational production relationships to develop a consensus as to the situations in which the survey or ethnographic approaches have a comparative advantage. This consensus could then serve as a basis for design of both educational management information systems and for a more comprehensive research agenda for the study of educational production and efficiency.

The limitations discussed here must be understood within the context of a more far-reaching limitation. Education's conservatism toward the application of efficiency concepts is simply a special case of the general administrative conservatism towards all

change. Unlike the case in the more progressive parts of the private sector, bureaucracies rarely offer incentives for managers to engage in change or experimentation and educational bureaucracies in particular often exert specific sanctions against innovation. In this context it is easy to understand why improvements do not occur even if understanding fails to reduce one's frustration with the process.

In this section an attempt has been made to accomplish two objectives:

1. familiarization of the non-economists with the basic economic concepts that support the measurement and analysis of educational efficiency, and

2. development of a standard set of terminology for efficiency analysis so as to minimize semantic confusion in the succeeding discussion.

Ideally, the purpose of a presentation such as this should be to simplify and clarify; to many non-economists the initial reaction to the preceding discussion may be that the whole area of educational production relationships now appears more complicated than before.

The reason for this is that the presentation of education as an input- output process analogous to other technical production relationships is simply wrong. While the input-output model may have great value as a metaphor to help the uninitiated gain some basic appreciation of educational production, understanding educational production relationships requires that one move to more complicated economic models (involving the complex relationships among multiple inputs, the consideration of variable technologies, and the subjective valuation of educational outputs and outcomes). But to be of any possible policy value, the economic models must be understood to provide only a framework within which behavioral psychology, pedagogy, administrative and management science, anthropology, political science, and information theory all must play important roles. Finally, one is left with the realization that all educational decisionmaking will take place without optimal information and will be performed by individuals who lack the ideal mix of personal and professional skills and experience.

But in this regard education is no different from the other social services; the point is decisions must be made and will be made. The function of the efficiency analyst is to improve both the decisionmaker and the decisionmaking process. Improved, not ideal, decisions are the only realistic and attainable goal.

Within this more restrained statement of the goal of education production analysis, one must face the fact that even improvement can never be certain. Production analysis for education remains limited by what is understood of the production relationships and what data can be generated (in a cost-effective manner) to support decisionmaking. In the

next section of the monograph, the purpose shall be to present what is known (or more correctly what analysts think is known) about educational production and efficiency.

While analysts should be modest about their level of conceptual or factual knowledge, they have no choice but to be relatively immodest in promoting the use of their knowledge by practitioners, planners, administrators, and policymakers. The cost, in financial and human terms, of erroneous educational policies is simply too great. The educational decisionmakers may choose to distrust or ignore the analysts' recommendations but it is crucial that the decisionmakers at least be exposed to them and allowed to consider them.

CHAPTER THREE

INDICATORS OF EFFECTIVENESS IN EDUCATIONAL PRODUCTION: INPUTS AND PROCESSES

In this chapter, educational effectiveness indicators will be discussed at the first two stages of educational production: inputs and processes. It should be repeated here that while the discussion will continue to focus on examples from primary and secondary education, the concepts presented and interpretations made often will be equally applicable to pre-primary education, vocational and technical schools or programs, post-secondary education, to pre-service and in-service teacher training programs, and to nonformal education.

Since efficiency is definable only in terms of both inputs and outputs, some question might be raised as to the propriety of discussing input and process measures as indicators of effectiveness. They are included here since, because the preferred output and outcome measures of educational effects are frequently absent, analysts often are forced to attempt to evaluate a school or program only on the basis of inputs and processes. As pointed out by Chapman and Windham (1986), school "quality" definitions are as likely to refer to inputs and processes as they are to outputs or outcomes (e.g., see Heyneman 1982, 1983; Heyneman and Loxley, 1983A, 1983B; Behrman and Birdsall, 1983; Fuller, 1985; and IEES, 1985). Thus, it seems appropriate to include in the present discussion a review of the measures that should help determine not only the costs of the school but its eventual effectiveness in achieving desired outputs and outcomes.

A second question might be raised as to the exclusion of home and community environment variables from this discussion. These contextual determinants are recognized as having critical importance and it is understood that educational planners and administrators need to evidence a greater sensitivity to the effects of the home and community context (Selowsky, 1980; Mercy and Steelman, 1982; Birdsall and Cochrane, 1982; and Johnstone and Jiyono, 1983). However, the purpose of this discussion is to examine the variables that are within the control or influence of the school administrator or planner. While it is not possible in the short run to alter parental education or earnings or to alter significantly the availability of educational and cultural opportunities within a given community, one process variable that will be discussed here is the school's success in motivating parental and community involvement.

I. INPUT INDICATORS

A. Teacher Characteristics

The tendency to judge the quality of a school or other educational institution by the cost, quantity, and/or quality of its inputs is not limited to developing nations. Often parents, students, administrators, and analysts have no other measures from which to make an evaluation. Also, since the inputs are within the direct control or influence of the educational authority, it has always made a certain intuitive sense to focus attention on the aspects of the school that can be affected by administrative personnel.

The most commonly studied input is the teacher and the teacher's characteristics. The teacher as the locus of classroom instructional activity is a part of the tradition of almost all cultures and has been institutionalized in most curricula and forms of classroom organization. Also, as was discussed earlier, many developing nations face such fiscal constraints and alternative priorities that it is extremely difficult to opt for other than a teacher-centered curriculum: after the teachers' salaries are paid there are few funds left in the education budget for alternative or even teacher-support methods of instruction.

A consideration that often is ignored in this debate, especially by those who promote deschooling or non-teacher centered instruction, is that teacher employment serves a variety of political and social purposes for any government (Illich, 1970). Even where teacher unions or associations do not exist, the teacher remains important as a representative and symbol of the central government. Even those who advocate less radical reforms (such as utilizing unqualified teachers in combination with alternative learning technologies such as programmed instruction or interactive radio) often will find themselves blocked because parents and government feel that improved teacher quality is the most visible and reliable means of school improvement.

The characteristics of teachers that form the basis for the most commonly used indicators of teacher quality are:

- formal educational attainment
- teacher training attainment
- age/experience
- attrition/turnover
- specialization
- ethnic/nationality
- subject mastery
- verbal ability
- attitudes
- teacher availability measures

The first two characteristics relate to the quality of formal preparation the individual has for being a teacher. The amount and quality of both academic education and teacher training are assumed to be positively correlated with the teacher's knowledge and with the teacher's ability to impart that knowledge to students.

Normally, the measures for these indicators are the years of education or training and the level of highest attainment. Sometimes, these indicators are expressed in terms of the government's or other authority's standards for qualification:

qualified-- possessing the academic and teacher training attainment appropriate to the assigned level and type of teaching.

underqualified-- possessing the academic but not the teacher training attainment appropriate to the level of assignment;

unqualified-- possessing neither the academic nor the teacher training attainment appropriate to the level of assignment.

The use of the qualifications measure for inter-country comparisons can be misleading since each country is free to establish its own standards. These standards often have as much (if not more) to do with the status of teacher supply and demand as with any objective standard of the appropriateness of education and training attainment to teacher assignments. Still, within a country or among countries with comparable standards and education/training systems, one can use the percentage distribution of teachers across the three standards of qualification as an indicator of input quality.

A second point of significance about the education and teacher training credentials of teachers is that most government and private pay systems reward higher levels of attainment. Thus, even if the assumption is correct that higher levels of attainment promote better instruction, the concomitant effect of teacher educational attainment on educational costs means that to be efficient, one must assume or be assured that the marginal cost of higher attainment qualifications is offset by the increased marginal output of the classrooms or schools in which the "more qualified" teachers are employed. In terms of government policy there often is an immediate and recurrent cost impact from upgrading teacher qualifications. The immediate effect comes from instituting or expanding the academic and teacher training programs necessary to produce a greater number of teachers with higher qualifications. The effect on recurrent cost is a result of having to pay greater annual salaries to the teachers once they attain higher qualifications.

A common phenomenon during a period of educational expansion is that there is a compounding effect from the interaction of the pay system attempting to absorb the

impacts of both more teachers and higher teacher qualifications for old and new teachers. Without proper consideration of budgetary impacts, such programs can create general fiscal problems and pose serious opportunity costs in terms of other social and development programs.

The teacher characteristic of age/experience is equally controversial. The age of the teacher is an indicator used as a proxy for either emotional maturity or experience when these characteristics cannot be measured directly. Also, in many cultures, the age of a teacher is an important determinant of the authority and respect that will be granted by students, parents, and community. Without this authority and respect, the education and training attainments of a teacher may be irrelevant.

Even where direct measures of experience are possible there may be a substantial gap between conceptualization and specification. As a concept, experience implies the embodiment of skills that occurs over time from the formal and informal learning opportunities to which the teacher is exposed. However, the experience variable normally is specified in terms of the number of years the individual has been a teacher. The conceptualization and the specification undoubtedly are correlated but the degree of correlation is subject to debate; it varies from teacher to teacher and, more importantly, varies within and among countries based on the availability of the learning opportunities for teachers outside the on-the-job experiences that occur normally within a classroom.

Like qualifications, age (as a proxy for experience) enters into some educational pay schemes as a determinant of salary. The most common specification of the age/experience variable is years-of-service. This is defined as the number of years from initial employment to present employment (if continuous) or the sum of years of teaching if employment has been interrupted at any time. Often, pay systems combine the years-of-service concept with qualifications into a pay system that has separate pay "steps" for each level of qualification and, within the qualification level, individual pay steps based on years-of-service at that qualification level.

Regardless of the form of instituting age and experience within the pay system, the benefit/cost consideration is the same as for qualifications. One must assume or be assured that the extra cost of having older, longer serving, or more experienced teachers is at least offset by the differential effect of these teacher characteristics on classroom and school outputs and outcomes. If not, there is then no educational justification for the pay system (although there may be significant social or political justifications).

Inversely related to the experience concept is the characteristic of teacher attrition. The loss of teachers from the educational system through retirement or resignation can involve a loss of exactly those personal qualities that the pay incentives for age and

experience were designed to promote. Thus, teacher attrition rates may be used as indicators of potential educational ineffectiveness at the classroom or school level; teacher turnover (based upon reassignment as well as retirement and resignation) is equally valid as a negative indicator of effectiveness.

Interestingly, the attrition and turnover indicators are less clear when applied to efficiency issues. Since the teachers who retire or resign may be (and usually are) replaced by teachers who are younger, less experienced, and/or less qualified, teacher attrition normally is concomitant with a lower cost of instruction. Again the educational authority is faced with a judgment concerning costs and benefits. Are the reductions in cost from the change in teachers enough to offset the probable redirections in the value of school effectiveness?

A more specific teacher qualification issue is the match of teacher specialization with the requirements for teachers. The most common problem, and one that occurs in both developed and developing nations, is the shortage of teachers trained in science and mathematics. Two of the most serious errors of aggregation in the analysis of teacher supply and demand are: (1) to ignore teacher specialization and therefore assume that a balance occurs when total teacher supply equals total teacher demand--in fact, a surplus of arts or social studies graduates does not solve the problem of a shortage of science and mathematics graduates; and (2) to ignore the geographic distribution of teachers by specialization- a national balance of teachers by specialization can disguise an urban over-supply of science and mathematics teachers and a rural under-supply.

Similar issues exist relative to the supply of instructors for vocational skills, technical concepts and applications, foreign languages, and many of the undergraduate and advanced courses in higher education. Since most educational systems pursue the illogical course of undifferentiated pay by specialization, the reduced effectiveness of education provided by inappropriately trained teachers is never concomitant with financial savings.

The reality, of course, is that attempts to remedy the maldistribution of teachers by specializations probably can occur only with an increase in the cost of teachers' services (and perhaps an increase in the cost of teacher training as more expensive teacher trainers, facilities, equipment, and materials are required). It is important that all teacher characteristics, but especially this one, the appropriateness of subject specializations, be considered in terms of the impact on aggregate effectiveness and equity standards.

A special characteristic of teachers that may represent a proxy for perceived educational quality or effectiveness is the teacher's ethnicity or nationality. In a multi-ethnic society students, parents, or others may identify positive or negative traits or

behaviors with members of certain ethnic groups. While this is more likely to be an issue of perceptions than reality, planners and administrators must be aware of these community attitudes. However, the exposure of students (and their families and communities) to members of other ethnic groups may be a purposeful determinant of the teacher assignment system. In any case, data on the distribution of teachers by ethnicity and location may be considered a valuable indicator of potential effectiveness in certain societies.

Similarly, dependence on expatriate personnel as teachers may be interpreted either in a positive or negative manner. As with ethnicity, the foreign origin of a teacher may have a beneficial impact in terms of promoting understanding and tolerance. However, the use of expatriate personnel has two possible negative factors, one financial and the other pedagogical, that must be considered. The negative financial factor is the higher salary costs usually borne by the educational system for foreign teachers. An exception to this is when the expatriates are paid for or seconded from donor nations. The cost of those foreigners paid by the host government, however, also can involve a balance of payments issue since the foreign teacher may demand to be paid in a foreign currency or demand currency exchange privileges so they can convert part of their salary payment for repatriation to their home country.

The negative pedagogical effects can occur because the expatriate may be unfamiliar with the local curriculum and the social and cultural context within which the curriculum has been developed. The tendency of expatriate teachers to ignore or underemphasize the local curriculum is increased in those cases where the expatriate does not expect to remain as a teacher in the host country for more than two or three years. An additional complaint often expressed about expatriate teachers is their failure to use the local language (or the local pronunciation) correctly and their inability to relate concepts to local history and experience.

Given that expatriate teachers cost more and may be less effective in some situations, why are they used? Obviously the explanation is that at the early stages of educational development the only means for meeting the demands for certain high-level and scarce teaching skills may be to employ expatriate teachers. This situation points out, however, the potentially powerful efficiency effects that can occur with indigenization of the teaching service. If quality sacrifices can be minimized, the benefits from the use of indigenous teachers can include lower salary costs, a reduced balance of payments effect, and the possibility of greater local and national relevance in the application of the curriculum. This discussion of the role and effect of expatriate teachers is illustrated most dramatically by the experience in the Yemen Arab Republic where, in 1982/83, only sixteen percent of primary teachers, seven percent of preparatory, and six percent of secondary teachers were Yemenis (IEES, 1986A).

To this point, the characteristics that have been discussed are proxy indicators--they are not valuable in themselves but have importance only in that possession of these characteristics may be correlated with possession of specific abilities, knowledge, attitudes, and behaviors that are understood to promote the desired educational outputs and outcomes. Another set of indicators exists that relates more directly to these desired characteristics of teachers.

Subject mastery is important in that it determines the extent of knowledge--of facts and skills--that the teacher can transfer. While obviously correlated with general attainment and subject specialization, subject mastery possessed by individual teachers will vary according to their own abilities, the effort they expended in knowledge acquisition, and the quality of training provided to them. Where subject mastery is lacking or inadequate, the teachers' knowledge can be supplemented by textbooks or educational support materials (Lockheed, et. al., 1987).

Teacher verbal ability is a critical factor and, in some studies, the input of greatest determinacy in student achievement (see surveys such as Husen, et al., 1978; Avalos and Haddad, 1981; and Green, 1983). In the traditional classroom, the teacher's ability to communicate facts and concepts is the major facilitator of student learning. In developing nations that face a scarcity of other inputs such as textbooks and instructional support materials, the teacher's ability to communicate will be the major school-provided instructional resource that will determine student acquisition of knowledge. Obviously, the total effectiveness of the teacher will be determined by the net effect of subject mastery and verbal ability. The effect of a high level of subject mastery can be diluted if a teacher has poor communication skills. Similarly, good communication skills are less valuable if a teacher has little knowledge to impart to students. The success of teachers (and the appropriateness of the instructional program at teacher training institutions) can be predicted based primarily upon the level and complementarity of these two characteristics.

A final important characteristic, and one that frequently is neglected in survey research, is the teacher's attitude toward the classroom process. This would include specific attitudes toward children, the community, the school administration, their fellow teachers, and the occupation of teaching. Some of these attitudes will originate in the teachers' own experiences as students; some will be a product of their teacher training courses; and others will reflect general social and community attitudes. Over time, however, the most important teacher attitudes will be those that they develop or modify as a result of their own experiences as classroom teachers. The determinant of these attitudes is the configuration of positive and negative incentives that exist for different forms of expressed attitudes and behaviors.

Chapter 3

Measurement of attitudes is a difficult methodological task. Survey instruments suffer from a skepticism as to the willingness of teachers to record their true attitudes as opposed to the ones that they feel are socially acceptable. * At the observational level, much more can be done in the measurement of attitudes even if the set of attitudes are inferred from teacher behavior rather than measured directly. Experience suggests that teachers' attitudes are a powerful force in determining their effort in their work and their empathy with students. The current interest in teacher incentives (going beyond salary and promotion consideration to an extensive number of monetary and nonmonetary influences; see Thiagarajan and Kemmerer, 1987) is based on the precept that teachers attitudes, and thus their behavior, can be modified by the actions of educational administrators, parents, and community officials.

Four teacher availability measures are commonly used to express the number of teachers available relative to some other unit of educational input. These are the student/teacher ratio, the teacher/class ratio, the teacher per school ratio, and the teacher instructional hours per week. The student-teacher ratio is derived by dividing the number of students by the number of teachers (or, preferably, the full-time equivalent number when some teachers are employed on a part-time basis). This is sometimes expressed in the inverse form of teacher per student; while the teacher per student ratio has the advantage of indicating the average share of a teacher's time available to a student the more common student/teacher ratio is used here.

Student-teacher ratios have been one of the least well understood measures used in educational effectiveness analysis (e.g., see Haddad, 1978; Glass and Smith, 1978; Glass, et al., 1982, and Hanushek, 1986). The assertion by many researchers has been that there is no proven advantage to small class size.** Given the rarity of small enrollments relative to teachers in most developing nations--except where these are concomitant with such forms of educational disadvantage as rurality, remote location, or multiple-class teaching responsibilities--the appropriate policy interpretation of these findings is less definite. Class size may be of great importance in dealing with certain

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* Even skeptics are surprised at times by the variety of attitudes that teachers can perceive as socially acceptable; in many nations the variety of types of socialization and the variation in degrees of social inculcation surprise those familiar with the more homogeneous situation in developed nations.

** In fact, of 112 estimates reviewed by Hanushek (1986), only 23 had statistically significant effects of class size and only 9 of these had a positive sign. However, Hanushek himself warns of the danger of equating teacher/student ratios with class size. The warning is even more appropriate in developing nations where the ratio of grade six to grade one enrollments, for example, can be quite small.

types of students and certain subject areas and should not be disregarded as an effectiveness variable.

The teacher per class measure helps identify those situations where over- or under-utilization of teachers can occur because of an inability to match teachers to classes on a one-to- one basis as is common in most instructional systems (even where a teacher is a subject matter specialist teaching multiple classes over a day, the total for the day should still approximate one full-time equivalent class per teacher). A ratio of more than one full-time or full-time equivalent teacher per class suggests that all teachers in the school or system are not fully utilized. This may be a result of requirements for additional non-class instructional activities, for outside class responsibilities (e.g., parental or community contacts), or simply a result of the need to provide a subject specialist to a school that is not sufficiently large to use the specialist full time. These explanations emphasize the fact that a ratio of more than one teacher per class is not proof of inefficiency; it simply requires a justification in terms of showing that the teacher's time is fully employed in other activities for the school or system or that the situation of low utilization cannot be remedied by alternative administrative arrangements (e.g., school consolidations or employing teachers who work in multiple schools on a rotating basis).

A teacher to class ratio of less than 1.0 suggests that multiple-class teaching must exist. While this poses potential instructional and administrative hardships on the teacher, the situation may be inevitable in cases of teacher shortages or rural schools with small total enrollments. Again, inefficiency exists in such situations only where an instructionally and financially feasible alternative exists that would enhance educational outputs and outcome without an offsetting increase in costs.

The teacher per school ratios are less readily interpretable because they require that one know the number of teachers required for a school. Some large schools will require multiple teachers for a single grade level; other schools that are incomplete will not have a full cycle of classes for their level of education; and, in rural areas, some schools may combine levels (normally primary and lower secondary) of education in a single school facility. The only certainty with this measure is that a ratio for an educational level that is lower than the number of grades in that level (less than six for a six-year primary cycle, for example) indicates incomplete schools, multi-grade teaching, or both.

Table One presents the ratio of teacher per student, teacher per class, and teacher per school for primary schools in the eleven governorates of the Yemen Arab Republic (Y.A.R.) in 1982/83. It is interesting to note that these teacher utilization data indicate a fairly large variation among the regions. The smallest student-teacher ratios are in two very rural governorates, Ha'rib and Al-Jawf, while the highest rates are in the

TABLE ONE

TEACHER AVAILABILITY MEASURES
YEMEN ARAB REPUBLIC
1982/83

GOVERNORATE	STUDENTS PER TEACHER	TEACHERS PER CLASS	TEACHERS PER SCHOOL
SANA'A	43.2	.65	3.1
TAIZ	48.9	.87	5.3
HODEIDAH	47.1	.81	3.8
IBB	54.6	.73	3.3
DHAMAR	47.9	.63	2.4
HAJJAH	38.9	.59	2.1
BEIDAH	39.6	.67	3.2
SA'ADA	32.5	.56	2.1
MAHWEET	43.0	.49	2.0
MA'RIB	26.8	.54	2.1
AL-JAWF	26.7	.53	1.8
TOTAL	45.7	.70	3.2

SOURCE: Ministry of Education, 1984 data reported in IEES Project, Yemen Arab Republic Education and Human Resources Sector Assessment, 1986.

relatively more urban governorates of Ibb and Taiz. The 45.7 average for all schools disguises a variation from classes in excess of 100:1 in some Grade One classes and very small enrollments in some Grade Five and Grade Six classes.

The teacher per class figure varies from .49 to .87 with an average of .70. This illustrates that the practice of multi-class teaching is common in most areas. Those governorates with the greatest proportion of small schools (Al-Jawf, Sa'ada, Ma'rib, Mahweet, and Hajjah) have the lowest ratios of teachers per class indicating the additional incidence of multi-class responsibilities in the most rural areas.

The number of teachers per school ranges between 1.8 and 5.3 with an average of 3.2. In the Y.A.R., the government has been successful in assigning teachers to rural schools; one goal of this policy is to have smaller class sizes help offset the educational disadvantages the rural schools face.

The final measure of teacher availability is expressed in the number of hours of instructional time spent per week in educational activities. In the process section a measurement device will be discussed for articulating how teachers actually spend their classroom time. The availability measure can be based on official "expectations" or observed behavior. In either case it is important to identify teacher functions that take place outside the classroom. For example, a report on rural schools in Shanxi Province, China (Study Team on the Situation of Rural Schools in Shanxi Province, 1986) noted that middle-school teachers are in class only 24 hours per week--about two-thirds of the average for their counterparts in Europe and North America. However, in the Chinese system teachers have intense out-of-class responsibilities including tutoring slower students, organizing enrichment activities, supervision of dormitories, and maintaining contacts with the parents and local community. For the time measure to be meaningful as an indicator of effectiveness one needs to know the full range of teacher functions.

This extended discussion of teacher measures is justified by the centrality of teachers to most national systems of instruction. The other input characteristics that follow are proposed more as complements to, rather than substitutes for, the teacher characteristics measures. The latter have a crucial role in any consideration of educational inputs as indicators of educational effectiveness.

B. Facilities

The next category of input indicators to be discussed is facility characteristics. The facility characteristics are divisible into issues of size and of availability of special use facilities (e.g., recreation areas, laboratories, and vocational/technical shops). The

aggregate or average physical size of the school or the classroom is not usually of direct importance; these measures may have some effect on construction costs (significant economies of scale--savings related to larger size--may exist in initial school construction) and there are some potentially negative scale effects in terms of school administration. However, as school inputs and as proxies for quality or potential effectiveness, the most important facilities characteristics are the utilization measures of students per school, students per classroom, and (where data is available) students per square yard or square meter. Inputs as defined here represent availability for utilization rather than actual utilization. The measures of students per school, per classroom, or per unit of area are used as inputs, not process measures, because they are measures of the availability of space and not of the actual form of its utilization. The form of utilization is a process, not an input issue, and will be discussed in the section on process indicators.

Students per school is an interpretable indicator only when one knows something about the normal physical size of the schools in a country, the nature of the instructional process (i.e., the requirement for special use facilities), and the distribution of population. For example, rural schools are almost always smaller, and smaller schools, because of the existence of economies of scale, are more costly per student; however, smaller schools are not inherently more inefficient. Efficiency is determined in terms of existing constraints and available alternatives. If a rural school's size causes it to cost 20 percent more per-pupil, that is inefficient only if some alternative is available to provide the education at a lower cost (or if the harsh judgment can be made that the value of educating rural students is not worth the extra cost that must be incurred).

The normal means of resolving the problem of small rural schools is through school consolidation. This requires either the commuting of some students to a more distant location or the provision of residential quarters for at least some of the students. In most developing nations the poor quality of transportation and the isolation of many rural communities (accentuated in many locations during the rainy season) often make the commuting alternative unfeasible. Transport (either in terms of infrastructure or vehicles) may improve over time (as it has in rural areas in more developed nations) and cause the alternative of daily student commuting to be more attractive. Provision of dormitories often is more expensive than the operation of the individual small schools. In most cultures, residential schools are not considered appropriate for children of primary school age. Even at the secondary level there may be opposition to residential schools that are coeducational; these cultural and social constraints further limit the ability of educational planners and administrators to reduce school costs through consolidation. The important point is for the educational analyst to be able to

distinguish between a situation of higher student costs that represents inefficiency and one that simply reflects the inevitabilities of the school location and environment.*

Issues related to classroom utilization indicators are similar to those discussed for school utilization indicators. If classrooms are a standard size and there are no distinctions for special uses, a very straightforward interpretation can be made. However, classroom size may vary by location, by level of education, by type of education, and by the subject matter taught in the classroom. Classroom utilization standards will vary by the same characteristics. A rural school inevitably may have fewer students per classroom, secondary classrooms normally will have fewer students than will primary ones, classrooms at a vocational school may be smaller then those found at academic schools, and a social studies classroom may be much larger than a science or art classroom. None of these relationships are rigid but they do point to the danger of interpreting quality or effectiveness based on aggregate or average data on facilities per student.

A more refined measure of the facilities indicator is the use of a unit of area (square meter or yard) to denote the average versus appropriate size for a school or classroom. To be of value, the measure should relate to the issues of location, level, type, and subject discussed above. Only then can an analyst compare the actual availability of facilities with that deemed appropriate, minimal, or optimal.

Some schools may be constructed at a size larger than current use requires. The purposeful creation of excess capacity can be justified when changes in population distribution or school attendance are expected to increase facilities utilization to the acceptable level in the future and where no substantial effect on cost is created in the interim. In many areas it may be less expensive (even considering the immediate effect of interest paid or foregone on building costs) to create the additional capacity at the time of initial construction than it is to make sequential additions to a school as enrollment increases. Thus, the analyst must know whether any under- utilization of facilities is a transitional or permanent condition of the school or school system.

Related to the above, aggregate measures of facilities utilization are those measures that simply list an inventory of the available special use facilities. It is common within the conduct of an educational census to collect data as to whether a school has a

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* It may be noted that urban schools, even with higher utilization rates, can be more costly per student because of the higher costs of land, material, or labor in urban areas. This would be a more common finding if the land-use cost for urban schools was priced in terms of the opportunity value (interest and depreciation) of the land on which the schools are built.

Laboratory, an administrative office, a workshop, student lavatories, a kitchen, etc. These censuses normally cannot provide information about the quality and utilization of these facilities. Observation at actual school sites will reveal that significant variation in the nature of provision and utilization of specific facilities for instruction or other purposes can exist even within a single special-use category.

The information available on facilities can often be at a level of detail that is surprising. For example, in the Yemen Arab Republic, the educational statistics office maintains data on the building materials used in school construction (stone, cement, bricks, wood, other), perceived overall condition (good, needs repair, poor), availability of special facilities (study rooms, administrative offices, bathrooms, storage rooms, and laboratories), availability of electricity, and availability of water. The Ministry of Education, as part of its design of a new educational management information system, is reexamining the facilities section of their school questionnaire to be sure the data produced relates to the data needs of the Ministry's decisionmakers.

The interest shown by ministries and other agencies in educational facilities is noteworthy given the low degree of importance assigned to facilities in most studies of determinacy. Fuller (1985), in a survey of World Bank research, confirmed earlier analyses that have found that while some correlations exist between facilities quality or special-use facilities availability and student achievement, these correlations are consistently small and of questionable policy significance. Windham (1986) noted:

> While some minimum facility quality undoubtedly is required in most environments, and there is a persuasive case to be made for facilities quality as a constraint on school learning, there is no similar case to be made, intuitively or statistically, for facilities construction as a major vehicle for efficiency enhancement. The status of facilities utilization is a more critical issue than the simple availability of schools built to Western standards.

C. Equipment

The discussion of equipment inputs as indicators of educational quality or effectiveness parallels that just presented for facilities inputs. Utilization measures will always be superior to availability measures as indicators of educational effects. However, availability measures may be all with which one has to work. The most important types of equipment one normally considers are laboratory equipment for the physical and natural sciences; vocational/technical equipment used in woodworking, metal working, electronics, practical engineering, and related subjects; and audio-visual equipment used in support of instruction (the traditional forms such as radios, film projectors, tape recorders, and overhead projectors have now been supplemented by the

newer technologies of television, video-cassettes, computers, and compact discs; Block, 1985).

The availability of even the most basic equipment is still a rarity in the primary schools of most developing nations and the incidence of all equipment is biased toward urban areas and the more developed and politically powerful regions of a nation. The reasons for this are simple. The schools that are advantaged in terms of their location in urban areas are the easiest to which to disseminate new equipment. These schools are also the most likely to have the electrical supply needed to operate much of the equipment and the teachers who are best prepared to use the equipment effectively. The result of this coincidence of locational advantage and access to educational equipment is that equipment availability is a very good correlational indicator of school quality and potential effectiveness whether or not a causal relationship can be established. The availability measure indicates the direct effect of additional instructional resources available to students as well as serving as a proxy for the complex mix of favorable economic and social biases indicated by the concept of locational advantage.

The use of the equipment measure as an indicator at the educational system level is more complex. Here, the proxy for locational advantage is diffused because one is working with aggregate or average measures of availability; increases in these latter measures should still be useful as indicators of systemic increases in quality and potential effectiveness because the measures do reflect an increase in the availability of instructional resources in the system. The measurement of the incidence of availability can be used to create valuable indicators of system equity. To the extent that availability is biased toward the already advantaged locations, the provision of equipment may be seen as reinforcing inequity by contributing to the convergence of disadvantage faced by students in remote and rural areas and the least developed regions. As educational equipment becomes more equally distributed among schools, its measurement will be a less useful indicator of quality. For a considerable time, however, this input, even in the absence of utilization data, will continue to play a potentially important role as a marker for the identification of advantaged and disadvantaged schools.

D. Educational Materials

The availability of educational materials has received increasing attention in the last decade because of growing evidence that it is an important correlate and a probable determination of classroom achievement (Heyneman, et. al. 1978 and 1983; Searle, 1985; Fuller, 1985; Suryadi, Windham, and Green, 1986; and Lockheed, et. al., 1987). The attention directed to educational materials has been divided between the question of providing basic textbooks (Heyneman, Farrell, and Sepulveda-Stuardo, 1978) and the introduction of modular programmed learning materials into classroom use

(Cummings, 1986). In both cases the materials are seen as having some effects that complement existing teacher skills and other effects that substitute for teacher inadequacies (Lockheed, et. al., 1987).

In terms of aggregate availability and the incidence of availability, textbooks are a less extreme case than is educational equipment. Increasingly, in most developing nations outside sub Saharan Africa, textbook distribution efforts are increasingly successful. The financial support of international donors and the efforts of indigenous curriculum officials also have resulted in an improvement in the overall quality and local relevance of textbook materials in the last decade. Where these efforts have been successful, the availability of textbooks is no longer a useful indicator, by itself, of school quality. Also, in these nations, textbook availability is less of a force to magnify existing inequality than was the case when the textbooks were available only or primarily in the socially advantaged locations.

In much of sub-Saharan Africa, and in some poorer countries elsewhere, the conditions of textbook availability are still at a critical stage. In some cases, such as Liberia and Somalia, potentially valuable textbook design and adaptation efforts are frustrated by the problem of distribution. The distribution constraints relate primarily to problems of finance, transport infrastructure, and the administrative capacity to manage the distribution effort. In other countries such as Cameroon, Kenya, and Botswana, the focus is on improving textbook utilization through provision of training in the pre-service and in-service teacher preparation programs. Throughout the developing world, better plans and policies are needed to deal with the three stages of instructional materials dissemination: development, delivery, and utilization (Windham, 1986).

In nations that have a large preponderance of underqualified and unqualified teachers, textbooks have a special role often underappreciated by ministry and donor officials. In addition to the traditional functions as an information resource and a curriculum design format, instructional materials can be a training device for the less qualified teachers. Teachers, by following the sequence and content of textbooks, programmed materials, or by using other instructional support supplies (maps, charts, diagrams, special-topic booklets), acquire both new knowledge and an appreciation for the principles upon which classroom organization for instruction are based. In the better textbooks and materials the design principals are more explicit as each learning unit includes new information, examples, questions, and even sample examinations. Even in the less well- designed materials a system of organization and a rationale are implicit and, over time, improved methods can be acquired by the conscientious teachers.

Programmed instructional materials, whether designed for use in activities led by the teacher or more independently by individual students or student groups, offer the most

explicit instructional design formats. However, whether explicit or implicit, instructional design characteristics of classroom materials will continue to be a major determinant of their value for on-the-job learning by teachers. Thus, the availability of these materials has implications not just for immediate quality and effectiveness but also for the long term developmental effectiveness of both teachers and materials.

Two major cost issues exist concerning instructional materials: the determinants of production and distribution costs and the responsibility for textbook financing. The determinants of textbook costs include a myriad of factors related to availability of paper, local printing capacity, the nature of the existing transportation infrastructure, and administrative capacity for the management of development and distribution activities. A major policy issue for many developing nations is the decision for internal or external publication of instructional materials. In nations such as Indonesia or the People's Republic of China, the economies of scale are enormous and thus internal publication is easy to justify. For smaller nations, and especially those smaller nations with a unique language such as Somalia, the policy problem is much more difficult to resolve. Internal publishing resources may not be adequate to meet the demand for educational materials in the local language and yet the relatively small quantity and specialization required for external publication of these materials results in the smaller nations often incurring a much higher unit-cost for instructional materials than would a larger nation.

Internally, distribution costs may be a significant retardant to efforts to disseminate materials equitably to remote rural areas. This issue of cost has an important convergent effect with the question of textbook financing (Mingat and Psacharopoulos, 1985; Jimenez, 1986; World Bank, 1986). In those nations where textbook costs are solely a responsibility of the government, the rural poor are left free of the burden of paying for textbooks but, too often, also are the last ever to obtain textbooks if they receive them at all. In contrast, where textbook costs are charged fully to the student or parent, the real sacrifice required to purchase textbooks may be greatest for those individuals in remote areas who have low incomes and also must pay higher prices because of the extra distribution cost to deliver books to rural or remote areas. A compromise system used in China and some other nations is that the government textbook monopoly provides textbooks everywhere at the same price; thus, the government bears the cost of distribution expenses outside the urban areas. Also, government at the various levels can decide to subsidize textbooks for certain geographical areas or for disadvantaged families. Partial subsidization in this form has the disadvantage of requiring a needs-basis or other criteria for judging who receives the

subsidy; however, general subsidization also has a cost in terms of government payment of charges that could be borne by more advantaged members of society.*

Instructional materials availability and costs are commonly used indicators of quality and effectiveness. A final issue in regard to these indicators is the assumed proportions necessary between instructional materials and students. Many textbook distribution schemes assume it is necessary to have one textbook (in each academic subject) for each student. While this is the common current pattern in most Western schools, it has not always been so and does not represent a functional requirement for instruction as much as a convenience for classroom management and a facilitating device for user-financing. More research needs to be done on alternatives of multi-student use of textbooks and the possible negative effects this may have on learning and on the teacher time required for classroom organization activities. At present, however, the ratios of textbooks or other instructional materials per-student, except at the extreme values, may be better indicators of family income or governmental fiscal capacity for education than they are of potential instructional effectiveness.

A final point that relates cost to effectiveness issues is the policy decision to change the approved textbooks or other materials. If the officially approved textbooks are changed, for example, then the result is to devalue all existing materials in the schools. This can be an especially damaging decision where families have "invested" in textbooks under the expectation that the books will be available for reuse by the families' younger children or could be resold in the secondhand textbook market that often exists in even the smallest villages. Regardless of whether the books are owned by families or by the school, the decision to replace textbooks can have the effect of wasting an educational input. The decision must be based on confidence that the advantages of the new textbooks, in terms of additional effectiveness, will offset the transitional increased marginal cost of abandoning the previous textbooks. The negative effects of a policy decision to introduce new educational materials can be minimized if a transition period is allowed. Given that textbooks rarely have a usable life of more than three or four years in developing nations, the concept of a transition period is not a difficult one to implement.

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* Thobani (1984) suggests that the common convergence of inadequate government fiscal resources and excess demand for certain educational services justifies consideration of the wider use of "user-fees" for education. Klees (1984) objects to what he sees as Thobani's limited analysis and suggests a wider "political economy" view. Both authors stress equity outcomes as a critical consideration in user-fee effects on educational efficiency.

Subsumed within the instructional materials input category is the issue of curriculum. In the past, curriculum quality issues (including national or local relevance) have been ignored in most studies of educational effectiveness or efficiency. It is not that economists are unappreciative of the potential role played by curriculum in determining both costs and effectiveness; the problem is that no agreement appears to exist, even among curriculum specialists, as to how to measure and value variation in curricula.* Until some consensus of opinion evolves or is mandated, curriculum inputs will continue to be underemphasized and will manifest themselves in studies of effectiveness and efficiency in terms of process indicators rather than as input indicators. The sole exception to this will be where the curriculum defines the quantity and nature of instructional materials to be used. In that case the instructional material inputs discussed above are joint indicators of materials and curriculum.

E. Administrative Capacity

The lack of attention paid in education production studies and analyses of effectiveness and efficiency to the influence of administration is puzzling. The literature suggests an increasing confidence that administrative capacity is a key variable, especially in determining performance of the best and worst schools (Paul, 1983; IEES 1984A,B,C, 1986A,B; Glickman, 1984). However, as was the case with the curriculum variable, there is little consensus as to how best to operationalize the concept of administrative capacity.

The most common measure used to indicate administrative competence is the educational attainment of the administrator. Sometimes this measure is refined to reflect specific exposure of the administrator to training in management and planning skills. Also, as with teacher input proxies, experience measures have been added in some specifications; this is operationalized as age, years of employment, or years of administrative responsibility. Conceptually, the experience factor should be at least as important as that of formal or specialized training since on the job learning is such a critical determinant of administrator competency. This is even more the case in developing nations where administrators are less likely to have substantial formal training in management science or decisionmaking.

In addition to the personal ability of the administrator, educational administrative capacity includes the appropriateness of organizational structures, individual and group attitudes toward hierarchical systems, the range of available personnel incentives, and data availability and utilization. Personal experience suggests that the ability of

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* However, an interesting example of the capacity of outcome based instruction to enhance learning is presented in Jones and Spady (1985).

administrators in many educational systems is less a problem than the inefficient bureaucratic structures within which they work, the social and cultural constraints on hierarchical decisionmaking, the limited incentives or sanctions that the administrators can apply to subordinates, and the lack of appropriateness, quality, and timeliness of data upon which the administrators must base decisions. Improved pre-service and in-service training for present or future administrators can be a positive influence (and thus of some value as a statistical measure) but the improvement of educational efficiency will require an integrated approach to all of the factors that ultimately determine administrative capacity.

This is a special case of a general point. Some measures may exist that are adaptable to quantitative and statistical analysis of effectiveness and efficiency. However, these are never the only important measures and, in cases like that of administrative capacity, the quantitative or statistical measures may not even be the most important.

The following section on process variables will include some additional indicators of administrative behavior that probably are better proxies of the capacity of the school or system administrator than the input measures of formal or specialized training and experience. However, the input measures mentioned here are of some value and have the major redeeming quality of being readily available as part of most educational statistical systems.

F. Summary of Input Measures

This section on inputs has emphasized those measures that represent the availability of resources to the classroom, school, and system. A measure of potential versus actual use is inherently inferior in measuring effectiveness although it may be an acceptable proxy measure of costs. With certain exceptions resource costs in education are determined by whether an item is made available not whether it is used. The important exception to this are certain materials or equipment which will not deteriorate as rapidly if not used. However, given maintenance conditions in the majority of educational institutions, even equipment will not be fully preserved simply by postponing its use. Also, the financial cost of supply is immediate and the postponement of use may only reduce the present value of the beneficial effects that eventually are realized (by shifting the incidence of benefits to a more distant time).

While the input measures are inferior to process measures they can prove to be cost-effective as data. The next section will indicate that the superior insight gained from the use of process variables often is purchased at a higher price in terms of time and labor costs. If one adds to this the additional limitation that process measures collected

through observational methods involve an inherent loss of generalizability, the conceptual advantages of process variables may not always justify their additional cost.

The point is that the modesty, and at times skepticism, directed toward the use of input measures is not always justified. Input measures are more readily available and often controlled more directly by the educational authority. While one may prefer to affect classroom or school behaviors and attitudes directly, one normally can only change those input characteristics of the participants that one believes are correlated with the desired behaviors and attitudes. Thus, effectiveness or efficiency enhancement activities must be understood as part of a process wherein the planner or administrator attempts to maximize the probability of increased effectiveness or efficiency based on: (1) the available information on inputs and their determinacy for process effects; (2) the probable relationship of process variables to desired outputs and outcomes; and (3) the probable costs of reforms relative to the expected availability of resources. In this situation certainty is impossible and a normal bureaucratic response to uncertainty is inaction.

The educational system's senior officials can combat this administrative inertia only by creating a management system that encourages responsible experimentation. As more is learned about process phenomena, educational outputs, and social outcomes, the results of basing educational decisions on available input measures will be improved. The skepticism toward the use of input measures in determining educational policy and practice is justified only when such measures are used in isolation from the more immediate processes and effects of education.

II. PROCESS INDICATORS

The analysis of educational process is a study of the interaction that takes place among inputs under different forms of classroom technologies (instructional systems). Because interaction among inputs rather than the action of individual inputs is the focus, the discussion of process indicators cannot follow the same outline used for discussing inputs. Rather, the discussion presented here will emphasize three aspects of analyzing the educational process: (1) the analysis of administrative behavior; (2) the analysis of teacher behavior (with an emphasis on patterns of time allocation); and (3) the study of specific student behaviors related to time on task and observable utilization of school-provided resources.

It should be made clear immediately that process variables are the least suited to survey analysis and, to be measured properly, normally require observational data collection. Thus, the analyst must be prepared to justify the decision to study process issues rather than simply the common variation of input and output indicators measured at a higher level of aggregation. Theisen, et. al. (1983) note that (p. 67-68):

> ... national studies are beset by a host of linguistic, logistical, and methodological problems....The time is ripe to move from aggregate, descriptive studies of determinants...to those that will be of use in vitalizing efforts to improve educational outcomes.

In the following discussion, an attempt is made to indicate the advantages of studying process variables.

A. Administrative Behavior

Given the availability of administrative input data in the form of educational attainment levels and years of experience, the first type of process data that might be collected relates to incidence and form of administrative monitoring. One example would be the frequency, length, and purpose of visits by school inspectors or advisors. It is recognized that the role of school inspectors varies greatly within and among developing nations and that the appropriateness of inspector training to their level of responsibilities is a point of controversy. However, if the purpose of visits (whether to police or to advise, whether aimed to monitor school administration or classroom instruction) is known, as well as the frequency and length of visit, then it is easier to interpret this data in terms of normal production relationships.

Without the knowledge of purpose, one can generate some anomalous statistical relationships. For example, if visits by school inspectors primarily are in response to administrative or instructional problems, one will find a negative correlation between the administrative indicator and school performance in the short run. This is a situation analogous to what one finds in the field of health; if medical personnel visit only when disease or injury exists then the fact of their visit is an indicator of a problem. However, if medical personnel visit primarily to promote improved health and safety, one would expect, over time, a positive correlation between frequency and length of visits and the resultant quality of health.

Similarly for the school, if visits of supervisors primarily are related to improving school administration and classroom instruction, then, over time, a positive relationship with school achievement measures should occur. If a positive relationship does not occur, one is forced to question the value of the inspectorate program. Either the supportive functions of the inspectors are not properly designed or the inspectors themselves are not adequately trained or motivated.

The example of the inspectorate is an excellent one to indicate the relative value of process versus input indicators. If one used only input measures for the valuation of the inspectorate role (e.g., number of inspectors, level of training, length of experience,

inspectors per school or per class, inspector salaries or total inspectorate costs), one could be seriously misled about the actual role of the inspectorate. A common phenomenon in the poorest nations is that while an inspectorate exists it is constrained from fulfilling its responsibilities by the shortage of funds for transport and per-diem costs. Thus, some inspectors do not inspect any schools and most inspectors find it exceedingly difficult to visit the more isolated schools (the very locations most in need of external administrative and instructional support). Even in the more advantaged nations, transport limitations can act as a serious constraint on transforming this potential resource into an input that directly affects school performance.

A second set of administrator process indicators would be those that measure the school administrator's interaction with teachers and pupils. Again, data on frequency and length of interaction will be useless without knowledge of purpose. Just as with external visits from inspectors, the internal visits by school administrators can be either to respond to existing problems or to prevent future problems. All school administrators undoubtedly will have some interaction of the first kind; the data question is the relative incidence of visits that involve "policing" teacher and pupil behavior versus those that involve support of classroom management, instruction, and individual and group learning.

The final major area of administrative behavior, and one that commonly is ignored by both survey and observational research, is the interaction with parents and communities. Contacts with parents have three important aspects: to encourage parental support of educational activities of the family's children; to promote parental and community involvement in the education process itself; and to interact with the community concerning problems of school discipline and poor student performance. The first purpose is achieved through administrator meetings with individual parents and parent groups during which the purpose of education is explained as are the school's expectations of the students. While largely a proselytizing activity, this is a legitimate administrative function and, in situations where many parents do not have educational experience themselves, a crucial one.

The promotion of parental and community involvement has three desired outcomes: (1) utilization of home resources in the education process; (2) involvement of community members in instructional and instructional support roles; and (3) participation of parents and community in providing financial support for the school. The ability of home resources to be supportive of school instruction obviously is limited by the educational level of parents, especially that of the mother who is likely to play the central role in assisting children with school work at home and in affecting their attitudes toward schooling. Some school policies -- such as use of a language of instruction different from that of the parents or of curricular modifications such as modern mathematics (emphasizing number theory) or modern science (such as the

Nuffield science program) -- can actually reduce the ability of parents or community members to assist student learning. In contrast, a special advantage of concurrent adult education in literacy and numeracy is that it has the ability to promote adult support and empathy for the learning processes of children.

The use of community resources in direct instruction in the classroom similarly is constrained by the education level and skills of the community members; unfortunately, such use also is constrained by conservative attitudes on the part of administrators and teachers who are reluctant to encourage "external" involvement in their activities. The community participation can be especially meaningful in providing craft skill training beyond the areas of competency possessed by the teachers and in assisting teachers or substituting for them during periods of absence.

Finally, the administrator's purpose in encouraging parental and community support can be designed to provide enrichment funds as a supplement to government funding or, in private education, can be required to assure the very existence of the school. The payment of special school fees for laboratory expenses and of textbook charges may be essential if all children are to have access to more equal educational resources in the classroom. Motivating parents to pay these amounts can be difficult in economically disadvantaged communities but the failure to do so can lead to poorer achievement relative to more advantaged communities and can accent the internal variation within the school between those who do buy these materials and those who do not.

The effective school administrator must deal with parents or community leaders concerning problems of school discipline or poor student performance. The enforcement of school rules and procedures can rarely be successful without parent and community support and this support relationship can be affected by the social and political roles the school occasionally is forced to assume (Salifu, 1985). The need to deal with complaints from families concerning student academic problems is another difficult task for the administrator. However, even these potentially negative contacts can have positive long term benefits if the initial relationship established with the home and community is used as a foundation for promoting the more positive interactions discussed above.

Usually the measurement of these administrative indicators will relate to the behaviors (frequency of contact, nature of meetings) of administrators rather than the success of the behavior. Where possible, measures of parent and community participation should be collected directly. The ascription of these behaviors to the actions of the administrator must be done in the understanding that some community or parental involvement may be self-generated rather than responses to administrator initiatives and that the teachers play a crucial complementary and intermediate role to that of the school administrator in establishing positive relationships with parents and

the larger community. While in actual practice it is impossible to determine statistically the degree of community initiative or to separate the direct effect of administrators from their effect through the encouragement of certain forms of teacher behavior, the need to include process measures for administrative inputs should be recognized. Many statistical studies of the educational process could leave one wondering why there are administrators at all rather than contributing to one's understanding of what administrators can do to promote educational objectives.

B. Teacher Time Allocations

The allocation of teacher time in education may be viewed as divisible into three broad categories of activities: (1) administrative tasks; (2) instructional tasks; and (3) monitoring and evaluation tasks. The measurement of the time distribution among these three activity categories provides a useful indicator of the teacher role in the educational process.

The administrative tasks of the teacher include contacts with parents and the community (as described above for administrators), classroom organization and record-keeping, and the maintenance of student discipline. * The monitoring and evaluation tasks include design and conduct of examinations and tests, grading, and decisions on student remediation and progression based on the evaluation procedures. Of course, the most complex teacher task, and the one to which the greatest proportion of time should be allocated, is instructional responsibility.

The time allocation pattern of the teacher's instructional activity may be depicted as a three by four matrix as indicated in Table Two. ** The horizontal categories relate to the form of instructional group with which the teacher works--full class, sub-group, or individual. The vertical categories relate to the individual parts of the instructional task--preparation, direct instruction, review, and remediation (evaluation has been included as a separate task, as noted above). Table Two includes a hypothetical distribution of teacher time; the distribution is similar to what one might find in a traditional classroom setting. Study of such time distribution data can reveal a great

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* In support of the importance of the teacher's administrative role, Brown and Saks (1980) note that: "Time is the most important scarce commodity that gets allocated in schools. It is clear to us that...the teacher needs to be a good manager as well as an expositor."

** Actual time allocation studies will vary depending upon the research issues emphasized, the resources available to the researcher, and the researcher's conceptualization of the classroom environment.

TABLE TWO

HYPOTHETICAL MATRIX OF TEACHER TIME ALLOCATION

ACTIVITY GROUP	PREPARATION	INSTRUCTION	REVIEW	REMEDIATION	TOTAL
FULL CLASS	6%	40%	15%	4%	65%
SUB-GROUPS	2%	10%	2%	1%	15%
INDIVIDUAL	2%	10%	3%	5%	20%
TOTAL	10%	60%	20%	10%	100%

deal about the nature of the classroom process. In this case, it is obvious that the teacher depends on full class lectures for the majority of direct instruction (with a comparable distribution of preparation time) but uses individual student contact as the major form of remediation. Review work is one-third (20% versus 60%) as much time as direct instruction and is again dominated by the full class lecture approach.

It must be remembered that the percentages used in the table refer only to time spent on the instructional task. If the teacher normally spends 15% of the school day on administration and 10% on monitoring and evaluation, then the remaining 75% is available for the instructional tasks depicted in Table Two. To find the actual percentage of total teacher time spent on a task one can multiply the percentages in the table by the 75% of time the table represents of all activities. For example, full class remediation takes 4% of instructional time and 3% of all time (75% times 4%).

The division of categories in a time allocation matrix are not fixed but should follow some rational model of how the teacher will actually perform. The use of educational materials in preparation, instruction, review and remediation could be indicated by adding a third dimension (vector) to the matrix. For example, materials use could be categorized as reference books, textbooks, maps and charts, other materials, and no materials. Then the time allocation for each cell in Table Two would be further distributed across the five materials use categories.

Time allocation data can be collected by survey but the results are notoriously unreliable due to the tendency of teachers or administrators to remember or reconstruct reality in line with desirable patterns of behavior. Observation is far superior although the observer must be relatively well trained if reliable results are to be produced.

A valuable purpose of the time use indicators is not to identify effectiveness <u>per se</u>, but to raise questions with the teacher or others about why certain time allocations exist and the rationale for them. A second use of time allocation measures is to judge the <u>implicit</u> technology used in the classroom. Even though a teacher may be provided with materials and equipment that are designed to promote a student- or materials-centered instructional approach, a time-allocation analysis may reveal that the teacher, through his or her own behavior, has maintained a teacher-centered operation that violates the conditions of the new instructional alternatives. In evaluation of pilot and experimental educational approaches, it is possible to conclude that a new approach has failed to improve student performance when, in fact, closer study of teacher behavior

might reveal that the new approach was never implemented or at least not implemented in the form the instructional designers had planned.*

Time allocation measures may be criticized because they are not directly interpretable as positive or negative in terms of educational effectiveness or efficiency. However, they do provide a basis for making sounder inferences about the use of the teacher resource and the nature of resource interaction within the classroom.

C. Student Time Allocations

Process measurement of student behavior follows much the same pattern as for teacher behavior. Survey approaches, depending on either teacher or student reconstruction of time allocations, are acceptable but generally considered inferior to the measurement by observational techniques. The measurement of individual student behavior is subject to a wide variety of structures; Table Three is one alternative and includes a hypothetical set of time allocation data.

For this hypothetical analysis of student time allocation two dimensions of student instructional behavior are selected. The first is the form of student interaction with the teacher and other students; the categories are (1) full class interaction (with teacher in lecture/discussion format), (2) small group with teacher present, (3) small group without teacher present, (4) individual tutorial with teacher, and (5) working alone. The second dimension of behavior is the form of materials used; here the categories are (1) no materials, (2) textbooks, (3) instructional support materials, and (4) audio-visual equipment.

In the example given, fully one-half of the student's time is spent in listening to lecture/discussion presentations without the use of any instructional materials. The next two largest categories of time are textbook use in a full class setting and textbook use alone by the student. In this example, support materials are relatively heavily used while audio/visual equipment is rarely used and only in the full class setting.

Again, time allocation data on students are not direct indicators of effectiveness or efficiency but do provide more informed judgments to be made about whether the instructional process is using resources properly and what the probable effects of instruction will be. This data, unlike most other measurements, can lend itself to the

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* This is an example of what Dobson and Cook (1980) refer to as Type III evaluation error; namely, the evaluation of a program or treatment that, in reality, has not occurred.

TABLE THREE

HYPOTHETICAL MATRIX OF STUDENT TIME ALLOCATION

FORM OF MATERIALS USE/ STUDENT INTERACTION	NO MATERIALS	TEXTBOOKS	SUPPORT MATERIALS	A/V EQUIP.	TOTAL
FULL CLASS	50%	10%	8%	2%	70%
SMALL GROUP WITH TEACHER	2%	2%	1%	0%	5%
SMALL GROUP WITHOUT TEACHER	1%	6%	3%	0%	10%
TUTORIAL	0%	0%	0%	0%	0%
ALONE	0%	10%	5%	0%	15%
TOTAL	53%	28%	17%	2%	100%

discussion of possible attitudinal and behavioral effects of instruction. Because each form of interaction elicits different patterns of student behavior, it is possible to suggest different probabilities for such traits as independence, leadership, or cooperation based on student time allocation data (this is especially true when the data is generated using observational techniques).

In designing the measurement of student behavior one can add new dimensions (emphasizing facility use, active versus passive student behavior, or varying subject matter emphasis, for example) or define new categories for the dimensions given (one may have a category for mixed-materials use since, for example, a textbook could be used in conjunction with other materials or with audio-visual equipment). These decisions are of less immediate concern than the recognition by analysts that the time-use and other behavioral data on students are a legitimate means of assessing quality and probable effectiveness or efficiency.

The data presented in Table Three represent only the time on-task. Any time allocation study would also have a separate classification for time off-task (either as a single category or as a behavioral dimension with a set of separate sub-categories of its own). However, the off-task time normally would not be included in the time allocation matrix since it would not cross- tabulate with the other dimensions (such as materials use). If 25% of the student's time is off-task, then the percentages presented in Table Three are percentages of the 75% of time on-task. For example, the 8% of time spent in full class use of support materials would equal 6% of the total student time (75% of 8%).

There are special applications of the student--and the teacher--time use data to analysis of equity effects. By analyzing student interaction with resources by student category (gender, ethnicity, social class) within a single classroom or school, one can develop a much more reliable indicator of probable inequality in achievement, attitudes, and behavior. It is interesting to observe whether students with existing learning disadvantages receive more or less attention from teachers and whether they are subject to a difference in the form and amount of tutorial or small group assistance. Educational input data that exclude these issues of process may indicate that disadvantaged students have potential access to equivalent teachers and other resources. Process measures of the same students, however, could indicate that the disadvantaged students receive substantially less direct access to teacher time, material resources, and peer support. Thus, different measures of the same classroom can result in indicators of effectiveness and efficiency that are interpretable in diametrically opposite ways.

Student behavior data, of the type discussed here, can be of value when used independently but is of greatest use when combined with other process data on administrators and teachers. Collectively, the behavioral data can give a more complete

explanation of how all of the resources of the classroom and school interact to produce educational effects. The relevance of this to educational planning and management is three-fold.

First, to the extent that administrator and teacher behaviors can be correlated with administrator and teacher characteristics, there will be a greater ability to interpret the effectiveness of education in those cases where only input data are available. The information linking characteristics to behaviors can serve as a basis for teacher/administrator selection criteria as well as helping to design teacher/administrator training programs. Second, the knowledge of effective behaviors can allow the curriculum for training programs to be further refined so as to develop the desired behavioral patterns and to allow selection of training candidates on the basis of conducive attitudes and behaviors. Third, this same information would give school administrators a better foundation for monitoring and evaluation of teachers and a basis for encouraging modification in observed teacher behaviors.

At present, these contributions to the management and planning of education are unrealized. Until a strong research commitment to process analysis is made the contribution never will be realized. One must overcome concerns as to subjectivity, immediacy, and generalize-ability and convince the educational system's leaders that ignorance of educational process is a major source of systemic inefficiency and a major barrier to effective educational reform.

Such work is an ideal activity for donor support since it is experimental but does allow for the production of generalizable techniques (and possibly generalizable findings). Such work requires a commitment of substantial time as well as resources. However, it would engender a valuable discussion of what is wanted from the educational process and what can and cannot be modified in the classroom environment. Because of collection costs, process data may never be as cost-effective in facilitating educational decisionmaking as are input data; however, they can be more cost-effective in promoting correct decisionmaking.

CHAPTER FOUR

INDICATORS OF EFFECTIVENESS IN EDUCATIONAL PRODUCTION: OUTPUTS AND OUTCOMES

In this chapter the discussion of educational effectiveness indicators will proceed to the two most commonly used categories of measures, educational outputs and educational outcomes. As with the earlier discussion of inputs and process indicators, the focus of the discussion will be on the value of the indicators in increasing the understanding of educational production relationships and of assessing educational effectiveness.

I. OUTPUT INDICATORS

To many persons, the use of input or process data to measure educational effectiveness is anti-intuitive. To them, effectiveness can only be indicated by what the school produces. In this section, educational outputs (the immediate effects of the educational activity) will be reviewed in four categories: (1) attainment effects, (2) achievement effects; (3) attitudinal/behavioral effects; and (4) equity effects. While this categorization does not exhaust all possible educational outputs it does encompass the large majority of those measures that commonly are used as indicators of classroom, school, or system effectiveness.

A. Attainment Effects

The simplest measures of attainment effects are those provided by educational enrollment statistics. From these statistics one can compare over time the number of students by grade or level of education, by program type (e.g., academic versus vocational, secular versus religious), by control (private versus government), and by subject specializations (these normally are used only in secondary and post-secondary institutions). These statistics may be used for comparisons over time at the system, school, and classroom level or for comparison among schools and classrooms either within or among the program, control, and specialization types.

Normally, increased attainment is considered a positive indicator of effectiveness since a desired output of education is more graduates. Educational attrition and repetition, on the other hand, reduce or slow attainment and, therefore, are considered negative indicators. It is useful, however, to note that high attainment rates can be achieved by lowering attainment standards. Conversely, high standards for attainment can result in higher levels of attrition or repetition. These points are made to indicate

that attainment data, without complementary data an achievement, are inherently inadequate measures of educational effectiveness. (See Haddad, 1979, for a discussion of the educational and economic implications of promotion and retention policies).

Rates of educational progression, repetition, and attrition can be calculated either from a cross-sectional or cohort format. Table Four presents a set of cohort data for the Yemen Arab Republic (YAR) for 1976/77 to 1982/83. The data on number of schools and number of classrooms indicate how rapidly the YAR's educational system expanded over that time period. The cross-sectional (single year) data for 1982/83 could be used to indicate the relative size of different grade levels as a percent of the previous grade, as given below:

Primary School Enrollments: 1982/83

Grade Two as percent of Grade One	=	81.12%
Grade Three as percent of Grade Two	=	79.91%
Grade Four as percent of Grade Three	=	68.54%
Grade Five as percent of Grade Four	=	63.98%
Grade Six as percent of Grade Five	=	68.22%

One also can attempt to approximate growth of the Grade One class by calculating Grade One enrollment in 1982/83 as a percent of Grade One enrollment in 1981/82. However, in the YAR this percentage (97.49%) is less that 100% because of the atypical decline in Grade One enrollments between the two years. In the two previous years the ratio was substantially in excess of 100%; 113.91% in 1981/82 and 114.37% in 1980/81. This anomaly is an indication of the problem of relying on cross-sectional data, even when comparative cross-sectional data is available for more than one year.

The decline in Grade One enrollments in 1982/83 is explained by the phenomenon of multiple age groups of students entering Grade One when new schools first open. When a village that previously has not had a school first receives one, students older than the normal Grade One student of age six or seven may enter Grade One. Thus, in subsequent years the total enrollments in Grade One may fall even though the number of Grade One six- or seven-year olds actually may increase.

An alternative to the cross-sectional student progression data presented earlier is possible if one calculates progression as a percent of the previous grade <u>in the previous year</u>. When one has successive year cross-sectional data of the type in Table Four this is possible. The result of such calculations are indicated on page 60.

TABLE FOUR

YEMEN ARAB REPUBLIC PRIMARY SCHOOL ENROLLMENTS BY GRADE

	GRADE LEVEL						
YEAR	ONE	TWO	THREE	FOUR	FIVE	SIX	TOTAL ENROLL-MENTS
1976/77	86,463	47,971	35,292	23,426	15,235	11,772	220,159
1977/78	91,804	57,784	41,729	28,081	18,184	13,704	251,286
1978/79	97,288	58,847	40,837	25,596	16,014	13,385	251,967
1979/80	140,215	70,491	49,640	33,279	25,138	16,486	335,249
1980/81	160,361	96,381	65,232	43,796	27,640	20,863	414,273
1981/82	182,666	129,845	87,887	58,499	37,682	26,417	522,996
1982/83	178,075	144,455	115,428	79,112	50,613	34,529	609,212

SOURCE: IEES Project, Yemen Arab Republic Education and Human Resources Sector Assessment, 1986.

Grade Two	(1982/83) as % of Grade One	(1981/82) =	79.08%
Grade Three	(1982/83) as % of Grade Two	(1981/82) =	88.90%
Grade Four	(1982/83) as % of Grade Three	(1981/82) =	90.01%
Grade Five	(1982/83) as % of Grade Four	(1981/82) =	86.52%
Grade Six	(1982/83) as % of Grade Five	(1981/82) =	91.63%

Normally, in an expanding educational system, the progression rates will be higher for a comparative cross-section than for a one-year cross-section. This is because the previous year's enrollments at each lower grade level will be smaller than the current year's. Again, the Grade One to Grade Two progression rate is an exception in the YAR example because of the anomaly of the 1982/83 Grade One enrollment decline.

Even this refined calculation of progression excludes an important factor. While it is obvious that most of this year's enrollment in a given grade should have originated in the previous year's prior grade level, the existence and effect of grade repetition cannot be determined from cross-sectional data. For example, in the YAR data, a probable explanation of the higher progression rate at the Grade Six level is not just that more Grade Five students progress to Grade Six but that Grade Six students are more likely to repeat than are students at other grades. Thus, the progression rate, as it normally is calculated based on aggregate data, compounds progression effects with repetition effects. Repetition levels tend to be highest in the earliest grades (where the requirement to learn a new language or basic skills may hold students back), where national tests are administered, or where purposeful bottlenecks appear in the system. The last two locations are often the same and frequently coincide with the administrative division of schooling -- that is, between primary and secondary, between junior secondary and senior secondary, and between secondary and higher education, for example.

It is important in studies of progression rates to distinguish whether the rate is calculated based upon graduation (leaving one grade level) or further attainment (entering the next grade level). In the YAR, for example, the calculation of primary school progression rates can use graduation from Grade Six or successful access to Grade Seven as the final standard of progression. For 1982/83, the number of Grade Seven students was equal to 77.0 percent of the Grade Six graduates the prior year. Thus, if one had calculated overall progression from Grade One in 1976/77 to Grade Six in 1981/82, the rate would have been 24.3 percent (21,045 graduates versus 86,463 Grade One students six years before). If Grade Seven admissions are used to measure overall progression for primary education, the progression rates would have been 23.5 percent (20,332 enrollees in Grade Seven in 1982/83 compared to the 86,463 Grade One students in 1976/77). Both progression rates have analytical value (although one based on graduation rate normally is preferred in measuring educational effectiveness), but one must be clear concerning the basis of rate before using it for policy analysis purposes.

Some of the problems with repetition will reappear in the calculation of overall progression rates. In the above examples, the number of graduates--exam passers--may include students who began in an earlier Grade One cohort than 1976/77. Also, the Grade Seven enrollment in 1982/83 may include students who are repeating Grade Seven and even some who delayed transition from Grade Six to Grade Seven for one or more years. The analyst must be able to approximate the reality behind these numbers or the calculated progression rates are only a mathematical and not a statistical exercise. Any two sets of numbers can be used to create fractions, percentages, and even correlations. The difference between mathematical methods and statistical methodology is that the latter requires that the sets of numbers be related to conceptually generated variables and that the numbers represent adequate measurements of the underlying concepts. Since many educational decisionmakers have neither the time nor, in some cases, the training to make methodological assessments, the analyst bears a special responsibility for methodological propriety.

The use of tracer studies of specific student cohorts can be used to supplement the information gained from more aggregate enrollment data. In Table Five, the results of the special cohort tracer survey conducted by the YAR's Educational Development Research Center (EDRC) are compared with the inter-grade progression rates generated earlier from the single-year cross section and the two-year cohort comparisons. While one normally might assume that the implicit errors in the cross-sectional method would render that estimate least useful and that the long-term cohort approach used by the EDRC is the most sophisticated approach, the results in Table Five indicate that these two rates are more similar to one another than either is to the two-year cohort rate. As noted earlier, one can be sure, in an expanding educational system, that the cross-sectional approach will underestimate actual progression levels. This is indicated in the table in that the cross-section rates are the lowest of the three sets given.

But how can one explain the great difference between the two-year cohort data and that derived from the ERDC tracer study? Three probable explanations exist. First, the degree of enrollment over-reporting in the normal enrollment census may have increased (or the degree of under-reporting may have decreased) in recent years with the result that data from the two most recent years would be relatively biased upward. Second, the exclusion of repetition effects from the tracer study's calculation of progression inevitably lowered the progression rate. And third, it is quite probable that current progression rates are higher in the early grades than was the case when the early years of the tracer study were being conducted. In addition to the many expected reasons why progression rates might increase over time, the YAR system was reducing its formerly large number of incomplete (less than six grade levels) schools during this time period. As schools added higher grade levels, progression rates increased because children could continue their primary education in their own community.

TABLE FIVE

COMPARISON OF PROGRESSION RATES CALCULATED BY ALTERNATIVE METHODS

GRADE LEVEL	ONE YEAR CROSS-SECTION	TWO YEAR INTER-GRADE COHORTS	SIX YEAR COHORT PROGRESSION	SIX YEAR COHORT REPETITION
GRADE ONE	----%	----%	----%	8.2%
GRADE TWO	81.1%	79.1%	71.0%	6.1%
GRADE THREE	79.9%	88.9%	74.7%	12.0%
GRADE FOUR	68.5%	90.0%	72.3%	7.4%
GRADE FIVE	64.0%	86.5%	77.4%	4.0%
GRADE SIX	68.2%	91.6%	81.3%	5.4%
GRADE ONE TO GRADE SIX	19.4%	50.1%	24.1%	-----

SOURCE: IEES Project, Yemen Arab Republic Education and Human Resource Sector Assessment, 1986

This discussion indicates the need to understand the nature of the data with which one is working. A major use of progression rates as indicators of effectiveness might be to compare rates among schools, regions, types of control, gender of students, or some other characteristic. Proper policy interpretations of these comparisons can only be made if one knows the context of school operations in the various types of schools being compared.

Psacharopoulos and Nguyen (1987) present an example of another measure of attainment effectiveness: the age-efficiency indicator. The indicator illustrates the extent to which the actual age distribution differs from the official norm. For example, if the "official" age for primary school enrollments is from 6 to 12, a "gross enrollment ratio" can be calculated as follows:

$$\text{Gross enrollment ratio} = \frac{\text{Enrollment at ages 5-17}}{\text{Population at ages 6-12}}$$

This can then be compared with a "net enrollment ratio" that is derived in similar fashion:

$$\text{Net enrollment ratio} = \frac{\text{Enrollment at ages 6-12}}{\text{Population at ages 6-12}}$$

The age-efficiency indicator is derived from the ratio of the net enrollment ratio to the gross enrollment ratio. Because the population term cancels out, the age-efficiency indicator is equal to the ratio of age 6 to 12 enrollments to age 5-17 enrollments. The assumption is that a system is more "efficient" when there are fewer students outside the normal age for a level of schooling. This indicator, like many other enrollment/population ratios that may be calculated, is useful only as long as one is cognizant of the role of the educational system. If remediation is a primary responsibility for the system or some subset of institutions, then the age-efficiency indicator could be lower in value and still indicate that the system or institutions were operating efficiently.

All of the attainment measures presented here are potentially appropriate indicators of educational effectiveness. When these attainment measures are combined with other measures, such as those of achievement and equity, an even better educational effectiveness indicator can be produced. And when these effectiveness indicators are combined with cost data (generated by the interaction of inputs and process variables) one finally can establish an indicator of educational efficiency.

B. Achievement Effects

Achievement effects are perhaps the most commonly used of output measures. Test scores, either the absolute level or pre-test/post test differences, are the most commonly used measures of achievement effects. However, the common use of testing, and its ready acceptance by educational decisionmakers, disguises a rather heated controversy among educators and analysts concerning the psychometric properties of individual tests, the tests' relevance to desired educational outputs, and the definition of educational achievement as measured student change in terms of test results.

The accepted credibility of testing as a measurement device appears to depend on four characteristics: (1) it is a seemingly objective measure; (2) test results lend themselves to inter-student and inter-group comparisons; (3) testing has been a traditional characteristic of educational systems and has been assumed to promote student discipline and effort; and (4) standardized testing can promote a centralization of educational authority. In contrast, the credibility of tests may be attacked on the basis of their validity and reliability relative to the underlying characteristics that the tests attempt to measure.

In addition, Chapman and Windham (1986) point out nine generalizations that can be made about the use of a test score as an appropriate indicator of educational achievement:

1. Testing is not evaluating;
2. Large scale standardized tests, the type most often used in developing countries, do not tell one what students know;
3. Tests do not measure learning directly;
4. Test scores are not perfect measures of knowledge or achievement;
5. Often the domain of skills or knowledge that a test seeks to measure is poorly understood;
6. There are insufficient psychometric or social bases for establishing standards of test success or failure;
7. As measured by tests, achievement may not be the most important criteria by which to judge an educational activity;
8. Program quality cannot be improved simply by raising test performance standards; and
9. Gain scores should never be used as a sole basis for program evaluation.

This general controversy over testing cannot be dealt with here; however, it is important that a more general recognition of the controversy over testing be promoted and an increased skepticism be encouraged toward the ready identification of test results with educational achievement.

However, some agreed measure of achievement must be established. This can be a test or the result of observational judgment (as it often is in the case of teacher assignment of student grades). However established, the achievement measure for a single individual or group (and the group may vary in size from a number of students within a single class to the group of students in a national or multi-national classification) can be interpreted in effectiveness terms in six main ways:

1. Absolute level of achievement;
2. Average level or distribution of achievement;
3. Group achievement relative to larger group average or distribution;
4. "Mastery" level of achievement;
5. Achievement gain; and
6. Effect size.

The absolute level of achievement is normally represented by a test score or assigned grade. If one understands the psychometric properties of the test or the mix of objective and subjective criteria used in assigning a grade, these measures have some value for policy interpretation. However, the absolute achievement measures rarely are used in policy analysis since it is more common that decisionmakers are dealing with groups of students and are more interested in achievement relative to other groups or relative to a different time.

The average level or distribution of achievement provides more information than the absolute levels in that one can now interpret individual level of achievement relative to a group average or pattern of distribution. While group means are the most commonly used measures of central tendency, in certain situations one may wish to use other measures such as the group median or mode. Alternatively individual scores may be stated in terms of the quartile, decile, or percentile in which they fall relative to the full distribution.

Similarly, the achievement of one group can be compared with that of a larger group. The comparison can be one of central tendencies or distributions. The latter might take the form of noting that 15 percent of one group scored above a certain level or grade while 25 percent of the second group scored above the same level or grade. Since equ... output concerns (discussed below) relate to distributional considerations, it

is important that achievement data be available in terms of measures of the distribution and not just measures of central tendency.*

In all of the cases discussed here it is important to know whether the assignment of a score or grade is norm-referenced or criterion-referenced. Norm-referenced achievement measures simply state where an individual student's or group's achievement falls in the overall distribution of those tested or graded. Thus, a score of 90% or grade of "A" is interpretable only in a relative, not an absolute, manner. In fact, such scores are ordinal not cardinal in interpretation since one cannot state that a score of 40 represents one-half the level of learning indicated by a score of 80; neither can one assume that the achievement difference between an A and B grade is equal to that between a B and C grade.

However, criterion-referenced scores (based on a criterion of skill or knowledge acquisition) also have their interpretive limitations. In addition to the standard psychometric problems of test design, Clark and Vogel (1985) have found that criterion- referenced tests have emphasized immediate educational outputs (practical knowledge of simple facts or routines) rather than the more generalized and desirable outputs (the learning of concepts and principles). While such bias is not inherent in criterion referenced tests, efficiency analysis requires knowledge of the type of test or grade criteria used and appreciation for any significant measurement biases.

The fourth form in which achievement measures may be interpreted is in terms of a "mastery" level. Here, the criterion-referenced test or grade is assigned a threshold value, below which it is judged that achievement is irrelevant in terms of mastery of the underlying criteria--whether they be conceptual or procedural (see, for example, Arlin, 1984, for a discussion of mastery learning and its relation to time and equity issues). Some mastery standards require that a score of 100 percent or grade of "A" be attained for mastery to be recognized. Other standards accept that mastery may be achieved at lower grades or scores and that achievement beyond mastery is possible. To specialists in the field of mastery learning these semantic distinctions are critical; to policy analysts it is necessary only to understand the level established for mastery and to be willing to accept the rationale for it.

Mastery standards commonly are viewed as antithetical to norm-referencing. In fact, mastery learning standards may be viewed as the sine qua non of the criterion-referenced

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* Postlethwaite (1987) supports the use of distributional comparisons and comparisons between parts of the distribution (e.g., quartile levels). As he notes (p. 157) "The question is, which knowledge is useful and needed (even if it is sometimes not perceived to be needed)?"

approach. Mastery tests are not only designed so that scores relate to underlying educational criteria but also require that any judgment of the scores is not itself left to the norms or subjectivity of the analyst.

The final two measures of achievement interpretation are achievement gain and effect size. Both measures are related to the economic concept of "value-added". Thus, unlike the aforementioned measures of achievement, these measures imply attribution of the change or difference in achievement to some other change. In the case of achievement gain for a person or group, the explicit change is one of time. However, implicitly, the pre-test is prior to some educational event and the post-test is after it. The nature of the event can be simply a passage of time but more commonly it relates to some form of instructional intervention. For example, the intervention may be one year of schooling or the use of some educational material or alternative technology for a fixed period of time. Regardless, as suggested in item 9 of the list of generalizations about use of test scores to indicate educational effectiveness, one faces a major question when using achievement gain as a measure of effectiveness: Namely, can one separate true achievement gains from anomalies introduced by test imperfections?

The interpretive situation is improved when one is comparing gains in group means and improved even more if one uses residualized gain measures (in which the gain is residualized by regressing the pre-test on the post-test score), residualized true-score estimates (a statistical attempt to separate true scores from error effects and assess change only in the true scores), or an analysis of covariance (used when group not individual student gains are the focus and one can avoid the confounding of results because of non-random constitution of the individual groups). Whatever approach is used, one sacrifices precision of measurement for comprehension by decisionmakers whose statistical training (and patience) may not be adequate to understand the modifications or even to understand why the modifications are made. Therefore it appears that, just as with testing generally, the use of gain scores, even with the above limitations, will continue to be acceptable to all but the most conservative methodologists.

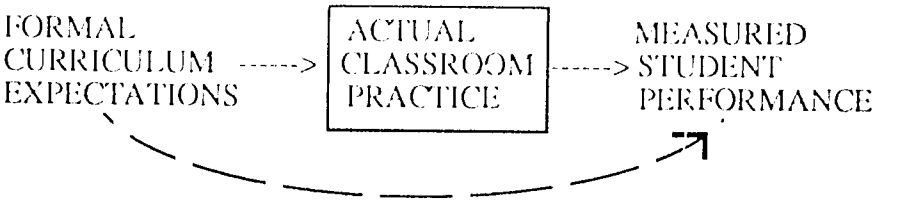
Similar problems exist in the use of effect sizes. Normally, effect size is defined as the difference between the average scores of an experimental and a control group, divided by the standard deviation of the control group. Effect size is a critically important concept since it often is the basis for deciding if a new instructional device or system deserves wider dissemination.

In interpreting effect size measures as an indicator of effectiveness, three considerations must be taken into account. First, are the only differences between the control and experimental group those that are explicitly designed as part of the experiment? The influence of an experimental condition on performance regardless of

the nature of the experiment (Hawthorne effects) is a sufficiently pervasive phenomenon that some inherent skepticism toward experimental successes is justified. Anything that changes the normal routine and focuses special attention on teachers and students is likely to elicit improved performance. The methodological question is whether similar effects could not be achieved without the specific experimental intervention that is being tested.

Similarly, one must examine the control and experimental groups closely to see that the teachers and students in one group are not significantly different from those in the other. In large experiments this can be achieved by random assignment to the two groups; smaller experiments will require stratification and matching of critical determinants such as those discussed earlier under input and process measures (Kelly, 1983, 1984). Finally, one must attempt to guarantee that the effect size measures will reflect experimental effects and not differences in the quantity or quality of resources (the "greenhouse" effect). Too often, the "success" of experimental classroom approaches compared to traditional models is a result of additional physical and human (especially supervisory) resources. In some poorer nations, the evidence that radio or television instruction or programmed learning is superior to traditional classroom results is hardly surprising if the traditional classroom lacks even the minimum teacher and instructional material resources that the traditional approach presumes. Effect sizes generated from such flawed research has little value for policy unless it can show that the increased cost of the experimental alternative is better invested in the alternative than in improving the traditional classroom by investing the additional funds there.

The second area of consideration in interpreting effect sizes is the presumed linkage of the test measure to the curriculum. The relationship of curriculum to testing is one that is mediated by classroom resources and behavior as indicated below:

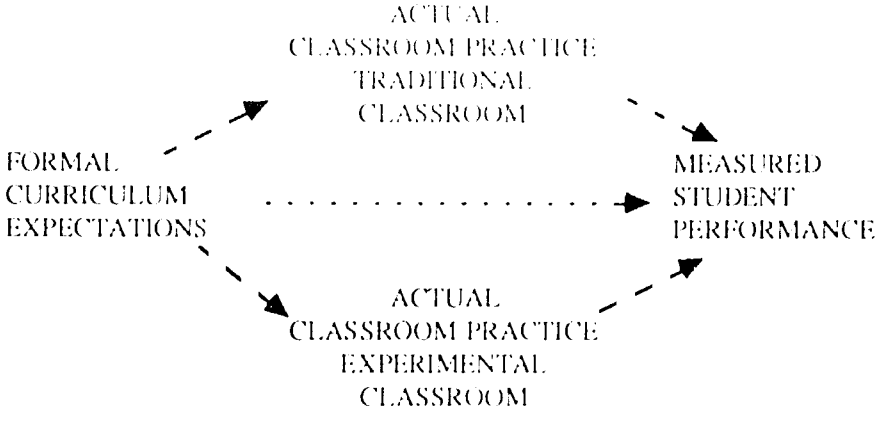


Measured student performance, the basis for calculating effect size, can be determined by three major relationships: the relationship of curriculum expectations to classroom practice, the relationship of performance measurement to classroom practice, and the relationship of performance measurement to curriculum expectations. The latter two relationships are the alternative criteria for examination design. Should the basis for test construction be the official curriculum expectations as stated in formal

documents or the actual classroom practice observed in schools? Variation in measured student performance can signal varied classroom practice or can indicate a difference in determinacy in terms of the curriculum's effect on classroom versus the test instrument.

That this is a real source of confusion is indicated by the example of the Improved Efficiency of Learning (IEL) Project in Liberia. Early evaluation results, based on West African Examination Council tests that claimed to be based on the national curriculum, indicated no superior student performance in the IEL schools relative to traditional schools. However, on examinations based on the IEL instructional program, the IEL schools did significantly better than the traditional schools. The interpretation of these contradictory results depends upon one's judgment as to the relative quality of the two curricula (the official national curriculum and the implicit IEL curriculum) and the validity and reliability of the two examinations.

Ideally, effect size should be a function only of differences in classroom practice as indicated below:



If the examination designed to measure student performance is a valid and reliable device in terms of its relationship to the curriculum, then the effect size differences are meaningful; if it is not, then the analyst will have a difficult, if not impossible, task to disentangle the various relationships among expectations, practices, and measurement. Too often, examinations are designed to measure the curriculum that is implicit in the experimental practices rather than that officially documented by the educational authority. Where the official curriculum is not articulated with great specificity, then it can be impossible to determine effect size in any meaningful manner. In the IEL example, the IEL professional staff maintained that their examination (as well as their instructional system) was more closely related to the national curriculum than was the examination administered by the West African Examinations Council. Given the state

of development of the Liberia curriculum at that time, the IEL assertion could not be readily rejected.

Thus it may be seen that the calculation of effect size differences are only the beginning, not the concluding, step in the analysis of alternative classroom systems. As with the measurement of student achievement generally, effect size analysis is subject to a significant degree of debate and subjective judgment. As was noted in the introduction, effectiveness and efficiency analysis do not remove the need to make policy choices but they do have the potential to improve the basis upon which those choices are made. The degree to which this potential is realized will depend upon the care and sophistication with which such data as achievement measures are generated and analyzed.

C. Attitudinal/Behavioral Effects

Output measures of educational effectiveness are dominated by the focus on the attainment and achievement issues discussed above. However, in many ways the public perception of education and the justification for government or community involvement in its regulation or financing are likely to relate as much to schooling's effects on student attitudes and behavior as it does to the more easily quantified measures of attainment and achievement.

It is interesting to note that in the classroom assignment of grades to students, teachers in many educational systems are asked to consider student classroom behavior as a factor. Some classroom grading systems even include special categories for such items as motivation, behavior, discipline, effort, and citizenship. These same concepts are rarely translated into standardized measures used at a level of aggregation above that of the school. Among the reasons for this the most important appear to be uncertainly over the nature of the desired attitudes and behaviors, controversy over the ability to measure these characteristics accurately, and confusion over how the classroom process relates to the development of the desired characteristics.

The mix of desired characteristics can be expected to vary from nation to nation. The relative emphasis on independent performance versus group relationships, on competition versus cooperation, on religious faith versus tolerance of other beliefs, and on traditional versus modern values will depend both on the personal values of the nation's political leadership (operating within constitutional limits where they exist and are operable) and these individuals' attitudes toward the propriety of using schools as a means of disseminating their own views. Almost all nations will use education to promote national pride but in some this will be extended to the point of promoting support for the ruling party or even of a single individual or family. The degree of controversy this promotes will depend upon the homogeneity of political views within

the nation. Similarly, some nations have designed their education system specifically to promote the nationally-supported religion (or a form of secularism in those nations where religion is discouraged) while other nations use education to encourage diversity, understanding, and tolerance. It should be recognized that attitudes toward religion are rarely a democratically-determined phenomenon; the insistence on religious unity is sometimes most extreme in those nations where multiple religious beliefs are most competitive.

Given that some agreement concerning desired attitudes and behaviors can be produced or imposed, one then must resolve the controversy over measurement. Problems of validity and reliability are even greater in this case than in the measurement of achievement gains. As with the measurement of teacher attitudes, one must be concerned whether responses provided on survey instruments are either accurate or truthful given the tendency for respondents to be able to determine the socially preferred answer. Observation of behavior is time and labor intensive and still can be an imprecise means of imputing the underlying attitudes or of predicting future behavior of students once they leave the restraints of the school environment.

A special area of attitudinal research has evolved from Inkeles' (1969) early work on "modernity." Studies of modernity attempt to relate educational attainment or participation to a set of attitudes that are stipulated to be more modern. Unfortunately, most studies of modernity appear more accurately to be studies of Westernization. In any case, the types of modern attitudes normally included in such studies are skepticism toward tradition, belief in science, and knowledge of the outside world.

Table Six depicts a questionnaire used in a World Bank study of education in Tanzania. While some of the questions might appear clearly related to modern attitudes, some relate to values about which even "modern" individuals could disagree. Because of doubt concerning causality, there is a stronger justification for using such modernity measures as student inputs (determinants of student process or performance) rather than as educational outputs. As inputs, one also does not have to be as concerned with the issue of the social desirability of the set of attitudes and can concentrate on whether the particular attitudes specified are identifiable and are positively or negatively correlated with desired patterns of classroom behavior or performance.

Overall, a contradiction exists between the possible importance of attitudinal and behavioral inputs of education and the serious difficulties of specifying, operationalizing, and measuring these outputs. The contradiction that exists relative to these outputs, however, is only another special case of the general situation for effectiveness analysis. Often, the more important and appropriate a concept or variable is, the more difficult it may be to specify, the greater the costs or barriers to

TABLE SIX

MODERNITY QUESTIONNAIRE

Please indicate your agreement or preference in the following statements by marking A for agree strongly, B for agree, C for disagree, D for disagree strongly.

_____1. If I was given a choice 20 shillings today or 40 shillings next month, I would take my 20 shillings today.
_____2. It is usually better to meet familiar people than new people.
_____3. Success depends more on luck than hard work.
_____4. It is usually not wise to try new things.
_____5. If you cannot solve a problem, the best thing to do is to leave it for a day or two.
_____6. Good planning is more important than hard work.
_____7. Some people are able to bring harm and misfortune to others through magic and sorcery.
_____8. A child should plan his own future.
_____9. Happiness is more important than success.
_____10. The only people one can really trust are one's family and relatives.
_____11. There is no sense in worrying about the future.
_____12. I would like to live in another country for some time.
_____13. It is generally a waste of time to plan for the future since unforeseen events can interfere with the plan.
_____14. It is generally not possible to understand why people behave the way they do.
_____15. Education is more important for boys than for girls.
_____16. I always try to get better marks than my classmates.
_____17. Often, feelings are a better guide to action than reason.
_____18. I am more ambitious than most of my friends.
_____19. It is better to learn about all nations rather than to concentrate on learning of one's own country only.
_____20. One must plan each day for the next.

SOURCE: G. Psacharopoulos and W. Loxley, Diversification of Secondary School Curriculum Study, Guidebook; (Washington, D.C.: Education Department, The World Bank, February, 1982), pp. 14-15.

operationalization, and the more substantial are the methodological limitations on measurement. To this general rule one can add that many of the most significant variables, once measured, are interpretable only by subjective means.

D. Equity Effects of Equality Measures

The use of equity effects as measures of output differs from the use of the aforementioned effects in that equity is a means of interpreting the other effects rather than an alternative, per se. Thus, equity effects can be expressed in terms of attainment measures, achievement measures, or attitude/behavior measures. Also, equity effects normally are expressed in terms of two dimensions: statistical measures of dispersion and measures of group differences. The first dimension of equity measures would include the range of a distribution, the quartile deviation, the mean deviation, the standard deviation, division among criteria levels, Lorenz curves, and Gini coefficients. The second dimension of equity would compare groups identified by such characteristics as gender, age, ethnicity or race, location, size of place, socioeconomic status, etc.) in terms of measures of the mean, mode, and median values as well as in terms of group differences in the values of the first dimension of equity measures. For example, one could compare mean achievement between males and females but also could compare the range of scores for the two groups. It is possible, for example, to have similar average achievement between male and female groups but to have male students achieve both the highest and lowest scores. Depending on the central tendency measure of achievement alone would disguise this phenomenon.

It is important to emphasize that the statistical measures of dispersion* are indicators only of inequality not inequity. Equity interpretations require subjective judgements concerning whether the inequalities are justified or acceptable. For the purposes of this presentation equity is best understood as denoting a judgment of "fairness" or "justice"; both of which are inherently subjective concepts. The measurement of educational output equality is important in two ways: equality is a basic indicator for making judgments of equity and the variation in output equality can affect student and teacher motivation. For students, one normally assumes that relatively high achievement promotes higher motivation and low achievement results in the opposite. However, such is the complexity of human nature that, for some students, superior performance may lead to future complacency and poor performance at one point in time can be a goad to higher motivation for success at a subsequent time. Whatever the conditions in individual students, the policy importance of equality

* The statistical measures are dealt with in the Appendix to this monograph.

measures are that they are an immediate basis for assessing equity and a potential indicator of future motivation.

All of the statistical measures discussed in the Appendix can play a role as indicators of educational effectiveness where equity considerations are a policy issue. Obviously, these are not the only measures used in the discussion of educational equality. In the next section, the discussion will review the second dimension of equity judgments that is based on comparing groups (in terms of both central tendencies and variation) rather than measuring variation per se. Some examples of this second dimension have already been given. For example, one can contrast all of the distribution measures mentioned above for specific groups that are defined in terms of characteristics deemed important for policy. As noted earlier, the most important or commonly used of these characteristics are gender, age, ethnicity/race, location, size of place, and socioeconomic status.

However, in addition to measures of distribution, inter-group comparisons can be made on the basis of the central tendency measures of mean, mode, and median. These terms are commonly understood but what is less well appreciated is when to use one rather than the others. As a standard rule:

(1) the mean should be used when each score should have equal weight, when maximum reliability is desired and when standard deviation or product-moment coefficients of correlation are to be calculated;

(2) the median should be used when an easily derived measure of central tendency is desired, when one wishes to neutralize the effect of extreme values, and when only ordinal rather than cardinal values of the distribution are available; and

(3) the mode should be used when a quick approximation of central tendency is desired and one has a special interest in maximum incidence (most frequently recurring) values.

A second problem with measures of central tendency used for inter-group comparisons is the degree of reliability that exists in terms of the differences between means, between medians, or between modes. The greatest statistical emphasis has been on the significance of differences between means.

The issue is whether a measured difference in the means of two groups represents a real and dependable difference or an accidental and transitory difference that is irrelevant for policy purposes. To assess significant differences in means the standard procedure is to test the null hypothesis, that is, the hypothesis that no "true" difference exists. The test varies depending upon whether the means are themselves correlated or uncorrelated. The detail for conducting tests of this type can be found in any standard textbook on introductory statistics.

In summarizing the use of group differences as an indicator of relative effectiveness, three conditions must be fulfilled before one is justified in making a policy inference:

(1) the difference between the measures of central tendency must be judged to be statistically significant;

(2) there must be some logical or statistical basis for assuming that the differences in central tendency and distributional measures are determined by factors within the control or influence of the school authority; and

(3) the magnitude of the difference is such that a policy emphasis on this condition may be shown to be cost-effective.

If the final two conditions are not fulfilled, then the measures discussed here may indicate "real" effects but not provide any basis for school reform. The policy alternative is either to accept the effects as given or to consider new means of school operation (including variations in the quantity and mix of resources) that will allow the school to have an impact on these outputs.

A final issue relative to measures of equity is that one must consider the school authorities' relative preference for different distributional patterns of achievement. While few schools or school systems can be said overtly to seek inequality as an educational output, schools and school systems can be expected to vary dramatically in their tolerance for inequality. Some schools are interested primarily in increasing average achievement. The three means of doing this are (1) to attempt to increase achievement of all children; (2) to emphasize increasing the achievement of advanced students; and (3) to emphasize improving the scores of students that are below-average in achievement.

Most teachers and administrators will assert that the first option is the one they pursue. However, if a school is judged in terms of its average achievement, the most rational procedure would be to combine school resources with those students who have the greatest probability of increasing their measured achievement. Unfortunately, neither the research literature nor logic can provide an answer with certainty as to who these students are.

Some teachers obviously believe that it is better or easier to invest their time with the more advantaged students; implicitly, they are making the assumption that the lack of intelligence or motivation of the poorer students cannot be overcome sufficiently to justify the teacher investing his or her time in these students. Other teachers operate in just the opposite fashion and assume the better students (by themselves or with educational materials) can continue to do well and that the proper allocation of teacher time is in favor of the disadvantaged learners.

If a different criterion than class or school average is used, then teacher behavior might change. For example, if a school were judged by the proportion of students who pass a school leaving examination there would be an explicit incentive to concentrate resources on those students who are on the margin in terms of examination success. Alternatively, if the school were judged by its ability to avoid wastage (dropouts and repetition), the resources might be focused on the students who are on the margin in terms of minimally acceptable attainment.

Overall, judging schools by specific central tendency or distributional criteria is likely to create a "triage" effect:

(1) those students are are judged to be successful without assistance may be left alone;

(2) those students who are judged to be impossible to help with the amount of assistance available will be left alone, and thus

(3) resources will be concentrated on those students who have the greatest marginal probability of being moved into the category of success.

Multiple problems exist in this situation. First, no single measure is likely to be an appropriate indicator of educational effectivenes. Second, even if a single measure existed, there is no assurance that the political and bureaucratic environment within which education operates would lead to its identification and dissemination. And three, most teachers in developing nations simply do not have the skills to make the type of psychological appraisals of ability and motivation that are subsumed within a "triage" decision process.

In the next section the discussion will move from outputs to outcomes of education. To repeat the distinction made earlier, educational outcomes are those effects that are more distant in time and more diffuse in incidence than are educational outputs.

II. OUTCOME INDICATORS

Dealing with educational outcomes involves the same two critical issues faced in dealing with educational outputs: identification and attribution. The issue of identification (including the steps of definition, specification, and measurement) of outcomes is similar in terms of relevance and difficulty to that dealt with in the outputs discussion. Although the variety of attributes to be included and the diversity of their incidence do make outcome identification slightly more difficult these are not insurmountable barriers.

More challenging to the analyst is the issue of attribution, i.e., causality and its direction between the education variables and the multiple variables that represent both

alternative and complementary outcomes. As was stressed earlier, no strong consensus can be said to exist in terms of the degree of attribution of educational outputs to educational inputs and processes. The effect of non-school influences and of relevant but unmeasured school influences, forces one to accept educational input-output studies with great care. Acceptance of the assumed direction of causality is only one of a multiple set of assumptions one must posit before proceeding to alter inputs and processes in the hope of altering educational outputs. In dealing with outcomes determinacy, one must accept a number of assumptions and be satisfied with a lower degree of certainty before proposing that a change in educational outputs can lead to a desired change in educational outcomes.

The reason for the heightened uncertainty is that outcomes are the result of the interaction of educational outputs with a great variety of external influences. These external influences may include the determinants for admission to higher levels of education and training, the supply and demand conditions in the labor market, or the multitude of planned and accidental influences that shape an individual's attitudes and behavior. In summary, educational outcomes are determined by many other factors than the nature and quantity of educational outputs and the degree of determinacy of inputs to outcomes is certainly less than the determinacy of inputs to outputs.

This discussion of educational outcomes will serve as the basis for the later discussion of external efficiency. The outcome measures that will be reviewed in detail here are the following:

1. Admission to further education and training;
2. Achievement in subsequent education and training;
3. Employment;
4. Earnings;
5. Attitudes/Behaviors; and
6. Externalities *

Each of these outcome categories can be used as an indicator of effectiveness and, when combined with appropriate cost data, as a measure of external efficiency.

A. Admission to Further Education and Training

As one graduates from each level of training the two major alternatives that one faces are to seek immediate employment or to continue education and training. As the

* Externalities are, in fact, a classification of the incidence of the prior five categories of outcomes rather than an alternative outcome category (as will be clarified in the later discussion).

level of educational attainment increases, the opportunity cost of education also increases in terms of foregone opportunities for employment and earnings. Some students are able to engage in part-time employment while continuing their education and training activities; other students may be fortunate enough to receive an education or training stipend that helps compensate them for their lost earnings while in school.

In both cases, the effect is to alter the benefit/cost relationship that is the basis for the schooling/training decision. In some situations, excessive subsidies can make continued education or training not only superior to the student's present alternatives but superior to the employment alternatives they face after graduation. In developing nations, this situation has occurred most frequently in teacher training programs and in vocational/technical training activities. The provision for part-time employment and the granting of stipends must be reviewed periodically to assure that these special opportunities are an incentive for training and not an incentive to avoid or postpone graduation.

Just as the graduate must choose between employment and further education or training, so can the effectiveness of the curriculum and instructional activities be judged in terms of how well the graduate is prepared for these two alternatives (and, indeed, how well prepared the graduate is to make a rational choice between the two). Unfortunately, no consensus exists in terms of the relationship between the school factors (inputs, process, outputs) and these two outcome alternatives. The propensity of educational managers to "vocationalize" the curriculum whenever graduate employment becomes a problem would suggest that a clear relationship has been established between curriculum and employment. This "vocational school fallacy", as Foster (1965) has termed it, has persisted in the face of a variety of logical arguments and statistical analyses (e.g., see Chapman and Windham, 1985).

At the early stages of education it is assumed that literacy and numeracy skills are of substantial applicability in both the labor market and in the competition for access to further schooling. The further one moves along in the educational system, the more intuitively appealing it is to assume that the school should provide some skills directly related to immediate employment. This tendency toward vocationalization is reinforced when severe bottlenecks are introduced into the system with the result that substantial portions of the age cohort are forced out of the academic system. Unfortunately, the benefits of training that are provided by vocational opportunities often are offset by the stigma of academic failure or ineligibility that employers identify with vocational school participants.

To use the students' progression to further education or training as a measure of educational effectiveness involves several dangers of misinterpretation. First, the choice to continue may be more a function of educational proximity than of past

performance. The high rates of educational progression in urban areas are, in part, a function of better achievement but also are a function of the greater availability of further opportunities in the immediate area. An equally accomplished rural student may not proceed to further education or training simply because the distance to a higher-level school may be too great. Even the provision of boarding schools at higher educational levels only reduces the cost differential, it does not eliminate it. And boarding may raise other cultural and financial limitations that are disincentives for the rural student.

Second, admission standards may vary over time or among locations such that it is difficult to identify effectiveness with educational progression rates. It is best to view admission criteria as the product of a supply and demand situation in which the supply of places in the higher level of education or training are demanded by graduates from the prerequisite level of education. Where and when demand is high relative to the supply of places, admission standards may be increased. Where demand is relatively low, admission standards may have to be reduced so as to fill all places.

The point is that academic standards for admission to a higher level of education or training are an interactive phenomenon incorporating aspects of both the supply of places for students and student demand for places. Thus, for any point in time, it is possibly misleading to use progression rates alone as a direct indicator of past educational effectiveness. It also is important to remember that admission standards based on examination results alone measure only one of the multiple outputs of education. The value of progression rates as an indicator of educational effectiveness will be determined by one's subjective valuation of the criteria used in selecting students for further education and training opportunities.

A third source of misinterpretation that can result from the use of progression rates as indicators of educational effectiveness is the problem of costs. This is, in fact, a more general case of the specific problem discussed above in the consideration of proximity as a determinant of further educational participation. The decision to continue one's education is not based solely on one's level of intellectual or social preparation; it is an investment decision that must consider costs as well as the probable benefits. And the perceived effect of costs will differ among individuals depending upon their family resources (assets and income) and the availability of financing (grants, loans, or work opportunities).

Once again, the analyst may feel confident that progression rates are positively correlated with past educational effectiveness yet still be reluctant to use progression rates as indicators of relative effectiveness among classes, schools, or regions. For example, two schools could graduate students who, by all standards, are identical in their educational accomplishments. One school may have a 70% progression rate to the next level of education and the other only a 25% rate. Since the graduates have the

same educational background the difference in progression rates must originate from other determinants. Unless one can control for all of the differences other than educational quality that may determine the decision to continue education or training, there is no obvious justification for assuming a class, school, or region is superior in effectiveness solely on the basis of differential progression rates.

The fourth and final major source of possible misinterpretation of progression rates relates to the differential value of further education. As noted above, the decision to continue schooling is an investment decision based on both costs and benefits. Even where educational effectiveness and costs are similar, students may face different probable benefits to further education. Education and training skills and knowledge are valuable depending upon their complementarity to other human capital characteristics of graduates and the nature of the labor market. The issue of complementarity is illustrated by the example of two graduates who differ only in terms of the business or professional associations of their families. The graduate with the advantage of these associations can expect a much shorter job search period and, probably, a higher initial salary and greater lifetime earnings. The graduate who is equivalent with the first except for these familial professional associations, must discount the benefits of education in terms of higher job search costs, lower initial salary, and lower lifetime earnings. At the margin, such personal differences may cause variations in progression rates that are totally unrelated to the effectiveness of the educational institution. Gender, race, and ethnicity are other human capital characteristics that may, in cases of employment and/or wage discrimination, or labor market segmentation, have differential degrees of complementarity to acquired academic and training skills.

In addition to family advantages, a second major factor affecting probable benefits is the nature of the labor market itself. The difficulty and cost of transportation as well as possible segmentation of the market between modern and traditional enterprises have aggravated the extant differences promoted by the persistent division between urban and rural markets for employment. The result is that two graduates of identical educational skills may make different educational progression decisions and both graduates will have made a rational choice given the probable benefits they may expect.

These human capital and labor market differences can be attenuated by restrictions on discrimination, improved labor mobility, and greater access to information. In fact, unequal access to information may itself create a differentiating effect on progression rates in some categories of graduates (it will usually be the more rural and economically disadvantaged ones who also have the least and least accurate information). At times, disadvantaged candidates fail to continue their education and training because they do not comprehend the probable net benefits or realize the actual availability of financing. More often the case is that the match between graduates and future opportunities is not a proper one because the appropriate information and counseling system does not exist.

The failure of societies, developed and developing, to invest in such systems commensurate with their enormous investments in education is one of the major anomalies of the human resource sector.

In summary, progression rates normally may be viewed as a positive correlate of educational effectiveness. However, relative effectiveness can be judged by using progression rates only when all of the other major determinants of the progression decision are controlled for adequately.

B. Achievement in Subsequent Education and Training

Since one purpose of education is to prepare the student for further learning, the use of measured achievement at a higher level of education or training as an indicator of the effectiveness of education may appear an obvious choice. In fact, progression rates are much more commonly used than are future achievement measures. There are three reasons for the infrequency with which future achievement measures are used: time delay, measurement problems, and uncertain determinacy. The time delay problem is obvious. If one must wait several months or even years to measure achievement at the next level of education or training then there is an inherent delay in being able to assess, analyze, and, if necessary, reform the earlier programs. While the conduct of education is an ongoing activity the attention spans of politicians, administrators, and even analysts are finite. The assessment of future achievement and the attempt to relate it to antecedent educational experiences is a valuable activity but not one that can satisfy the system's need for timely results. Because of this, future achievement analysis probably will continue to be used (where it is used at all) as a complementary research activity to less time-extensive evaluations of educational effectiveness.

In those cases where time is not a barrier, there are still a set of measurement problems related to the analysis of future achievement. All of the cautionary comments presented in the earlier discussion of achievement measures as outputs would apply as well to the use of future achievement measures as educational outcomes. In addition to the normal problem of assessing and interpreting differences in school grading or examination results, one must also be concerned with the problem of changes in the group being measured. If one is able to trace the individual students this is less of a problem. However, as is more common, one may trace a group which itself can undergo changes.

For example, if one wishes to assess the effectiveness of Primary School A graduates in terms of their achievement in Secondary School X, two problems exist. First, all School A graduates may not go to secondary school (or, because of migration, may go to a school other than School X). Second, the grades or examination results of School X may include the performance of students from schools other than School A.

The result is that the achievement levels in Secondary School X are not solely related to the graduates of Primary School A and may not even be predominantly related to those graduates.

This methodological problem, unlike those raised earlier for assessing achievement results, is relatively easy to resolve. It only requires that an explicit tracer study approach be adopted from the beginning. However, the problem is a real one and should preclude unjustified ascription of future achievement effects to a preceding level of education when one has not taken into account the constituency of the measured group.

The final reason for the scarcity with which future achievement measures are used is the problem of determinacy. While most will concede that achievement at any level of education or training is determined in part by the skills and knowledge the student brings from prior education, there is no consensus about the degree of determinacy such prior experience has over achievement. For example, in measuring Grade Seven reading achievement, in addition to the students' ability at the start of Grade Seven (itself an imperfect proxy for the effectiveness of earlier education) one must consider the effect of Grade Seven inputs and processes as well as the continuing effects of nonschool determinants.

The result is that, while a major goal of education at any level may be to prepare students to achieve more successfully at the next level, the measurement of future achievement is not a certain indicator of prior educational effectiveness. Only by controlling for other concurrent determinants can one be assured of a proper estimate of the effect of prior experiences. And, because of the problems of separating school and nonschool effects, even this measure of prior experiences is not an indicator solely of educational effectiveness.

Even with the three problems of time delay, measurement difficulties, and uncertain determinacy, the measurement of future achievement can still play a role in assessing educational effectiveness. However, it can be implemented effectively only in a tracer study approach that will allow for proper control of other influences on achievement and a stable definition of the group being measured. Even in this form, the future achievement measure is not adequate by itself to indicate effectiveness. To be most appropriate for analysis, it should be used as part of a set of multiple indicators of educational effectiveness.

C. Employment

To those students who do not continue their education, whether the discontinuance is by choice or not, the major consideration of educational effectiveness will be how

well education has prepared them for employment. Here, the term employment is used to encompass the full range of activities from household chores, to casual self-employment, to informal and formal entrepreneurial enterprises, and to employment in the modern formal sector. Too often the discussion of educational effectiveness has been limited only to the last of these employment forms, i.e., whether a school leaver can obtain employment in the modern formal sector. However, much of education's effect may be revealed in the other forms of employment.

This especially is true for those who leave school at the primary and junior secondary levels. The most useful cognitive skills they will have acquired from the education system will be those of basic literacy and numeracy. Research, such as that conducted on farmer productivity (Basu, 1969; Jamison and Lau, 1982; Jamison and Moock, 1984; Cotlear, 1986; and Chou and Lau, 1987), suggests that these basic educational skills can have a direct effect on the ability of workers to acquire and use information. While some debate exists over the means by which basic education translates into greater productivity (is it the skills, per se, or the attitude toward new information), it has been a generally accepted premise for educational development in the last decade that of all education and training alternatives, basic educational development has the most direct and cost-effective relationship with general economic development (World Bank, 1980).

The basic education provided to women can have a variety of positive influences even in the home. These range from improvement in time allocation and better health and consumer behavior to a more supportive attitude for family entrepreneurial activities and the education of children. Where the culture allows female participation in employment outside the home, the provision of basic education can have at least as dramatic an effect on productivity of women as of men. Since women often engage in the small scale enterprises (tourist crafts, herding, weaving, brewing, etc.) that provide a cash contribution to the family's subsistence agrarian income, the educational effectiveness issue is of vital importance in this regard. Often, it is the women in the family who control the cash funds used to finance family contributions to educational costs.

The skills of literacy and numeracy are essential for all small scale entrepreneurial activities. While some such activities may exist without educated participants, the entrepreneurial markets will never become regularized or equitable without the abilities implied by literacy and numeracy. The effectiveness of education can properly be indicated by how well school leavers are prepared to engage their acquired skills to meet the entrepreneurial opportunities that present themselves, even in the most rural and remote areas of developing nations.

As an indicator of educational effectiveness, employment is, however, only a partial measure. Obviously, the analyst needs to know the type of job and the productivity of the school leaver in the job to assess the full effectiveness of education. However, employment rates still are commonly used measures in the assessment of an educational institution's or system's effect on the economy.

The calculation of employment rates normally is done by dividing the number of employed workers by the size of the active labor force. The active labor force is defined as the sum of the employed workers and all others who are actively seeking employment. A problem with the employment index (or the unemployment index which equals one minus the employment index) is that neither the number nor the proportion of unemployed workers who are "actively" seeking employment remains constant over time. For example, if there are 1,000,000 individuals in the active labor force and 900,000 are employed, then the employment index is 90%. If, because of economic improvements, another 50,000 workers are employed, the employment index, normally will not increase to 95% (950,000/1,000,000) as one might expect. Because more jobs are available, some individuals who were not actively seeking employment will begin to do so, thus increasing the size of the labor force. If the effect of 50,000 new jobs is to attract 25,000 new individuals into the labor force, then the new employment index will be 92.7% (950,000/1,025,000) rather than 95%. A similar pattern occurs during periods of poor economic activity: as employment declines some labor force participants abandon hope of finding employment and leave the active labor force. The result of this phenomenon (which is a function of the definition of the employment rate) is that changes in the index of employment are less than proportional to changes in the index of economic activity.

In most cases it will be preferable to use the level of employment or the change in employment rather than the index itself as an indicator of how well education is preparing school leavers for employment. However, since aggregate employment data covers such a wide age range (usually 14 or 18 years to 65 or 70 years) and such data is often unavailable or unreliable, the best means of studying education's employment effect is through data that concentrate on recent school leavers. While such data may sometimes be retrievable from aggregate employment statistics, the most useful data is that collected from tracer studies. The use of tracer studies allows more detailed collection on the personal characteristics of the school leavers and of determinant characteristics of the labor market.

The analysis of tracer study data on the education-employment linkage can be summarized in terms of three decision points: (1) the decision to continue or discontinue education; (2) the decision to accept immediately available employment or engage in job search behavior; and (3) the decision to accept a specific form of employment. None of these decisions are free; each is constrained, at least in part, by

the decisions of others. For example, in a system of competitive admission for higher levels of education some students will not qualify for the next level of education. Even if they have the desire to continue, the availability of private schooling and of the resources to finance a private schooling choice will determine if the student will be able to continue his or her education.

Once the decision is made to seek employment, the individual school leaver must decide whether to accept employment of a type that is available immediately (if any is available) or to engage in a job search process in anticipation of finding employment that is more suited to his or her skills and interest. Job search behavior, like education itself, is an investment activity for the individual. Thus, it is subject to a comparison of benefits and costs. The job search costs may be reduced if the school leaver can engage in some form of employment while seeking a more suitable job (in the same manner that students finance educational costs through part-time employment while in school). The willingness and ability to migrate (an investment process itself) can increase both the potential costs and the potential benefits of the job search process. Migration will be engaged in whenever the probable net benefits of migration (including the emotional and practical considerations of separation from the family and home community) are considered positive. The job search process for an individual is facilitated by the availability of information and personal connections. In this, as in so much else, the urban and higher socioeconomic status individuals will have an initial advantage.

Job search (measured in time and success of job acquisition -- ideally, this can be "weighted" by the quality of the job procured) is a superior indicator of educational effectiveness than are simple employment rates. First, the job search measure emphasizes the current pattern of interaction between educational leavers and the job market. Second, increases in the length of the job search period are the first warning of labor market stagnation for a particular skill or type of school leaver. For example, employment rates of school leavers six months after the end of their education could be constant at 85 percent over a series of five successive cohorts. And yet, job search data for the five cohorts could reveal that each successive cohort has taken a longer period of time to attain that 85 percent employment figure. Changes in the quality of jobs and in the length of the job search process are early indicators of possible labor market problems for a particular type of school leaver. The changes may be the result of cyclical variation but could signal a long-term ("secular") change in employment patterns. For this reason, the value of tracer studies can only be fully appreciated when the studies are conducted on a regular recurrent basis.

The final decision in the job search process relates to selection of a job of a certain type. Based on available information, the school leaver should select a form of employment that will maximize the net benefits (the present value of the sum of

benefits minus costs) over time. However, this assumes that the individual has adequate patience and resources to forego immediate benefits in some occupations for more substantial but delayed benefits in other occupations. Just as a highly trained graduate may need to spend a longer time seeking a job complementary to his or her skills, so the same graduate may have to be willing and able to spend the initial years of employment earning less than they could in alternative employment. As Becker (1964) has explained, employment that provides general skill training (training that can benefit other employees) will have to be financed, at least in part, by the worker. This financing normally will take the form of lower wages during the training period.

The second major consideration (in addition to training opportunities) in selecting an occupation is to consider the monetary and nonmonetary aspects of the job. Earnings (which will be discussed in the next section) dominate most school leavers' considerations but stability of employment is also of great importance. The attractiveness of government employment in many developing nations relates more to stability than to wage levels or social status (IEES, 1984C). In more sophisticated decision situations the school leaver must consider the balance between earnings and "hedonic" wage differences. Hedonic differences are the positive or negative nonmonetary aspects of employment that may lead the school leaver to accept a lower or demand a higher wage or salary. Hedonic differences sometimes are restricted to psychological factors such as job status or intrinsic pleasure but often are expanded to include all equalizing differences such as location, difficulty, and the nature of any job-related hazards.

However defined, the importance of hedonic and equalizing differences is that they suggest the impropriety of using general job categories or monetary earnings as a sole measure for ranking employment success. The quality of a job may relate to where one is located (national capital, regional center, or local village) and the value of earnings are affected both by the cost-of-living and the range of goods available for purchase.

In summary, employment rates, job search patterns, and job quality measures all are legitimate indicators of employment outcomes of education. None is a perfect measure when used alone but, when used in concert and over time so that patterns may be identified and tracked, they have a collective value as an indicator of educational effectiveness. Because such collective measures are not reducible to a single numerical index, the tendency in policy analysis has been to use the employment measures separately or to ignore employment measures as distinct indicators in favor of the more easily understood measure of earnings.

D. Earnings*

Of all measures used to indicate the effectiveness of education, the earnings measure is second only to achievement. Since the popularization of human capital models during the 1960s, the earnings measure has attained a consensus of acceptance among economists as a primary outcome measure for education. There are many reasons for this but the three most important appear to be the following:

1. The logical and empirical obviousness of earnings as a goal of individual educational choice. Both statistical surveys and the individual experiences of policy analysts suggest that an increasing majority of students are pursuing education as a means of increasing their personal economic advantage. It is accepted that earnings are the best signal to students of the economic advantages available in occupations and the best indicator of the success of graduates in procuring the desired advantages.

2. Monetary earnings are an undimensional numeraire. Unlike almost all other effectiveness indicators, earnings have a unit of measurement that appears to be readily understood by most people and to have a similar meaning across locations and time (allowing discounting for changes in the purchasing power of currency). Thus, the monetary measure of earnings is seen providing a "common yardstick" (Ray, 1984) in comparing different types of benefits and benefits with costs;

3. Earnings figures are readily available. There is a common assumption that individuals are willing and able to report their earnings (as well as income) and that such reports are a reliable data base for analysis. Many education studies assume that students are able to report on parental or total family earnings with a similar degree of accuracy.

None of these three reasons for the popular use of earnings measures is fully refutable but neither is it necessary or reasonable to accept them without question.

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* Economists distinguish earnings from income by limiting the definition of earnings to the monetary benefits of employing the individual's human capacities (physical and mental) during the current time period. The latter condition is an important one because income is defined as inclusive of earnings plus "unearned" monetary receipts such as rents, dividends, interest, and transfer payments. Since the basis for these latter receipts may be past earnings, they are "unearned" only in terms of this time period and the phrase is not intended to imply a judgment concerning the propriety or ethics of receiving these forms of income.

If one decides to use earnings measures as the primary outcome measure there remains a large set of residual decisions which must to be made. Among these, the most significant include the following:

1. to use initial earnings or lifetime earnings;
2. to use cohort versus cross-sectional data;
3. to use group means versus median's versus marginal values for earnings;
4. to attempt to control for ability differences in earnings determination;
5. to use a wage function approach or to accept nominal wage differences as given;
6. to correct for purchasing power and other equalizing differences; and
7. to validate earnings reports.

Obviously, the rationale for investing in education is in terms of education's potential effect on earnings over the full lifetime of the educated persons. Based on this understanding, it would seem equally obvious that lifetime earnings are a superior measure to initial earnings as an indicator of educational effectiveness. The difficulty is that there are severe problems in forecasting the expected lifetime earnings of any particular individual or group at a given point in time. To use past earnings patterns for different levels and types of education or training is appropriate but these figures, even if available and acceptably accurate, must be modified to take into account changing labor market conditions.

Dore (1976) has presented the definitive explanation for the devaluing of educational credentials over time in both developed and developing nations. The problem is most dramatic in developing nations where the number of high level jobs is small and where educational expansion at the postsecondary level is proceeding rapidly. Within a single generation an older sibling's college degree can provide entree into senior government service, a middle sibling's degree can qualify him or her for a director's position, and the youngest sibling may be fortunate, with exactly the same degree, to obtain an entry level clerical position in a government ministry. In this environment, the use of ex post earnings data can greatly overstate future earnings potential. Such earnings data may indicate the effectiveness of education twenty or thirty years ago but is not a valid indicator of the current effectiveness of education.

The value of initial earnings as an effectiveness indicator is that it provides an immediate measure of education's interaction with the labor market. There still are problems concerning the relationship of initial to lifetime earnings and of earnings as a result of education rather than hedonic or equalizing differences, but the initial earnings measure is often to be preferred to ex post earnings measures as an indicator of educational effectiveness.

FIGURE TWO

COMPARISON OF CROSS-SECTIONAL
AND COHORT EARNINGS PROFILE

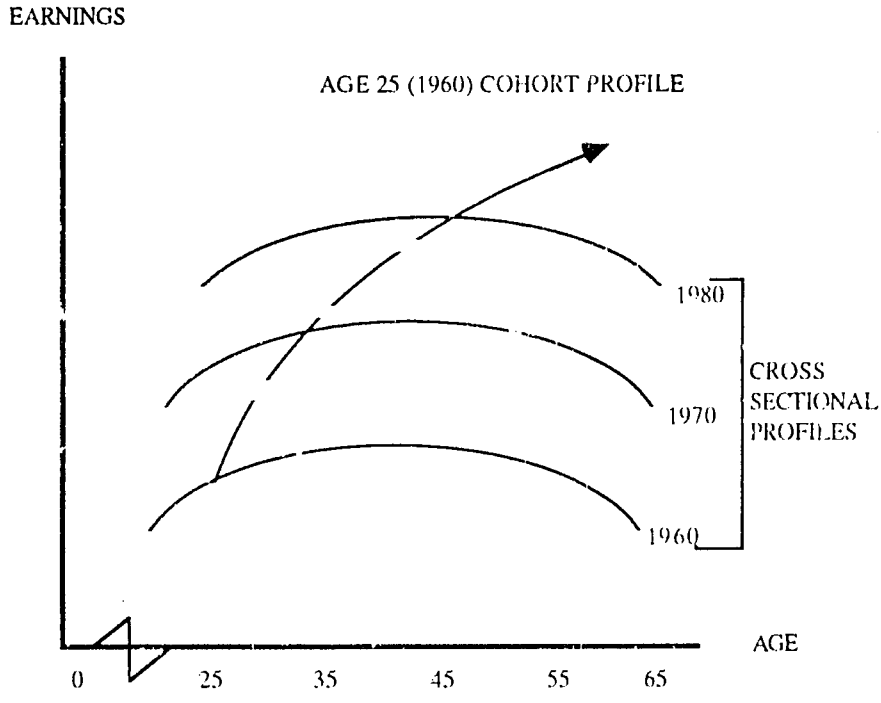

Figure Two indicates the difference in age-earnings profiles depending upon one's use of cross-sectional or cohort profiles. As Colberg and Windham indicated in 1970, the *ex post* cohort and cross-sectional profiles each indicate quite different aspects of earnings patterns over one's lifetime.*

The cross-sectional profile is useful to indicate the relative earnings of individuals of different ages, but with the same level of education, at a single point in time. The relative concavity of the curves can indicate a varying scarcity of educational qualifications among the age groups and/or changes in the quality of education over time. The cohort profile traces a single age group over time and indicates how the single cohort's earnings adjust through the years to changes in the "vintage" of skills, continued on-the-job human capital investments, and different relative scarcities of educational qualifications.

If one considers the age 25 group in 1960, one can see that using the cross-sectional profile as an expected earnings profile would have understated the increase in earnings dramatically over this group's lifetime. Some of this difference in profiles would be reduced if one converted all earnings to 1960 purchasing power equivalents ("real" earnings profiles). Even with this adjustment, real productivity gains over time would cause the cross-sectional profiles to understate the realized cohort profiles.

One means of improving over the use of initial earnings alone as an educational effectiveness indicator is to take the ratio of initial earnings to lifetime earnings for the most recently available cohort. Modify this ratio by current forecasts of changes in productivity and the future scarcity of the educational credential of the group under study, and then this new ratio can be applied to the current measure of initial earnings to produce an expected lifetime income value. If this is appropriately discounted for time preference, one has a relatively simple approximation of education's expected lifetime effect on earnings. This process assumes an acceptable quality of past earnings data and future forecasts of productivity, labor market changes, and inflation. For most developing nations, the wisest decision may be to use initial earnings alone as the effectiveness indicator and involve the other data on earnings profiles, etc. in one's policy analysis but not in calculation of a quantified indicator. Finally, one always must return to the basic rule of the advantage for recurrent collection of data and designing all reforms and innovations with sufficient flexibility so that further changes may be made as more and/or better data become available.

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* See Bowman (1986) for a current example of the importance of considering cohort effects in the analysis of educational/earnings relationships.

Another debate over methods of calculating earnings measures relates to the preference for the mean versus the median as the preferred measure of central tendency and of the relevance of either measure of central tendency compared to marginal earnings as a basis for estimating educational effects. There is no need here to repeat the common argument over the advantages of mean versus median values. It is adequate simply to remember that every advantage of mean versus median can equally be interpreted as a disadvantage. The choice of central tendency measure devolves to a question of how one wishes to deal with extreme values in the earnings distribution. If they are considered significant (as in calculations of earnings probabilities) the mean earnings measure should be used; if not (as when data quality is assumed to be most questionable at the extremes of the range) then the median earnings measure is preferable.

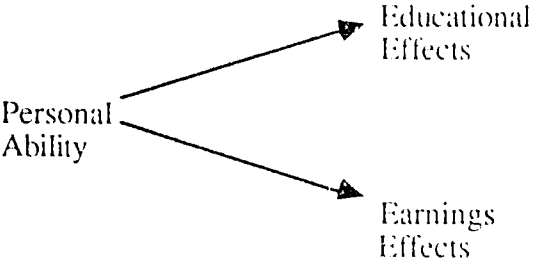
In terms of economic wage theory, the best earnings measure for estimating the effectiveness of education on the current age cohort would be marginal earnings, i.e., the earnings of the next worker or group of workers to be employed. This is a significant point, however, only if the marginal wage or salary is substantially different from the current mean or median. If the current mean earnings, for example, of a certain group of school leavers is $3,000 per year, the expected earnings of the next group to be employed would have to be significantly above or below this level for the marginal earnings consideration to be relevant. In competitive markets or where bureaucratic pay systems fix earnings over time, the mean/median earnings of the current group of employees and the marginal earnings of the next group will not differ significantly.

The major exception to this is when an increased output of school leavers at a certain level exceeds the ability of the labor market to absorb them. In such a case one of two things can happen: earnings will decline below that of past levels or else earnings will remain the same but employment probabilities will decline. The last is a point too often overlooked in earnings calculations as measures of educational effectiveness. The earnings measure used as an effectiveness indicator should not be the earnings level of employed graduates alone but the product of the probability of graduates being employed and the earnings level.

For example, in the case above mean earnings were $3,000. If, for the next cohort, earnings remain the same but the percent of school leavers employed declines from 100 percent to 80 percent, then the effectiveness indicator should decline from $3,000 (100% x $3,000) to $2,400 (80% x $3,000). The advantage of this definition of the earnings measure is that it can capture the effect of simultaneous changes in earnings and employment probabilities. Thus, an increase in earnings to $3,100 could be offset by a decline in employment probability to 90%. The value of the indicator ($2,790) is less than the original $3,000 value even though nominal earnings have increased.

Thus, the initial earnings measure discussed above should be understood to be a product of both earnings and employment probabilities.

Blaug (1972) has noted that there is no more consistent correlation in the social sciences than that between education and earnings. A major barrier to a straight-forward interpretation of this correlation as proof of causality is the issue of individual ability.* Theoretically, it is possible for the correlation relationship between education and earnings to be spurious if both are, in fact, functions solely of ability and thus unrelated to one another. An extreme view of the causal relationships would be as shown here:



As depicted here, education has no determinant effect on earnings. Personal ability is the determinant of the educational effects (outputs such as attainment and achievement) and of the earnings effects (normally considered an educational outcome). For this set of relationships to be valid, education can have no causal effect on earnings.

This would mean that any individual would have the same earnings regardless of whether or not they have any educational accomplishments. The correlation between education and earnings would be only a coincidence of culture or tradition (more able people both consume more education and earn more money) but earnings effects could not be used as an indicator of educational effectiveness because no direct causal link would exist between the two.

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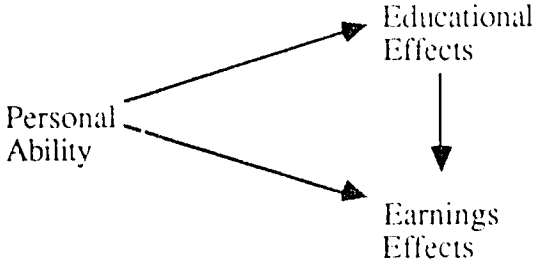
* Ability as used here refers to the measured skills and knowledge possessed by individuals at the time they begin a certain phase of education or training. It is not used in the sense of innate ability or to delineate genetic advantages or disadvantages. The difficulty of measuring ability in a meaningful way is great enough without attempting to parcel out original and acquired traits of students or trainees (a pursuit that is methodologically difficult and often irrelevant for the policy debate). See Griliches (1977) for indications of the difficulties encountered in estimating ability effects in the education - earnings relationship.

Even if statistical evidence were lacking to support a residual effect of education on earnings when one controls for ability, logic and personal experience would lead one to reject the extreme model presented above. However, the extreme model contains more than a grain of truth. If one studies the consensus model of the relationships among ability, education, and earnings it is obvious that some consideration of ability effects must be taken into account in using earnings as an effectiveness indicator.



In fact, two forms of ability determinacy are shown. A direct effect of ability on earnings and an indirect effect through personal ability's impact on educational outputs.

In the earlier analysis of educational outputs it was stressed that the effect of education in terms of achievement must consider the concept of learning gain or value-added even though these measures pose serious methodological problems. Similarly, the effect of education on earnings must be considered in terms of how much earnings for a group would have been with and without education. For example, assume two groups of students exist, A and B, and group A has greater skills and knowledge than group B. Further assume that the effect of upper secondary education on their earnings are shown to be as follows:

Group A increases average earnings from $3,500 to $4,500.

Group B increases average earnings from $2,500 to $4,000.

Group B will be seen to earn less than Group A both with and without the additional earnings. But the increase in earnings as a result of the additional education will be greater for Group B, whether measured in absolute terms ($1,500 to $1,000) or as a percentage increase (60.0 percent versus 28.6 percent). The point is that use of earnings levels alone would have indicated that the education of Group A was more effective because it would have compounded earnings and ability effects.

The example of personal ability is a special case of the more general need to control for non-education determinacy when using earnings as an indicator of educational effectiveness. The common means of this control is through use of an "earnings

function," an equation that states earnings as a function of the influences that determine the supply and demand for labor. Just as the educational production function attempts to estimate the degree of determinacy of various inputs to educational outputs, the earnings function attempts to estimate the determinacy of all factors (including education) that influence personal or group earnings. The coefficient on education in the earnings function can then be used to indicate educational effectiveness. The use of earnings functions has been especially common in present value and rate of return studies (discussed later in the section on educational efficiency measures).

This use of earnings functions can result in an example of apparent methodological precision disguising implicit methodological carelessness. In such statistically estimated functions there is no guarantee that adequate care will be taken to operationalize the education variable. A common definition of education is years of attainment; "more careful" studies may go so far as to include a variable to distinguish the type of education. Earnings function studies have varied widely in the care with which they have attempted to control for spurious relationships as well as the number and types of other determinant variables included in the earnings equation. The propensity of earnings to be determined by such educationally- correlated variables as personal ability, occupational experience, on-the-job training, and social advantage means that the failure to include such variables--and to operationalize them properly--can lead to a systematic overstatement of education's effect on earnings and thus will mean that earnings, as an indicator of educational effectiveness, will be a seriously flawed measure.

The argument here is not that the earnings functions are not perfect methodological instruments; the economist and educational analyst is in no position to establish such lofty standards Rather, the point is that earnings functions must meet a minimum standard of adequacy in producing a weight on the educational variable that can be interpreted directly as a measure of educational effectiveness in terms of the earnings outcome.

Two final decisions are left to the analyst still prepared to use the earnings measure to indicate the effectiveness of education. The first is a methodological correction--adjusting for differences in the purchasing power of earnings in different settings--and the second is a data collection issue--validation of earnings reports. The four types of purchasing power adjustments most commonly made are for differences in the time of receipt of earnings, for urban versus rural differences, for regional differences, and for inter-country differences.

Price differences between urban and rural areas and from region to region within a country are as obvious as they are difficult to measure. The normal procedure to establish earnings equivalents is to identify a standard "market-basket" of goods and

services and then to price this market-basket in the different locations. To do this successfully requires a careful selection of a set of goods and services to be considered (this normally is based on a survey of consumer behavior) and the collection of accurate price data.

One of the most erroneous perceptions one can have is that general prices are lower in rural areas of most developing areas. Prices for some locally produced foodstuffs may indeed be lower, but the large majority of modern products and services are more expensive. It requires less currency to live in rural areas not because prices are lower but because the levels of consumption are lower. An educational example can illustrate this point. Most educational systems have standardized pay for teachers regardless of where they are located. However, because of the common aversion to the isolation and hardship of rural life, the rural school consistently will have the greatest problems with late assignment of teachers, absenteeism, and turnover. Thus, the amount paid the rural teacher may be the same (although it can be even less because many systems place the newest or least-qualified teachers in rural schools), but the quality of educational service received is likely to be poorer.

A similar situation may exist for textbooks whose prices are controlled by government. The rural parent may not have to pay more for a textbook but, because of economic realities such as transportation and storage costs, will find that fewer if any textbooks are available for their children. The rural parent often is left with the choice of no textbooks or buying a more expensive textbook copy on the "unofficial" market.

A final example of confusion that enters into purchasing power comparisons is that of housing. Housing is frequently cited as the most dramatic example of why it costs more to live in urban areas. And yet, the comparison is not made with the same quality of housing in rural areas. Certainly it costs more to live in a modern house in an urban area (and especially one with electricity and water) than in a traditional house in a rural area. For purchasing power comparisons to be meaningful, one must compare not the same nominal "thing" but the same quality of thing between urban and rural areas and among regional locations. The current interest in teacher incentives research (Thiagarajan and Kemmerer, 1987) is based in large part upon an increasing recognition that purchasing power and other disequalizing differences must be considered in teacher remuneration if any progress is to be made in providing similar educational services in dissimilar settings.

The final earnings decision is one of validation. Probably the greatest single (non-tax) earnings validation effort ever undertaken is that currently engaged in by the United States government as part of the federally funded, need-based college student assistance program. While controversy persists over the accuracy of earnings reports and the efficiency of attempts to validate them (Windham, 1985), the main lesson that emerges

is that the validity of earnings reports depends upon their use. Obviously, when self-reported earnings are a basis for the assessment of financial obligations (whether taxes or a parental or student contribution to educational costs), there is a vested interest in underreporting. Also, aggregate patterns of earnings distributions are more likely to be correct (because of the tendency of spurious errors to be partially offsetting) than are earnings reports on an individual basis (of the type used in many earnings functions studies).

Simply put, earnings reports are only as accurate as the care taken by the researcher to collect and interpret the data will allow them to be. At a minimum, reports should be validated on a sample basis; this is especially important when students or school personnel are asked to estimate family earnings of the students.

Once again, the detailed discussion of a variable such as earnings would seem to lead to discouragement concerning its use. This is not the desired effect. Rather, the warnings and questions raised here are designed to promote care and reasoned use, not to promote abandonment of the earnings variable. In any case, the concern for overreaction is probably misplaced. Previous calls for greater methodological care in the economics of education have not led to any excesses of methodological conservatism. The modal response has been to ignore the warnings and proceed as before. This pattern will not change until the users of data -- planners and policymakers -- are sufficiently informed to demand more careful analyses. As stated in the introduction, the promotion of that condition is the single most important goal of this report.

E. Attitudes and Behaviors*

The attitudes and behaviors that are viewed as educational outcomes are basically the same as those discussed earlier as educational outputs. The ones which have received greatest attention in the research literature are attitudes and behaviors concerning education itself, toward social issues and understanding (an extension of the "modernity" concept), toward issues of human rights and responsibilities, toward political participation, and the effect of education on consumption behavior. In this section, the discussion will focus on four of these: the effects on social responsibility, social views, political participation,and consumption behavior.

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* Hinchliffe (1986) is an excellent source for a discussion of a wide range of nonmonetary effects of education other than those covered here.

A common claim made for education in the 1960s was that education had the potential to save substantial sums of public monies by reducing unemployment and propensities for anti-social behavior (specifically crimes against persons and property). The claim for unemployment reduction is in part valid and in part a fallacy of composition. To the extent that the education of individuals increases the social productivity of material capital, it is possible that increased educational programs can lead to an aggregate increase in the number of jobs. However, one can not conclude from the fact that unemployment rates decline among individuals as their level of education increases that increasing aggregate educational levels in the general population will have a direct and proportional effect on aggregate unemployment.

For example, college graduates, on average, have a lower unemployment rate than high school graduates. However, it is a non-sequitur to suggest that educating all current high school graduates to the college degree level would reduce their unemployment levels to those of current college graduates. Two problems exist with this scenario. First, other social and personal differences exist between the current populations of college and high school graduates that will remain to the advantage of the current college group even if the educational advantage is removed (ability, motivation, and social class advantages are examples of these). Second, the scenario ignores that education serves a second purpose in addition to increasing productivity--it helps employers ration jobs among competing job seekers.

Thus, if the difference in educational credentials is removed, employers may be expected to have even fewer traditionally college-level jobs than there are college graduates. The employers will need to devise a new or expanded system for rationing these jobs. Perhaps differences in the institutions attended will be used or individual tests of achievement will be considered. The result of removing the educational credential as a factor will be to the advantage of some of the former high school graduates. But this is the fallacy of composition in the original argument: increased education for a single individual helps because it can increase both the person's productivity and the scarcity value of their educational credentials. The latter effect will be lost if everyone's education is increased. The lesson to be understood from this discussion is that education is a more immediate tool for reducing unemployment at the individual than at the aggregate level. Education can affect the latter but aggregate unemployment, as discussed above, is an imperfect measure to indicate aggregate educational effectiveness.

A second aspect of education's effect on social responsibility is the claim that education reduces crime (Ehrlich, 1975). To the extent that education can increase employment and earnings for an individual, and if crime is a result of individual poverty and need, the link between education and reduced crime may be established. However,

at least two general modifications to this assertion may be proposed. The first is that the definition of crime normally is established by those with the highest levels of education and earnings and it is not surprising, therefore, that the greatest censure is reserved for those acts least commonly associated with this group. Second, a certain cynicism might suggest that whatever the effect of education on the frequency of crime it certainly appears to have an effect on the scale and form of crime. Specifically, the corruption of senior private and public officials or the social disruptions that originate on university campuses, and, more generally, the phenomenon described in Western societies as "white collar" crime are evidence that education is an imperfect prophylactic against certain types of criminal behavior.

Abandoning such cynicism, education may be seen to have two major effects relative to criminal behavior. First, education--in compact with the family and the religious institution--is a major means for any culture to inform its newest members of the definitions of anti-social behaviors and the sanctions that may be imposed against them (Straughan, 1982). Second, to the extent that education increases economic or ethical conditions of individuals, it raises the opportunity cost of criminal or unethical behavior. In summary, education does have some effect on criminal propensity but the effect is not sufficiently direct or measurable that these behavioral outcomes can be used as indicators of general educational effectiveness.

A more certain benefit of education appears to be the effect of increased education on fertility (Caldwell, 1980). Given the pressures placed on all social enterprises by the rapidly increasing populations in the less developed nations, the ability of increased education to promote reduced population growth rates could be one of its most critical outcomes. The effect of education on fertility is the result of a complex process that involves other determinants such as income and urbanization (Cochrane, 1986) but basically involves both a change in attitudes toward family size and the ability to understand and utilize contraceptive techniques. Educational systems vary widely in terms of the explicitness with which population and fertility issues are dealt with in the curriculum.

The second category of attitudinal and behavioral effects of education to be discussed is that of the social views of graduates or school leavers. To use such an effect as an outcome indicator would require that the social view or views be identifiable and measurable and that the causality of education be sufficiently certain that attribution could be assigned with an acceptable degree of confidence. An inherent problem with an outcome such as the social views of graduates or school leavers is that, in a politically diverse society, strong differences of opinion may exist as to the attractiveness of specific views.

For example, the production in education of the acceptance of preferences for liberal or conservative political positions, religious or secular viewpoints, insular versus internationalist attitudes, etc., will be commended or condemned depending upon the prevailing view of the current government or of the public. Nations vary dramatically in terms of the range of consensus views and in the nation's willingness to use education to propagate these views. The two most controversial areas are religion and politics. In certain societies there is no controversy (at least internally) in the use of education to promote the national religion or ideology or to make use of education as a vehicle to promote the current political leadership.

One of the more impressive aspects of modern education, in both the developed and developing worlds, is that the same school curriculum can attempt to incorporate the conditional skepticism of the scientific method with calls for unquestioning acceptance of religious or political doctrine. The inherent conflict between the two curricular activities has led to a degree of political resistance to education in some countries where graduates have begun to apply rational tools to matters of religious or political faith. Political resistance to education, however, is constrained by the polar pressures of the social demand for educational opportunity and the economic demand for skilled graduates. In any case, social views, whether produced by education or not, will rarely be an acceptable indicator of educational effectiveness.

A refinement of the preceding category has produced the behavioral measure related to political participation. This outcome of education is intended to be a more objectively measurable effect of education. There is little question that both political office and participation in electoral activity is positively correlated with educational attainment.

This outcome of education may be classified appropriately as a social benefit of education; it may even be used as an outcome measure that is indicative of a specific aspect of the effectiveness of education; however, it deals with such a singular aspect of the total mix of desired educational outcomes that, by itself, it has only a minor role to play in the assessment of general educational effectiveness. More important in this regard is the effect of education on consumption behavior.

In addition to the effect of education on earnings, research has long found an effect of education on how earnings are used to meet consumer needs (Michael, 1972). Basically education improves the ability of an individual to acquire information, to use information in making consumer choices, and, in concert with the educationally-influenced higher earnings level, to allocate consumption decisions in such a way as to increase individual utility over time. The first two effects, on the acquisition and use of information, are identical in type to how education affects earning potential. Because of

enhanced literacy, numeracy, logic, and knowledge (the experience of others) the educated person can acquire information from a wider variety of sources and at a lower cost than can the less educated individual.

Once the information is obtained these same educationally acquired attributes allow the educated person to process the information for better decisionmaking about consumer alternatives. The educated person will understand better the need to compare benefits and costs, will have more of the skills necessary to separate objective and subjective costs and effects, and will be better prepared to assign subjective evaluations to the decision process. Theodore Schultz (1975) has asserted that the major contribution of education to an individual's welfare is in education's ability to improve the individual's capacity to deal with "disequilibria." In this context, the term "disequilibria" refers to any situation in which change is required and choices must be made. By improving the efficiency of both information acquisition and use, education enhances the individual's skill in improving his or her own utility or happiness.

The final influence of education on consumption behavior is a result of the interaction of the information effects discussed above with the higher earnings. An often underestimated advantage of higher earnings is that it allows the more educated person additional resources to widen consumption choices across distance and over time. Urban studies of the poor often find higher unit costs for food and services because of the low income person's inability to travel to locations where prices are lower or to store items effectively and thus allow for savings due to purchases of larger quantities at one time. Also, the availability of credit and the educated individual's improved ability to understand and utilize it, permits a better planning of consumption over time.

The reason why the change in consumption behavior normally is considered more important as an educational outcome than are the other effects on attitudes and behavior is that the consumption effect is more objectively determined and, through its interaction with earnings, has a greater influence within the total set of outcomes. The latter point is important to understand because, regardless of the emphasis on methodological care and detail, and the use of multiple measures and indicators espoused here, most effectiveness studies of education will concentrate on earnings as the primary outcome measure. However, if education increases the efficient use of as well as the production of, earnings, analysts who use only the earnings indicator will underestimate the relative effectiveness of education in terms of individual utility or happiness (the ultimate product desired for the investment in education).

For example, if increasing education from the primary graduate level to the secondary graduate level increases mean earnings by $2,500 (when controlling for all other determinants of earnings), this amount will not depict the true difference between

the two levels of education. If secondary school graduates are more efficient in using their income than are primary school graduates, again under ceteris paribus conditions, the "effect" of education will be in excess of the earnings effect of $2,500. This implies that effectiveness or efficiency studies that use earnings effects alone as the measure of educational effectiveness will be biased consistently downward in their evaluations.

This could lead to a less than optimal investment in education by individuals or society. Also, since some types of education may have a greater effect on consumption patterns (and it remains to be proven that academic education differs significantly from vocational education in this regard) there could be a relative misinvestment among the different types of education and training if earnings levels alone are used as the measure of educational outcome effects.

F. Externalities

Externalities are not so much a separate outcome but rather a means of categorizing many of the outcomes already discussed here. An externality of education is any effect of education, positive or negative, on other individuals that was neither intended nor a basis for the education decision itself (thus, they are "external" to the process). The term "spillover" effects is sometimes used to imply the same lack of direct intention in causality. The externalities of education are the basis for identifying the "social" benefits and costs of education. While ideally such social effects should be available to all individuals without exclusion (see Windham, 1979B, for a discussion of this issue relative to higher education and the rationale for its inclusion in public or private financing decisions) the terms social benefits and social costs have now become, even to most economists, synonymous with positive and negative externalities. Windham (1972, 1976) lists eight major externalities of education:

(1) increased social mobility;

(2) change in the distribution of earnings or income;

(3) changes in attitudes and values;

(4) improved political participation and leadership;

(5) lower unemployment;

(6) improved mix of manpower skills;

(7) enhancement of the productivity of physical capital; and

(8) an increased quantity and quality of research.

In discussing research on these externalities in the case of higher education, Windham noted in 1972 that:

> The existence of beneficial externalities from the production of college graduates is uncertain; their manner and extent await elaboration even if they do exist; and if they are specified objectively, they still do not constitute by themselves, an adequate justification for public subsidies of the (higher) educational process.

Fifteen years later this situation remains unchanged for higher education and, if anything, the uncertain existence of externalities and the question of their relevance has been extended to the earlier levels of education.

Externalities enter into the analysis of educational effectiveness and efficiency because one must separate the determinants for judging the effect of education on the individual versus the effect on the society. Some outcomes discussed here, such as altered attitudes or values and increased political participation, are appropriate measures of educational effects only for society and not for the individual. By definition, externalities are those effects not considered by the individual who is making the education decision.

However, these outcomes may be a legitimate measure to be included in society's judgment of educational effectiveness. The use of the externality concept to categorize outcome variables between those relevant to the individual and those relevant only to the societal collective is crucial since effectiveness or efficiency studies are designed for evaluation and improvement of the decision process of individuals and of society. Most outcome research suggests that greater attention needs to be paid both to the improved identification and measurement of externalities and to a more careful separation of individual and external outcomes of the education process.

This extended discussion of outcomes concludes the discussion of educational effectiveness indicators. As noted at the beginning of the outcome section, the measurement of outcome effects and their attribution in whole or in part to educational determinants are even more severe challenges than was the case for the more direct and

immediate educational outputs. However, the outcomes have greater influence and scope in terms of capturing education's long term effect on individual and social utility.

In the next section, the discussion will turn to educational efficiency. This requires a combination of the effectiveness measures with information on educational costs. Following a brief discussion of cost identification and measurement, the efficiency analysis will be presented based upon the decision criteria models discussed earlier: benefit/cost analysis, cost-effectiveness analysis, least-cost analysis, and cost-utility analysis. Efficiency models will be studied in terms of single time period analyses but the discussion also will stress educational decisions where the incidence of effects and costs takes place over multiple time periods.

CHAPTER FIVE

THE ANALYSIS OF INDICATORS OF EDUCATIONAL EFFICIENCY

Efficiency analysis of education incorporates all of the concepts and issues presented in the preceding chapters on educational effectiveness. In addition, it adds the consideration of educational costs and imposes on the cost and effectiveness measures specific decision models for the relating of efficiency measures to educational decisionmaking. It is critically important that one realize that the efficiency analysis can be no better than the effectiveness and cost data it incorporates. And data quality in this context refers not just to accuracy and timeliness but also to the scope and relevance of the effectiveness and cost measures used.

The discussion of educational efficiency will begin with an introduction to the basic concepts of cost. In the earlier conceptual discussion brief mention was made of cost definitions (average, total, marginal, etc.). Here, the emphasis will be upon the operationalization of cost concepts as measures to be used in the discussion of educational efficiency.

I. THE MEASUREMENT AND INTERPRETATION OF EDUCATIONAL COSTS

In measuring educational costs for project or program analysis there are two main approaches that may be used: the aggregate approach and the ingredients approach. In the aggregate approach one uses cost data that already exists to estimate the quantity and value of resources used in the production of the educational outputs or outcomes under study. For example, in the IEES Project's Yemen Arab Republic (Y.A.R.) education and human resources sector assessment of 1984, government expenditure data were available for each major level and type of education. The cost data included expenditures on teachers and educational materials and some recurrent facilities expenditures (for major repair and maintenance activities). Also available were the central and regional administrative costs of the education system although the government normally did not divide these cost by levels and types of education. This division was accomplished by assuming that the share of administrative costs borne by each level and type of education was proportional to enrollment. While an acceptable approach, the assumption of enrollment proportionality of costs probably overestimates cost at lower relative to higher educational levels. Most government administrators in the Yemen Arab Republic felt that there was a higher involvement of administrative resources per student at the post-primary levels of education.

Unlike the accounting system in many nations, the educational accounts in the Y.A.R. also allowed inclusion of donor support for current expenditures (in the

recurrent budget this was almost exclusively support for teachers). Even with the detail available on expenditure by level and type of education, the government of the Y.A.R. still realizes that much in its cost data system needs to be reformed and is in the process of making such improvements. The major data concerns of the government are general accuracy, differences between amounts allocated and actually expended for a given year, and the lack of adequate statistics on private and community contributions.

The last aspect was dealt with in Botswana by using the ingredients approach, the second major costing method. In the ingredients approach one takes the separate categories of inputs (ingredients) and sums these to a total. Depending upon available date, the inputs may be summed on an aggregate (total expenditures) or unit (per student, classroom, or school) basis. In Botswana, the calculation was done on a per-student basis, for each of three school control categories, with the separate inputs of the parents and family identified as follows:

- initial enrollment contributions
- registration fee for school leaving examination
- student activities fee
- uniforms
- labor for school maintenance and repair.

These private contributions varied in amount by level and type of education. At the upper secondary level and in vocational programs some schools also charged fees for materials and laboratory expenses. It should be noted that items with a life of more than one year--such as school uniforms--were annualized by dividing the original costs by the expected number of years of usable life. Table Seven summarizes the cost data calculated for the Botswana sector assessment.

A more extended example of the challenge faced in deriving cost estimates by the ingredients approach is presented by the EHR sector assessment update report for the Government of Botswana (IEES, 1986B). Again, little expenditure detail was available for specific levels of the system for the major inputs (staff, equipment, materials, and facilities). Rather, the government budget (as indicated in Table Eight), presented expenditure categories including both activity forms (central administration -- called "headquarters" -- and curriculum development, for example) and levels of the system (primary education, secondary education, etc.) Unfortunately, the major school expenditure, teachers' salaries, was not divided by the level or type of education but instead was aggregated into the single category of the unified teaching services. Similarly, bursaries for all program types and levels were a single category and not presented so as to allow analysis of bursaries in specific programs.

The solution to this was to develop, with the Botswana Ministry of Education personnel, a system for allocating the amounts in the aggregated categories across the

TABLE SEVEN

BOTSWANA SECONDARY SCHOOLING
UNIT COSTS, 1982-83

	Government			Government-Aided			Community Junior		
Type	Student Cost	Gov't Cost	Total	Student Cost	Gov't Cost	Total	Student Cost	Gov't Cost	Total
Tuition	P 20			P 20			P 200	P20 (Grant)	
Uniforms	10			10			10		
Books/ Supplies	35			35			Incl. in tuition		
Exam Fees	5			5			5		
Dinner (Day Pupils)	12	76							
or Room/Board (boarders)	60	114						114	
Teacher Salaries		357							
Other Salaries		100							
Other Expenses		238							
Subtotal		809 less tuition (boarders) or 771 less tuition (day pupils)		70	415				
Boarders	130	789	919						
	82	751	833	70	395	465	215	134	349

SOURCE: IEES Project, Botswana Education and Human Resources Sector Assessment, 1984.

TABLE EIGHT

GOVERNMENT OF BOTSWANA
MINISTRY OF EDUCATION RECURRENT BUDGET
1984/85 AND 1990/91

Department	1984/85 Expenditure (P'000)	1984/85 Percent	1990/91 Expenditure (P'000)	1990/91 Percent	ANNUAL GROWTH RATE
Headquarters*	7,756	10.4%	17,477	12.6%	14.5%
Primary Education	842	1.1%	1,083	0.8%	4.3%
Secondary Education	10,357	13.9%	23,094	16.6%	14.3%
Teacher Training	1,602	2.1%	2,404	1.7%	7.0%
Technical Education	2,259	3.0%	9,241	6.6%	26.5%
Nonformal Education	817	1.1%	868	0.6%	1.0%
Unified Teaching Services	41,852	56.0%	67,528	48.6%	8.3%
Curriculum Development	1,032	1.4%	1,095	0.8%	1.0%
Bursaries	8,232	11.0%	16,249	11.7%	12.0%
TOTAL	74,749	100.0%	139,039	100.0%	10.9%

*Includes the University of Botswana and the Brigades.
NOTE: 1984/85 figures are forecasts and 1990/91 are National Development Plan 6 targets
SOURCE: IEES Project, Botswana Education and Human Resources Sector Assessment Update, 1986.

levels and types of education. For teachers this was done based upon separate data on teacher assignments by types of academic and teacher training credentials. From this it was possible to derive the probable salary levels. For other categories, such as curriculum development, adequate data did not exist for allocation and, thus the category was folded in with other general administrative costs and distributed based upon the assumption of enrollment proportionality as was discussed above.

The cost situation was made more complicated in Botswana by the existence of educational financial support from ministries other than the Ministry of Education, local support, and some private family costs. Based on available data and assumptions about expenditure levels and incidence, estimates were made for seven major levels or types of education (with additional detail on the three major vocational/technical programs).

Table Nine presents the cost data for Botswana for the years 1983/84 (calculated for the original sector assessment--HEES, 1984B) and 1984/85 (government figures used in the assessment update--HEES, 1986B). Differences between the two sets of figures result from real changes in the interim (for example, the government was making substantial new investments in vocational and technical education during this period), changes in enrollments (since these are unit not aggregate costs), better cost data, and different assumptions for distributing central costs. The latter two changes were initiated in response to some of the data questions raised in the initial Botswana assessment and the resultant reinforced appreciation for the value of accurate cost data in policy analysis. While the average reader may be surprised by the disparity between the two estimates in some items, most cost analysts would be gratified by the fact that the new figures follow basically the same pattern as the earlier ones. This especially is so given that the earlier estimates were derived under less than ideal conditions of time and resources. Like all effectiveness or efficiency work, cost analysis should be done on a recurrent basis, ideally on at least an annual basis, both to identify trends and to allow for a cumulative improvement in the methodology of deriving costs.

Cost analysis has as its primary purpose the production of cost figures for use with effectiveness measures to produce indicators of educational efficiency. However, at times cost data are used without parallel effectiveness data and yet some conclusions, or at least inferences, concerning efficiency may be drawn. This is justified only in selected situations. For example, the data presented in Table Nine can be adapted to create a form of cost index. The most common approach is to set primary education equal to 1.0 and derive indices for the other levels and types of education in terms of their costs relative to that of primary education. For the 1983/84 data in Table Nine, the primary education cost is 189 Pula, so all other costs would be divided by this amount to produce the indices on page 111.

TABLE NINE

GOVERNMENT OF BOTSWANA
UNiT COSTS OF EDUCATION

1983/84 - 1984/85
(Pula per Year)

ITEM	1983/84	1984/85
Primary Education	189	160
Secondary Education	833*	733
Brigades	1000	1000
Other Vocational/Technical	2123	3160
Botswana Polytechnic	2955	N/A
Automobile Training Trade School	2428	N/A
Botswana Institute of Administration and Commerce	987	N/A
Teacher Education	938	1455
University of Botswana	7143	8079
Nonformal Education	N/A	25

*Government or government-aided schools only

SOURCE: IEES Project, Botswana Education and Human Resources Sector Assessment Update, 1986.

Primary Education	1.0
Secondary Education	4.0
Brigades	5.3
Other Vocational/Technical	11.2
Botswana Polytechnic	15.6
Automobile Training Trade School	12.8
Botswana Institute of Administration and Commerce	5.2
Teacher Education	5.0
University of Botswana	37.8

A danger of this form of cost analysis is that the politician or administrator may be unduly surprised at the scale of some of the differences. This problem can be aggravated if the data is presented in a polemic form such as "every college student means the sacrifice of places for 38 primary school students." The "sacrifice" measure is accurate only if the unit costs also are marginal costs (otherwise it may be possible to expand the number of either college or primary students without requiring a reduction in the other proportional to the index) and budget levels are constrained for aggregate educational expenditure (a condition that unfortunately is increasingly common in all nations).

Obviously, costs differences of the type depicted in the indices must be offset by differences in the effectiveness of the education and training categories. The cost data, used in isolation of effectiveness data, may raise important questions but can never answer them. The antipathy many administrators and project directors have toward cost analysis is that, unless such analysis is done for all competing forms of education, cost data can place a program or project at a political or bureaucratic disadvantage. This results because normal accounting procedures in ministries often exclude some costs and overlook others. Thus, a detailed analysis that reveals these costs will make a program or project appear relatively more expensive than other programs that have not been analyzed in a similar fashion. Such comparisons of costs are best done when effectiveness among the alternatives is the same (or is assumed to be the same as in most least-cost analyses). This often is the case in pre-project assessments and even in some project evaluations.

One of the most detailed analyses of costs done on a major educational development project was that conducted with World Bank financing for the joint Government of Liberia-USAID Improving the Efficiency of Learning (IEL) project (Windham, 1983 A,B,C,D,E).* These analyses covered issues of unit costs by grade level, cost

* The IEL project involved the use of programmed teaching materials in Grades One

variation among school locations, projections of dissemination costs by alternative dissemination schemes, comparisons of cost versus effectiveness between the IEL and control schools, and a revised cost analysis based on changes in the materials requirement for the IEL program.

The changes were encouraged in part by findings in the earlier cost analyses. Among the major points of the cost analysis were: (1) that the IEL system had large economy of scale effects but that actual class sizes except at the grade one or two level did not allow the system to take advantage of those scale effects; (2) the system was more adaptable in terms of relative costs to urban schools than the rural ones for which they were first designed; and (3) that dissemination costs would be greatest in the rural schools because of high transport and management costs.

Even with these concerns, the results of the cost analysis were positive for the IEL methodology. Table Ten summarizes the cost comparisons for the original and revised IEL system and for three assumptions about textbook costs. The two major residual concerns were the absorptive fiscal capacity of the Liberian government and the question of the government's commitment to the IEL approach versus the traditional textbook-based system. In 1986, the Government of Liberia, assisted by the USAID-financed IEES project, designed an integrated IEL-textbook system for consideration as the core instructional system for primary education in Liberia (IEES, 1986). Much of this design work was based upon updating and modification of the original cost analyses.

Once cost estimates are generated, by either the aggregate or the ingredients approach, one still has to be prepared for the problem of their appropriate analysis. The relationship of costs to class or school size poses a special problem in this regard. In the IEL example, it was noted that the costliness of the IEL materials, and thus their relative cost when compared to textbooks, varied depending upon class size. When any input cost is fixed--that is, it does not increase in aggregate amount with enrollment, then the unit (per-student) cost of that input must decline as enrollment increases.

The view of the teacher expense as a fixed cost of education presents a basis for examining this concept of unit cost. Part A of Figure Three indicates that the average

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and Two and in the first semester of Grade Three. Thereafter, programmed learning modules were provided for the remainder of the six year primary cycle. The modularized IEL system involved the use of basic instructional modules, reading booklets, review booklets, practice booklets and semester tests. At the higher grade levels student guides, test booklets and test answer keys, block tests, and an arts and craft manual were provided.

TABLE TEN

RELATIVE PER-STUDENT COSTS OF INSTRUCTIONAL MATERIALS

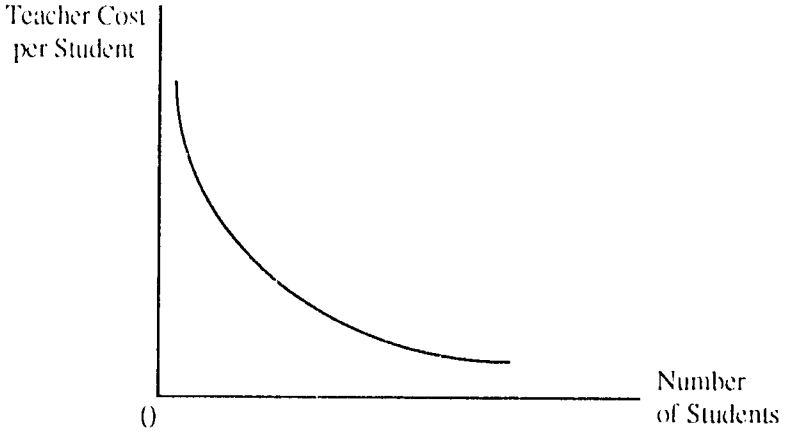
Grade Level and Instructional Material	NUMBER OF STUDENTS IN CLASS 20	40	60
Grade One			
IEL (Original)	$5.91	$2.95	$1.97
IEL (Revised)	3.55	1.78	1.18
Textbook (A)	9.38	9.38	9.38
Textbook (B)	4.69	4.69	4.69
Textbook (C)	2.35	2.35	2.35
Grade Two			
IEL (Original)	$6.27	$3.13	$2.09
IEL (Revised)	4.13	2.06	1.38
Textbook (A)	10.88	10.88	10.88
Textbook (B)	5.44	5.44	5.44
Textbook (C)	2.72	2.72	2.72
Grade Three			
IEL (Original)	$6.11	$3.07	$2.04
IEL (Revised)	3.34	1.67	1.11
Textbook (A)	10.78	10.73	10.73
Textbook (B)	5.37	5.37	5.37
Textbook (C)	2.68	2.68	2.68
Grade Four			
IEL (Original)	$6.70	$3.35	$2.23
IEL (Revised)	2.80	1.40	.98
Textbook (A)	9.42	9.42	9.42
Textbook (B)	4.71	4.71	4.71
Textbook (C)	2.36	2.36	2.36
Grade Five			
IEL (Original)	$6.70	$3.35	$2.23
IEL (Revised)	2.80	1.40	.93
Textbook (A)	11.65	11.65	11.65
Textbook (B)	5.83	5.83	5.83
Textbook (C)	2.91	2.91	2.91
Grade Six			
IEL (Original)	$6.70	$3.35	$2.23
IEL (Revised)	2.80	1.40	.93
Textbook (A)	9.02	9.02	9.02
Textbook (B)	4.51	4.51	4.51
Textbook (C)	2.26	2.26	2.26

SOURCE: D.M. Windham, "Cost Estimates at the Revised 'Improved Efficiency of Learning' Project's Materials Component", 1983.

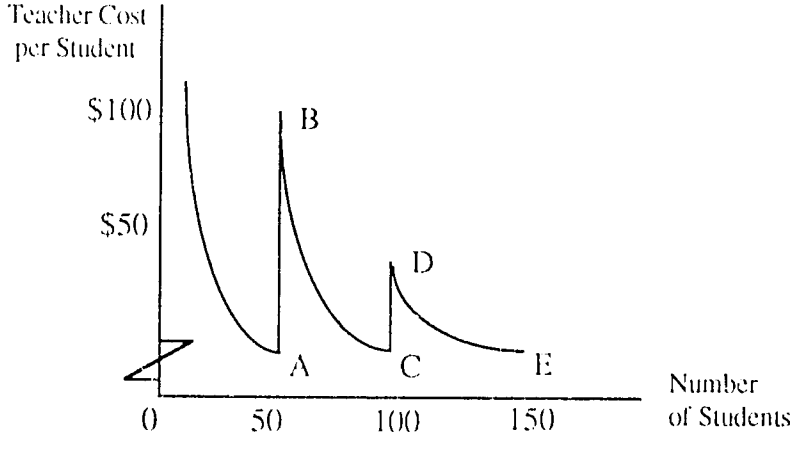
NOTE: Textbook (A) refers to approved texts at one text per student. (Textbook B) refers to reduced price texts at one text per student. Textbook (C) refers to reduced price texts at two per student.

FIGURE THREE
TEACHER COSTS PER STUDENT

I. SINGLE TEACHER CASE



I. MULTIPLE-TEACHER CASE



cost per-student has a declining (and asymptotic) relationship with enrollment when teacher cost is the only classroom cost. If one ignores the effect of class size on student achievement, then one can see that smaller classes inevitably will have the disadvantage of a higher unit cost than will larger classes. The decline in average cost that comes with expansion in the size (scale) of classroom operation is an example of an economy of scale. Part B of Figure Three indicates the "step-function" that exists as one expands the analysis of unit cost from the single to multiple classroom situations. The peaks in the function that occur at points A and B result when a new teacher (or teacher plus classroom) is added to accommodate more students. If one has one teacher that costs $2,500 per year and fifty students, the unit cost is $50 ($2,500 divided by 50) as indicated at point A. If a new teacher is hired when the fifty-first student is granted admission, then the total teacher cost will increase to $5,000 (2 times $2,500) and the new unit cost will rise to $98.04 ($2,500 divided by 51) as indicated at point B. Cost will once again begin to decline as new students are added. Eventually, when there are 100 students, the unit cost (at point C) once again will be $50 ($5,000 divided by 100) or the same as at point A.

This relationship is an important one in understanding the concept of economics of scale within a class and within a single school and in understanding administrator approaches to teacher utilization. One often hears comments about small classes being "uneconomic." This is a special case of the general error of confusing economy or efficiency with inexpensiveness. Small class size does mean higher unit costs; however, as was noted earlier for the case of rural schools, such a situation is only uneconomic when the practical considerations and production conditions would allow for larger classes. In many rural areas, for example, it is not possible to have large class sizes (especially in the upper grades where prior attrition has had an effect on the available candidates). Also within the production conditions of the teacher-centered classroom there are few ways to alter the unit cost with the exception of resorting to multiple class teaching--an alternative that can pose problems in terms of achievement levels.

Another case of justified higher unit cost is where the subject matter (e.g. laboratory science) or the nature of the students (e.g., learning impaired pupils) require much greater individual attention than a larger class will allow. In summary, analysts need to be very careful about identifying unit cost variations with inefficiency when at best, higher unit costs are a possible symptom; at worst, they can be a totally misleading indicator for policy formulation. The solution is to have more information on unit costs and more information on the classroom context within which the costs are generated.

Before concluding this discussion of educational costs, a small digression is justified on the "perception" of educational costs. It is one of the common characteristics of

educational production that the perception of cost varies depending upon the role of the individual within the educational hierarchy. The parent or student may view all costs as given or fixed with the exception of student time. In a society where child labor remains an important contributing factor to family welfare, the amount of time required for schooling and its incidence within the work day and across the calendar year will have a dramatic effect on the willingness of parents to release children to participate in school activities. Depending upon cultural standards, parents may have different opportunity costs (the value of the perceived sacrifice in allowing the child to attend school) for male versus female children; when combined with labor market biases in favor of males, the net, if not aggregate, effect of these cost and benefit comparisons is normally in favor of male education over female education (with the inevitable result of maintaining across generations the very gender inequality that education programs often are designed to ameliorate).

Mandatory schooling, if enforced, has the effect of reducing the legal opportunity costs of child participation in schooling to zero. It does not affect the real sacrifice to the family, of course, and that is why enforcement not pronouncement of compulsory schooling is the key determinant to changing family behavior. While mandatory participation laws or regulations may require participation they do not, by themselves, assure regular attendance, retention, or motivation in learning. A major problem in many developing nations is that compulsory education laws have been instituted prior to the establishment of a school system that can benefit most students. The result can be a disillusionment with education by some parents and children and an abandonment of the school system for private and nonformal alternatives or even for a return to traditional child or young adult forms of employment. For some sub-Saharan African societies the failure of the educational system has been coincident with the failure of general economic development. Thus, the opportunity costs of education are lower (because of fewer jobs for children and young adults) and some children may be caught between the equally dismal alternatives of a seemingly ineffective education and a labor market which requires increasingly high educational credentials for even the most rudimentary of modern sector jobs.

While the costs of student participation are quite real to the parent and student they often are ignored by the teacher in designing instructional conduct in the classroom. Viewing the student time as "free" may lead the teacher to institute activities that make poor use of student time, including leaving students to wait for further instructions or assignments. While some time off-task is inevitable, the danger in the teacher having an unconcerned attitude toward a proper utilization of student time is that all students, but especially the more advanced students who are likely to complete assignments more quickly, may develop negative classroom attitudes and bad work habits.

As suggested here, the dramatic difference in the student versus teacher judgment as to the value of student time is at the heart of many classroom problems. Teachers are vested with the authority to use both their own time and that of the students; thus, there may be excessive use of the lecture format because this approach economizes on teacher time even though it may be wasteful of individual student time relative to small group, tutorial, or self-study alternatives. A proper administrative approach would require that the teacher's choice of instructional technology consider the cost of all inputs and not just that of their own time and effort.

The complaint of the student *vis à vis* the teacher often is echoed by teacher complaints about parents, supervisors, and administrators. Many teachers may feel that the "managers" of the schools are making management decisions as if there were a zero marginal cost to using teacher time. Thus, decisions are made to change the educational process by increasing the demands on teachers rather than by supplying the teachers with the complementary inputs necessary to make the teachers more effective. The rationale is that teacher responsibilities can be increased without affecting the notional school budget which is not the case if additional instructional support materials or equipment are provided. What often results, of course, is that the new responsibilities are either unfulfilled or exert a real "cost" in terms of general teacher motivation and effort (and can lead to reduced retention of teachers and substantial concomitant costs for the training of new teachers and the loss of expertise). Given the salary of teaching in most developing countries, anything which increases the burden to teachers of remaining in their occupation will drive out of teaching those who have the best opportunities in other employment. While there is unlikely to be a perfect correlation between the pedagogical ability of teachers and other job opportunities, the correlation is assumed to be positive; the implication is that there will always be a tendency to lose the better teachers first if the "cost" of being a teacher is increased substantially.

Finally, individual school administrators often feel that central government bureaucrats or politicians may not consider the implications for local school costs in the pronouncement of new programs or policies. There is no more consistent pattern of policy practice in education over the last twenty years, in both developed and developing nations, than for central authorities to devolve new responsibilities on the local school without a concomitant increase in the resources with which to meet these new responsibilities. The foregoing is not a specific criticism of attempts to increase the level of effort of educational practitioners; rather, it is a general warning that a failure to consider costs--in all their forms--may lead not just to the failure of new reforms but to the creation of counterproductive results.

From this brief discussion it may be seen that there is policy insight to be gained from the analysis of cost issues even when effectiveness measures are not available. * Whatever the contribution of cost analyses alone, however, their real value lies with their use in conjunction with the effectiveness measures discussed earlier in this report. In the next section a listing and brief discussion will be presented dealing with the alternative indicators of educational efficiency that may be produced when one has both cost and effectiveness data.

II. ALTERNATIVE EDUCATIONAL EFFICIENCY INDICATORS

The following discussion of efficiency may appear almost anticlimactic given the detailed discussions of effectiveness measures. As noted above, any valid effectiveness measure, when combined with cost data, can be used to indicate the degree of efficiency with respect to the resource measured. However, in the discussion that follows the emphasis will be on those effectiveness measures--such as number of students, graduates, achievement, or earnings--that are most frequently used to indicate educational efficiency.

The discussion will be organized around the four models of efficiency analysis presented earlier: benefit/cost, cost-effectiveness, least-cost, and cost-utility. Within each category the discussion will focus on examples of the effectiveness measures appropriate to the particular model as well as some further methodological issues that arise relative to the specific model or its operationalization. The discussion is not exhaustive and does not include all of the aforementioned effectiveness measures. As was noted in discussing them in detail, some measures simply are too narrow to be used alone as a general efficiency indicator. Others simply cannot be operationalized at a reasonable level of objectivity and/or for a reasonable data expense. However, the list of indicators presented here are important in themselves and as prototypes for other indicators that may be developed if alternative and preferred measures of effectiveness become available. In summary, the indicators discussed below are indicative of the major range of indicators one is likely to encounter in educational policy analysis in either a developed or developing nation.

A. Benefit/Cost Analysis

In business situations the direct outputs of the production process have a financial value (based upon market or social judgment) that is stated in monetary terms. Thus,

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* Support from non-economists for the important role of cost analysis can be found in Friend (1985), Cummings (1986), and Postlethwaite (1987).

the comparison of benefit/cost ratios for business alternatives is a common means of promoting rationality in the decision process. Whether the benefits and costs are for a single time period or occur over multiple time periods has no effect on the validity of the benefit/cost criterion: it is equally suitable for either consumption or investment decisions.

Education and the educational production process are not directly analogous to the situation in the business sector. The direct outputs of education, such as attainment and achievement results, are not directly expressible in financial terms. To identify a benefit of education in such terms requires shifting to the less direct outcomes such as employment and earnings. Employment effects themselves are interpretable in financial terms only to the extent they affect the probability of receiving different patterns of future earnings or of reducing obligations for social support such as unemployment and welfare transfer payments. Also, the consumption aspects of education are rarely considered directly; more often, they are treated as a residual effect or as an explanation for expenditures on education in excess of what can be justified by the investment criteria.

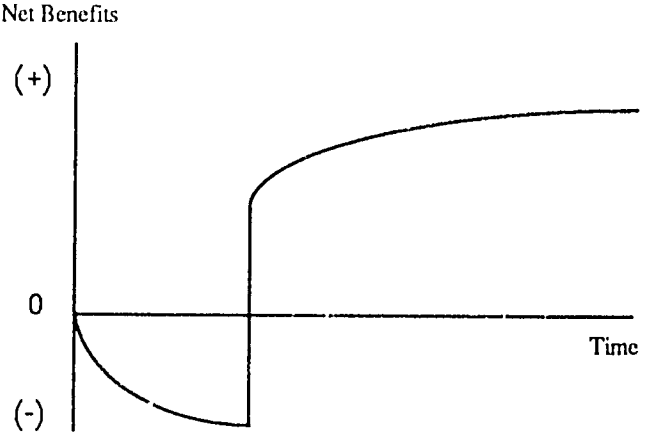
Because education takes place over time and its results (especially those related to earnings) occur over an even more extended time, two special forms of benefit/cost analysis have been used in studying educational investments: the present value of benefit/cost approach and the rate of return approach. Both models are based on net benefit and cost relationships such as those shown in Figure Four, Parts A and B. In Part A, there is a single net cost period followed by a period of varying net benefits. This is analogous to the normal understanding of a period of education and training (during which direct costs and opportunity costs are incurred) followed by a period of higher earnings. Part B indicates a pattern of recurrent net cost as would occur if an individual had to interrupt employment periodically for new or refresher training.

It is critical to understand that the diagrams represent net costs and benefits to the individual for every single time period. Benefits from education may occur while the person is still in training and the person may have additional costs during the employment period to maintain the value of their education.

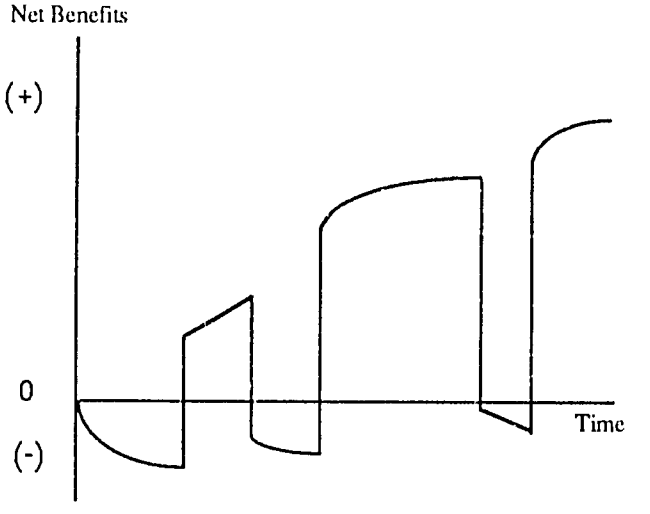
The concept of opportunity cost was raised in the original discussion of efficiency and educational production. If training or education requires that an individual sacrifice employment or leisure time then the value of this time is a "cost" of education. Most commonly this is operationalized in terms of the foregone earnings of the individual--the reduction in earnings as a result of the time spent as a trainee or student. Similarly, the earnings benefits must be not total earnings but the increase in earnings as a result of the education or training program.

FIGURE FOUR
INCIDENCE OF NET BENEFITS OVER TIME

A. Single net-cost (investment) period



B. Multiple net-cost (investment) periods



The net benefit curves presented in Figure Four are for individuals and would be relevant for individual decisions about education. If one were analyzing social decisions about educational investments additional factors would have to be considered since some costs and benefits would not appear as a direct effect upon the individual student or trainee. For example, the amount of subsidy (of tuition, housing, food, etc.) paid by government or other social agencies to assist the student/trainee should be added as a cost factor to the amounts paid directly by the individuals; similarly, some authors insist that the higher amount of taxes paid on higher incomes by graduates is a benefit to society and should be added to the net amounts received by the individual (Windham, 1981, suggests that only the difference between the educated person's increased tax payments and his or her increased use of public services should be so considered). Externalities, both positive and negative, also must be included in the analysis in order to facilitate the social decisions and to increase their rationality.

Given the data in Figure Four (understanding that it may be private or social, for an individual or for a group), it is possible to calculate either a present value of benefit/cost ratio or a rate of return statistic. The details of present value analysis can be found in any undergraduate finance text. The standard reference for rate of return analysis is Psacharopoulos' Returns to Education (1973). However much one may disagree with his application of the methodology (Klees, 1986), no better treatment has been provided of the basic concepts of rate of return estimation.

Both forms of analysis depend on comparing benefits and costs over time. The present value approach calculates the time discounted value of benefits minus costs for all the time periods in which benefits or costs occur. The formula used is:

$$PV = \sum_{t=1}^{n} \frac{B_t - C_t}{(1+r)^t}$$

where:
- PV = the sum of the present values of the net benefits (Bt-Ct)
- B_t = benefits in each time period
- C_t = costs in each time period
- n = number of time periods "t"
- r = rate of discount.

For an educational investment to be justified the present value of net benefits must not be negative (if they are zero the investment leaves the investor's present condition unchanged) and the present value must be at least equal to that of alternative investments.

While the present value approach is logical and obvious and has pedagogical merit in training individuals in the investment concept, it has not been the more popular criterion. Rather, the rate of return approach for education has dominated the economic literature in the same manner that rate of return has been the preferred criterion in business investment analysis. One would use the same formula as above but, rather than using an externally defined rate of discount (most commonly the cost of borrowing funds), one solves the equation to find the unique rate of interest that will cause the present value of the sum of net benefits to equal zero. By definition, this is the same rate of interest that sets the present value of benefits equal to the present value of costs; it thus establishes the rate of interest at which the project will "break-even."

This approach satisfies the criterion of non-negativity, since if the calculated rate of return exceeds the appropriate external rate (the rate of borrowing, for example), one can be sure the present value of net benefits is positive. However, the rate of return approach should be avoided in comparing mutually exclusive alternatives (forms of education or educational/work alternatives that cannot be pursued simultaneously). Ray (1984) notes:

> In such comparisons, the project with the highest rate of return is not necessarily the one with the higher NPV and is therefore not necessarily the best project. While a variant of the rate of return technique can be used to indicate the correct choice in such cases, it is usually cumbersome and prone to error. The rate of return technique is therefore not fully satisfactory.

A (cynical) explanation for the continued use of rate of return analysis in spite of this methodological weakness may lie in its apparent complexity to noneconomists.

This debate aside, the investment analysis criteria as indicators of educational efficiency will and should continue to be used. Those technicians who misuse such analyses are no more culpable than are the administrators and others who have not made the effort to master the concepts and thus are not able to interpret the results of such analyses for themselves. As with all efficiency analyses, the investment criterion of benefit/cost is not the sole answer but can be a significant contributor to better understanding and thus to better answers.

The educational system, and the economic environment in which its operates, will need better answers desperately in the next two decades. Ignoring the effect of education on earnings is foolish both professionally and politically for policy analysts; failing to improve the quality of the analysis of this relationship through proper use of benefit-cost approaches would be equally foolish.

B. Cost-Effectiveness Analysis

In moving from financial benefits to quantitative effects one greatly expands the number of output and outcome measures of effectiveness that may be combined with cost to generate an indicator of educational efficiency. Of the vast number of alternative forms of indicators that could be discussed based on the earlier survey of educational effectiveness measures, five indicators will be emphasized here because of their frequency of use, general availability from standard data sources, and meaningfulness for policy analysis:

- unit cost
- cycle costs
- attrition cost
- cost per unit of achievement
- cost per unit of dispersion

Unit costs may appear an unsuitable indicator of educational efficiency since it measures only total costs divided by the number of students (or the total of an ingredients-based summation of the various cost inputs for an average student). The purpose of unit cost calculations, however, is to allow one to compare the available, even if minimal, quantitative data on education with qualitative information and inferential analysis to identify areas of potential inefficiency. This then allows the analyst to study the specific problems and opportunities that exist for improving effectiveness (as equated with size of enrollments) for a particular level and type of education. Although not sophisticated, unit cost analysis is often all that the availability and quality of cost and effectiveness data will permit.

Where enrollment data allow, it also is recommended that cycle costs be calculated. Cycle cost is defined as the average number of student years of education provided by the educational system relative to every graduate produced. It is calculated from a table of past enrollment patterns or a table of enrollment projections. Cycle cost is not the average time it takes each graduate to complete the cycle. The cycle cost indicator includes the years of education (including repetition) of the graduates plus the years of education (again including repetition) of all non-graduates.

A comparison of financial unit and cycle costs (years multiplied by the cost per year) is presented in Table Eleven (from the Botswana sector assessment of 1984). The unit cost data has been derived for 1983/84 by the inputs (ingredients) approach and is equal to Pula 189 per year. Part II of Table Eleven indicates the expected progression rates including repetition for the seven year primary cycle that existed in Botswana in 1983/84. For every 1,000 students who begin standard (grade) one in Year One, the table depicts how many students will be in each succeeding grade and year. The high

TABLE ELEVEN

PUBLIC PRIMARY SCHOOLING IN BOTSWANA: ESTIMATES OF UNIT COSTS AND CYCLE COSTS 1983/84

I. UNIT COSTS

Cost to Parents (uniforms & misc.)	P 15
Cost to Government	
MOE	P 136
MLGL	18
Local	20
Subtotal	174
Total Cost	P189

II. CYCLE COSTS

Year	Pupils per Standard*						
	One	Two	Three	Four	Five	Six	Seven
One	1,000						
Two		978					
Three			969				
Four				1,037			
Five					882		
Six						833	
Seven							1,083

A. Cost of an A or B pass = 21.4 years or P4,045
B. Cost of an A,B,C pass = 10.3 years or P1,947

* Assumption of progression rates based on Ministry of Finance and Development Planning projections for 1983 forward.

SOURCE: IEES Project, Botswana Education and Human Resources Sector Assessment, 1984.

figures for standards four and seven are because of the higher rates of repetition in those two years.

Out of every 1,000 students who begin, 317 are expected eventually to receive an A or B pass and 658 an A,B, or C pass on the national primary school leaving examination. Thus the cycle cost for this example is equal to the number of passes on the examination (graduates) divided by the total student years of education (6,782 = 1,000 + 978 + 969 + 1,037 + 882 + 883 + 1,083). Thus, the cycle cost for A and B passes is 317/6,782 or 21.4 student years; 21.4 years times the unit cost of Pula 189 results in a financial cycle cost of Pula 4,045. If one uses the more generous definition of A,B, and C passes to define graduates, then the cycle cost in years is 10.3 (658/6,782) and in financial terms is Pula 1,947 (10.3 x P189). Again note that no graduate is expected to take 10.3 and certainly not 21.4 years of education to finish the seven year cycle; and yet, these years of education will have to be provided by the education system because of the effect of repetition and attrition.

A possible weakness in the cycle cost methodology is that it values only graduates. Where school leavers prior to graduation are determined to have derived significant benefit from schooling some adjustment can be introduced to grant partial value to such school leavers. The most common example of this is in primary education where the achievement of literacy and numeracy will, even if the individual does not graduate from the primary cycle, have significant social and personal effects. A counter argument to this concern is the fact that labor markets, at least at the entry level, are keyed to graduation levels and certificates and not to years of attainment or acquired skills per se. One need only compare the earnings or employment of graduates and near-graduates of secondary school and higher education institutions to see the impact of the labor market fixation on graduate certificates.

A third and related efficiency indicator that can be calculated from basic data is the attrition cost index (in part, a misnomer because it includes both attrition and repetition effects). It is based upon the ratio of cycle cost to the product of unit cost multiplied by the number of years in the schooling or training cycle. For example, for the Botswana data cited above, the cost per primary cycle graduate ideally would be Pula 1,323; this is the product of unit cost of Pula 189 times the seven years required in primary education. When this value is compared with the actual cycle costs, one derives an attrition cost index of 3.06 (4,045/1,323) for A and B level graduates and 1.47 (1947/1,323) for A,B, and C level graduates. It should be recognized that since the unit cost figure is in both the numerator and the denominator, cycle and attrition costs may be calculated from student years alone. This is important to remember if unit costs are unavailable or unreliable and one still needs an efficiency indicator incorporating attrition, repetition, and graduation rates.

Unit and cycle costs and the attrition cost index operate under the assumption that students or graduates are the desired output of education and that enrollments and graduation rates are acceptable effectiveness indicators. The enrollments would be completely valid as an indicator only if graduation had no pay off, per se. The graduation measure is an adequate indicator only if one can be sure what the status of "graduate" implies in terms of the cognitive and noncognitive attributes valued by the market or society. Because neither of these assumptions is fulfilled in reality, one can use these efficiency indicators only with great care and in full knowledge of their narrow conceptual base.

To widen that conceptual base, researchers have tried to measure the specific achievement of students and graduates. The methodological and interpretive limitations on these measurements were discussed earlier. Assuming these can be eliminated or, more probably, controlled for in the analysis, the comparison of costs with effectiveness in achievement would be an improved indicator of educational efficiency. What the analyst seeks to identify is whether a change in expenditure can lead to a change in achievement.

Of course, the goal of efficiency analysis is to identify the most efficient not the most expensive forms of education. The researcher must be assured or prepared to assume that the additional expenditures are allocated across inputs in such a manner (i.e., within the most effective technology) that the expenditures are focused on the inputs that can make the greatest contribution to the desired output or outcome measure(s). The desired measure or measures of outputs or outcomes must be selected based on the value judgments of the key decisionmakers. For example, if the key decisionmakers are interested in the effect of education on national economic development it would not be useful to supply them with information on the efficiency with which education promotes enhanced appreciation of art (unless one can show a causal or coincident relationship of art appreciation with economic development outcomes). Similarly, if the key decisionmakers primarily are interested in education's effect on student and graduate political opinions and loyalties, they may find little value in information on the average effect of education in terms of enhanced mathematical skills.

The achievement measure chosen must be selected based upon the preferences of the users of the efficiency information. The most common subject areas selected are language and mathematics scores because of the centrality of these two topics within the school curriculum. Achievement in social studies, civics, art, science, etc. potentially are equally valid but they have been less commonly used measures of academic achievement.

When multiple subject areas are of interest, it is preferable to analyze them individually rather than to create an artificial index (by creating a weighted or unweighted average of the achievement scores across subject areas). The meaning and relevance of an index or average such as this is uncertain and will not be as readily interpretable by decisionmakers as will the separate results by subject area. An additional advantage of presenting the individual scores to decisionmakers is that it forces them to weight the individual values (language versus mathematics skills for example) and prohibits the researchers from imposing their own values as to the relative importance of the subject areas in an implicit manner that may not be recognized by the decisionmakers.

Once the achievement effectiveness measure is selected (and one has controlled for other determinants)* it is "simply" a matter of comparing how the cost variations among the sample, or population of cases, affects the achievement measure. In an experimental setting both the control of other variables and the isolation of expenditure on the most productive inputs are easier to achieve. In what is termed "natural experiments", using data from the normal population of education, these controls are exerted statistically. However, one can only control for those variables which do, in fact, vary across the population.

For example, one can test the effect of class size changes on costs and achievement in an experimental population by creating classes that vary in size but are standardized (to the extent feasible) in every other manner of determinant (Cahen, et al., 1983, is one of the few cases of an experiment which involved change of class size during the experiment). But in the actual education population one may find either that class size varies only within a narrow range (because of regulations, teacher assignment policies, or some other cultural or bureaucratic standard) or that it varies outside this range only in cases correlated with other determinants such as size of place or multiclass teaching practices. An example is that small upper-primary classes in many countries exist but they are so highly correlated with rural location that statistically one cannot separate the causal effects. Similarly, in some countries, large classes may be identified with urban areas where population is greater or with rural areas where teacher supply is more of a problem. The point to be remembered is that statistical controls are not always fully effective in the analysis of non-experimental data.

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* To compare costs with achievement outcomes without controlling for other determinants is methodologically unsound and requires extreme caution in the interpretation of the results.

The issue of class size (mentioned above and in the earlier effectiveness section of this report) illustrates this point. Many studies in the U.S. and Europe in the 1960s and 1970s found no class size effects on measured achievement. This is hardly surprising given that class size variation was concentrated in the range of 25 to 35 students. However, one can conceive of class size effects without expecting them to have an impact within the narrow range that exists in the standard school or training center. Logically, a tutorial (one student to one teacher) would be a superior form of instruction in certain settings, especially if cognitive achievement is the primarily desired output. More importantly, the monolithic attitude of donors and national administrators concerning the irrelevance of class size has restricted the responsiveness of educational systems to the special needs for remediation activities for physically or learning disabled students and the special requirements of certain courses of study such as laboratory sciences and foreign language (see, for example, the recommendations for remote rural Chinese schools in the China Study Report, 1986).

The lesson to be learned from the cost-effectiveness studies of the last three decades is one of caution in interpretation and the need for greater care in the conduct of such research. A final example of the latter is that cost effects are almost always more easily attributable to an instructional change or innovation than are achievement effects. The danger is that an inherently conservative if not negative attitude toward educational changes (and certainly experimentation) can develop. The solution is not to offset this by manifestation of an evangelical zeal on the part of the change advocates. Rather, the decisionmakers themselves must become more competent in questioning research design and conduct and in interpreting research results. With greater competence will come greater confidence in their ability to monitor educational change and reform.

The analysis of cost per unit of achievement always must assume that dispersion (variation in individual achievement results) is constant or irrelevant. However, given the importance assigned by most societies to education as an equalizing force, it is possible to design an efficiency study that would look at cost per unit of dispersion as one indicator of efficiency (with controls to assure that reduced dispersion is not concomitant with reduced average performance). Any measure of dispersion could be used but the standard deviation and Gini coefficients (see Appendix) are the most useful measures. Again, in line with economic theory, one is interested in the effect of a change in cost on the change in the measure of dispersion.

The instructional technology as well as the relative and absolute use of inputs must be considered in determining effects upon the equality of achievement results. The methodological issues of control and determinacy are exactly the same as discussed above for cost-effectiveness analyses that use mean achievement as the effectiveness measure. The infrequency of cost-effectiveness studies that focus solely on dispersion

indicates that both policy analysts and, one assumes, decisionmakers consider equality of outcomes a secondary, albeit legitimate, effectiveness measure.

In fact, one of the great needs in educational policy analysis is to advance the position of dispersion of results to parity with that of mean achievement. Concern about achievement must be concern about the distribution of achievement, not just its central tendency. Not only is every child of equal importance--although some studies either ignore or are oblivious to this point. The outcome effects of education are a function of the distribution or mix of output characteristics and not just a function of the mean level. The labor market responds to the differences in workers as effectively as it does to their common traits; to date most educational research has not been as attuned to measures of dispersion as they have been to measures of central tendency and this weakness needs to be remedied.

To many economists and educational researchers, achievement equality is not a subordinate goal but must be concomitant to changes in achievement means. One can make a policy decision to sacrifice equality in order to promote mean achievement or even to sacrifice the achievement results of part of a population to benefit another part of the population. But this should be a decision based on sound knowledge of the relationships between educational costs and both individual achievement levels and differences. Otherwise, one may make sacrifices that are unnecessary or institute policies that are inefficient in their tradeoff of achievement growth versus achievement equality. To have the prerequisite information to make these critical choices, the analyst must possess cost-effectiveness data related both to the unit of achievement and to the unit of dispersion.

C. Least-Cost Analysis

As defined earlier, least-cost analysis seeks to identify the least expensive means of producing a given effectiveness with the effectiveness measure specified in any form or combination of the forms discussed earlier. However, this approach does not provide the analyst license to ignore effectiveness issues. A review of donor and government project proposals could lead one to this misinterpretation. While one cannot always prove that the alternatives under consideration are equally effective, some evidence should be provided that the differences in effectiveness are of a scale that is irrelevant for the current policy considerations. If one can only assume equal effectiveness among the alternatives, the analysis might be better described as a form of cost analysis (such as was described for the Liberian IEL project) and not as cost-effectiveness analysis.

Least cost analysis can be used for each of the four types of effectiveness measures discussed earlier: inputs, processes, outputs, and outcomes. Examples of least-cost

analysis based on inputs would be those that focus on cost per teacher, per textbook, per class, or per school. Here, one is defining the effect as an input type and seeking to identify the most efficient way of delivering that input. Similarly, one can compare classroom or school costs under varying instructional systems (technologies) so as to assess the effect of alternative processes on costs (per student or per graduate). The assumption in both the input and process definitions of effectiveness must be that these measures are "acceptable" proxies for the more obviously relevant output and outcome measures of effectiveness.

Least-cost analysis of output measures is preferable for this reason. Common output measures in least cost analysis are attainment rates, achievement levels, and attitudinal or behavioral measures. These studies differ from cost- effectiveness in that, in least-cost analysis the analyst must show that the effectiveness measure does not vary or vary significantly rather than, as in cost-effectiveness analysis, study how the effectiveness measure varies for a fixed change in cost. Least-cost analysis emphasizes cost differences while cost-effectiveness analysis emphasizes the changes in both cost and effects.

Finally, outcome measures such as employment, earnings, social attitudes, etc. may be used in least-cost analysis although it becomes more difficult to assert that such effects are invariable across educational alternatives. The most common form of least-cost analysis then is the one dealing with outputs, and within the output category, the most common effectiveness measure is that of achievement.

D. Cost-Utility Analysis

Little additional detail on cost-utility analysis can be presented here except to emphasize again the distinctions from least-cost and cost-effectiveness analysis. Cost-utility analysis can be based on data from any of the preceding forms of efficiency analysis. It differs from the least-cost analysis in that, in cost-utility analysis, the value of both costs and effects may be subjectively determined and there is no need to standardize (through proof or assumption) the effectiveness side of the equation. Cost-utility analysis also does not depend solely on objectively quantified costs and effects of the types found in cost-effectiveness and benefit/cost analysis.

To help clarify these distinctions further, researchers engage in benefit/cost, cost-effectiveness, and least-cost analyses but decisionmakers (especially administrators and politicians but including individual parents and students) always engage in cost-utility analysis. Rarely can the "objective" forms of efficiency analysis be sufficiently comprehensive that one would base educational decisions solely on the ratios or coefficients they generate. It is the responsibility of decisionmakers, public or private, to be informed of the quantitative findings but the final decisions almost always will

come down to a question of applying their own values and experiences in interpreting the available data.

When researchers bewail the indifference shown toward their results by apparently uninformed decisionmakers, the researchers sometimes have justification: in organizations that have a history of inaccurate, incomplete, and untimely data, a bureaucratic culture of personal culpability, and a highly politicized public sector, many decisionmakers have not been encouraged to acquire the skills that would allow them to utilize educational policy data purposefully. More often, however, the researchers are failing to appreciate the more complex utility determinants of choice faced by the educational decisionmakers. Even if the decisionmakers accept the analysts' data, they still must interpret the data for themselves in terms of the larger social or political systems within which they operate and their own values.

For example, a common finding in the last decade has been that most developing nations have a relative over-investment in higher education and an under-investment at lower levels (such findings only rarely deal with the inefficiency--misinvestment --at all levels). Researchers often express dismay that such findings do not spur administrative reforms and reallocation of resources from higher education to other human resource subsectors. The role of higher education, however, is such that it is not subject to reform based on these narrowly-defined efficiency indicators. Rather, because higher education serves multiple roles in addition to promoting national economic development (e.g., a national or regional status symbol, a service institution for the elite, and an escape valve for the pressures of unemployment from an excessively expanded secondary education sector), the narrow definition of most higher education efficiency indicators allow them only limited applicability to the decision process. The decisionmakers do not necessarily ignore the results of the efficiency researchers; they may, however, assign the results less weight than the researcher would.

Convergence between research results and decisionmakers' premises can only occur through the increased use of multiple indicators of efficiency. As noted in the introduction to the economic concepts related to efficiency, the definition of efficiency is a function of the definition of educational goals --the desired outputs and outcomes. Since it is possible for a single individual (stakeholder) to have multiple goals, and since almost all educational activities have multiple stakeholders, the use of single dimensions of effectiveness based upon a narrow definition of cognitive achievement or financial success is dramatically inappropriate.

Given the serious methodological limitations faced by all educational analysts and the special problems of applying economic concepts to such a complex activity as education, the solution will not be found only in improved technical devices for measurement or even by more expensive analyses. Objective data can be improved but

even the best objective data will not eliminate the need for subjective judgments by decisionmakers. In the final instance, all educational decisions--from the individual student-teacher interaction to the formulation of national policy- are cost-utility decisions.

The researchers' responsibility is to widen the efficiency definition to include more outputs and outcomes and to improve the accuracy, breadth, and timeliness with which this data is provided. The most dramatic example of what happens when researchers fail to do this is the sad history of educational innovation projects. Whether the innovation is educational radio or television, programmed teaching or instructional materials, or any other attempt to affect traditional classroom practice, the myopic focus of the researchers on achievement results alone has been a primary reason why dissemination of these innovations has been so rare and so slow. Achievement results are important, but so are costs, so are administrative changes, so are parent, teacher, and public attitudes. The undimensional definition of educational effects has led the educational innovations to be experimental successes (by their own narrow definitions) but dissemination failures.

In some cases these failures are good things; administrators or others may have recognized what the researchers did not: the innovative system would not have operated efficiently outside the "greenhouses" of the controlled innovative classrooms and schools. Unfortunately, many of the "failed" innovations would have been of substantial benefit to many children and, eventually, to the larger society. In these cases, the failure of the researchers becomes a failure for the educational system and for the society.

The culpability of the researchers lies in their unwillingness to identify the appropriate efficiency indicators before the researchers begin their work. Instead of assigning an efficiency indicator the researchers feel is important (and often selected because of its relative ease of measurement), the researchers should have engaged in identifying the critical stakeholders and eliciting from them the appropriate measures of efficiency. Not all of these will be easily operationalized and, for some, the cost-effectiveness of their collection will not justify including the efficiency standard in the research. But identifying the multiple indicators that stakeholders feel are important will improve the relevance of the quantitative results and alert the researchers to the data gaps in the policy relevance of their work. Knowledge of the latter can help researchers prepare the presentation of their results in a manner such that all stakeholders will understand better why certain outcomes or outputs important to them are not part of the research results.

If the above discourse sounds uncomfortably close to a description of needs assessments or marketing surveys, that should not be surprising. The concept of

"social marketing" that has had such a salutary impact in health and agriculture dissemination activities has not yet been utilized effectively by educationalists. Social marketing has two main initial functions: to identify the wants and needs of the subject population and to promote new or altered definitions of individual wants. Applied to efficiency analysis, the first function is fulfilled by identifying the outputs and outcomes the various stakeholders to education believe are important. The second function is more proactive in that one attempts to introduce new output/outcome goals or to alter existing ones.

For example, parents may desire economic success for their child but not understand why mathematics skills are a relevant indicator; the researcher cum social marketer for efficiency analysis can attempt to show parents how certain educational skills can promote the goal the parents already have (thus altering the parents' understanding of effectiveness or efficiency analysis based on mathematics achievement). In another case, teachers or administrators may not see cost containment as an issue relevant for them. By convincing them of the alternative uses of time and resources in the classroom and of the dire consequences that will follow from the exhaustion of national fiscal capacity, a new standard of efficiency incorporating cost considerations may be accepted by these stakeholders.

The discussion of efficiency indicators completes the review of the application of the economic concepts of production and utility to education. Before proceeding to the summary discussion and the presentation of recommendations for research and policy, the next section will present a discussion of the role of efficiency analysis in the creation and maintenance of educational management information systems. This discussion is included here because of the importance of institutionalizing efficiency analysis within the normal workings of the education system. To date, efficiency analysis has been an ad hoc occurrence in the management of educational institutions and systems; since the major impact of efficiency analysis can best be realized from the cumulative impact of its recurrent use, the present situation is one that, if maintained, will continue to limit the value of efficiency analysis and retard the efficiency of educational operations.

CHAPTER SIX

EFFICIENCY ANALYSIS AND EDUCATIONAL MANAGEMENT INFORMATION SYSTEMS*

The relationship of efficiency analysis to the creation and use of an educational management information system (EMIS) often has been misunderstood. Efficiency analysis is not a means of using the EMIS, it should be the means of designing the EMIS. Efficiency analysis does not say jes. what can be done with data but, more importantly, establishes criteria for determining what data should be collected. This latter contribution is especially important in that the present EMIS operations in most developing nations suggest that tradition and ease of collection often are primary criteria used in the identification of data for collection.

Why should efficiency, rather than quality or equity, be the organizing principle for an EMIS system? Quite simply the efficiency concept incorporates the most inclusive set of criteria one could have for assessment or evaluation of an educational system or of its components. The efficiency concept is inclusive of concerns for quality or equity, whether these latter concepts are defined in terms of inputs, processes, outputs, or outcomes. In addition, by giving equal place in the analysis to both costs and effects, the efficiency concept is more responsive to economic realities and more responsible in terms of recognizing the legitimacy of other social and individual uses of resources. Finally, as was suggested in the efficiency chapter, there is a direct link between understanding how to use efficiency data and conceptualizing the design of an EMIS in terms of multiple indicators and multiple stakeholders.

Because management information systems (MIS) have been developed primarily by non-economists, there has not been the emphasis on a central organizing principle for the systems that one might have expected given that MIS originated in the systems analysis work of Simon (1977). Simon's basic structure of systems analysis parallels that of efficiency analysis in that one begins with problem definition and proceeds through establishment of criteria to the proposal and evaluation of alternative solutions to the selection of an "optimal" choice. This is exactly the economic model of choice

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* The discussion presented in this section has benefited from the review of the EMIS-related literature in the IEES Project's Issues and Opportunities for Energizing Educational Systems (1987). Some of the current presentation is directly traceable to that excellent summary prepared primarily by Jerry Messec of Florida State University.

and was adapted by-- rather than originating with--Simon from classical as well as neo-classical economic literature. Efficiency analysis is, in fact, an application of systems analysis where one seeks to optimize the interaction of costs and effects within constraints on available resources including information.

Information as a scarce resource and as a resource subject to cost-effectiveness considerations has been a major contribution of the work of Simon and of his followers in the MIS and EMIS fields. Paralleling the developments in information system concepts in the last thirty years has been an even more dramatic development in the equipment (hardware) by which information can be processed. Kroeber and Watson (1984) note the dangers inherent in the fascination of planners with the high-technology hardware of MIS (as opposed to the poor quality of data sources and decision-criteria which have not kept pace with the developments in MIS equipment). In stressing what a management information system does rather than how it does it, MIS reformers are attempting to rebalance the information field in line with concerns expressed here about efficiency data and their use.

The simultaneous development of computers (and their heightened sophistication) has led to a common confusion that MIS is a computer system. In fact, MIS have existed ever since the first systematic collection of data and such systematic collection can be traced to the earliest records of civilization. The improvement of MIS requires two major changes: (1) the ability to identify data needs of users and cost-effective means for the collection of this data at a level of acceptable quality, and (2) more timely and detailed presentation of data in a form readily interpretable by the users. Computers have helped in the first instance by facilitating certain forms of collection and, more importantly, by reducing some forms of transcription and aggregation errors common to pre-computer systems. In the second instance, computers have certainly reduced processing time for large data sets and have allowed much greater detail in the presentation of results.

Given the significant contribution of computers, there are still two important steps left if a sophisticated and responsive MIS or EMIS operation is to be established: (1) the formulation of better criteria for data collection and articulation and (2) better training for data users so they can make use of the data that will become available in greater quantity and detail. These steps cannot be achieved through a further emphasis on hardware development. Both require a new emphasis in terms of the methodological approach taken to the role of information in decisionmaking. Again, the conclusion of this report is that efficiency analysis and its subsumed body of concepts provide the best organizing principles both for the establishment of data criteria and the training of data users.

I. DATA CRITERIA

The critical task in designing an EMIS is the definition of information needs. This can be done in one of three main ways. First, information can be collected because it has "always" been collected and/or because it is relatively easy to collect (the emphasis on enrollment data versus achievement data is explainable in this way). Second, one can conduct a "felt-need" analysis of major decisionmakers in which one asks them to articulate the types of information they require and to assign priorities among the information types. Third, one can impose on the system a set of criteria based on theory and experience but related more to what the MIS professional feels is needed rather than what the end-user or decisionmaker feels is needed. The proposed use of efficiency analysis as an organizing principle for an EMIS will involve the integration of both the second and third ways of identifying data needs.

The use of a felt-needs approach alone can encounter a variety of problems. One example is that the decisionmakers may not be able to explain in adequate detail the type of information they require. Many organizations fail to express clear decisionmaking criteria or, even if they express them, do not apply them in a significant proportion of their operations.

Matthies and Matthies (1977) describe the possible frustration that may be encountered by information specialists who interview managers in an attempt to elicit decisionmaking details: "Frustrated MIS designers may accuse managers of not adequately understanding their work, while frustrated managers may argue that the designer is not able to comprehend their organization." The tension between information designers and users lies in the fact that the designers seek to simplify the decision process into its objective and measurable components while users operate in a more complex environment where information use is influenced both by organizational structures and bureaucratic practices and by cloudy criteria for success and a partial and uncertain linkage between decisions and decision effects.

This situation parallels that discussed earlier between the use of objective data to establish a framework for the subjective cost-utility judgments of decisionmakers. The problem for many information users is their fear that more and better objective data will make it increasingly difficult to rationalize (in the non-perjorative sense) their inevitably subjective decisions. The problem is aggravated by those information designers whose hubris extends to the point that they resent--and attempt to prevent--any intervention of subjectivity in their information system. Such individuals seek to establish mechanistic processes based on quantitative data and fixed, objective criteria; while some technical and engineering applications of MIS may justify such an approach, it is totally inappropriate for a social activity such as education. In fact, the

intrusion of mechanistic processes may be counterproductive in that it can elicit hostility to the EMIS itself by the affected users.

One must accept the fact that within a complex organization such as an educational institution or system one will find decisionmakers who lack the training necessary to do their job. One of the most consistent findings of the IEES series of sector assessments was that the educational bureaucracies were characterized by large numbers of middle-level managers who did not have either formal or on-the-job training concomitant with their responsibilities. In such a situation it is necessary to develop other means for identifying the data needs of the system. Hurtubise (1984) suggests an analysis of the organization with the information designers responsible for identifying structure, environment, and the planning and control processes (the techniques used would include documentation review, observations, and interviews).

Because of the earlier-stated bias of designers toward simplification of processes and quantification of data, there is a danger that the designers will develop an inappropriately abstract model of the enterprise. This problem was anticipated by Lucas (1973) who proposed the participation of two committees in the design process:

- A priorities committee would assist the designer in making resource allocation decisions and thus avoid conflict between the design of the system and its users. The committee would also bring a better comprehension to the design process of why some projects are undertaken, why others are denied, and how decisions are made for new activities or expansion of existing commitments.

- A user committee would include a large representative group of users and would involve them in the design process. This would result in better informed design and avoidance of possible future conflicts.

Only through the synergistic efforts of the two committees could it be assured that the data criteria of the information system would be both responsive to decisionmakers' perceived needs and to the externally determined requirements (based on needs the decisionmakers may not be competent in ability or training to perceive or articulate).

The assertion here is that there may be a third level of needed competence in addition to that of organizational decisionmakers and information system specialists. There is a need for a conceptual framework for decisionmaking that is generic to scarcity and choice, not just generic to a single information system or organizational structure. That generic conceptual framework is efficiency analysis. Thus, it is asserted here that the principles of efficiency analysis are not just an approach to structuring an EMIS but can be viewed appropriately as the approach. The efficiency approach defines the alternative types of data that can be collected, offers criteria for choosing among them,

provides alternative decision criteria for using the data with the criteria adaptable to different forms of quantification and levels of objective versus subjective valuation, and even suggests the types of training needed by data users. No other conceptual approach is so comprehensive in the applicability of its parts to educational information and its management as is the efficiency concept. And because it may be divided into cost and effects and these two concepts are further divisible into subjective and objective values, and the objective values can be monetary or nonmonetary, one is presented with a wide range of data specifications that may be selected depending on the needs of the users.

II. TRAINING CRITERIA

The training of data and information users has been a challenge faced by all those who desire to improve organizational or system effectiveness but it has posed special problems in the education and human resource sectors because of the quantity of managerial or administrative personnel, the complexity of the choices they face, and the frequent inappropriateness of the educationalists' past training. The last is a problem whether administrators are former teachers without training or professional managers without classroom or school administrative experience. The need for management training is the most commonly cited administrative problem in education; in part this is because most educational systems promote managers from within the teaching cadre.

The question with which efficiency analysis can help is: What form of management training is likely to be the most useful in preparing educational planners and administrators in the use of cost and effectiveness information? From the earlier discussions presented here, four general categories of training appear necessary for the effective educational manager:

1. specific skill training;
2. training in the conceptual framework of efficiency analysis;
3. training in logic and data-based argument; and
4. training in the application of skills, concepts, and logic to the requirements of their jobs.

Specific skill training for managers has been dominated in recent years by the attention paid to computer training. Too often, the focus has been on training the manager to operate a computer rather than on how to use it as part of the information/decision system. It may soon be common in the developing world -- as it is increasingly in developed nations -- for managers to operate their own exomputer terminals. However, for the present, the priority need is to develop high-level computer skills among data technicians who can provide better data processing for managers. Obviously, basic computer knowledge is valuable for managers. First, they need to know what data is available and what the data technicians, by use of the

computer, can do with the data. Second, some of the managerial lack of enthusiasm for computers is based upon their concern about subordinate personnel who have skills they, the bureaucratic superiors, do not possess. Basic computer training can both allay these concerns and assure more effective coordination between management and technical personnel.

A possibly more mundane but potentially more important set of skills that should be improved by management training are the skills of assimilating the information in data summaries and reports. All educational managers have experience in this area but they often have not had the proper training in how to study a data summary as a means of generating further data questions and alternative policy recommendations. Similarly, technical reports may be impossible for the manager to evaluate with the result that either the technicians' conclusions and recommendations may be accepted without proper questioning of the assumptions or statistical and personal biases or the report's potentially useful views will be ignored because of the manager's inability to comprehend them.

To permit managers to process the information in data summaries and reports requires the three further forms of training listed above. First, the managers must be trained in the conceptual framework of the efficiency analysis. This includes understanding the general framework and definitions and also the ability to comprehend why the efficiency analysis is comprehensive and central to management decisionmaking. Managers also need to become familiar with why and how efficiency analysis was developed and the specific value and limitations of its application to education. This training in the conceptual framework of efficiency analysis should consist of four parts: (1) establishment of basic terminology with clear definitions; (2) relating efficiency concepts to the basic terminology; (3) indication of the specific application of educational measures as efficiency indicators; and (4) discussion of the statistical, conceptual, and financial limitations of efficiency analysis in the practice of actual educational management activities.

Once familiarity with the conceptual framework has been achieved, educational managers need to receive training in logic and data-based argument. To some this may seem an unrealistic and unworkable requirement; others may feel it is unnecessary or inappropriate because it involves imposition of an arbitrarily selected form of intellectual approach on the behavior of the trainees. Training in logic and data-based argument is difficult but not impossible. Many programs of study--mathematics, statistics, physical science, economics-- impose a preferred form of logic on students. Whether described as the scientific method, formal logic, or rational behavior, these approaches to reasoning all place a premium on questioning of data, testing of alternatives, the relationship of premises to conclusions, and the consistency of findings.

Recently, a joint program of the USAID-financed IEES project, the World Bank's Education and Training Division, and the University of Lome was begun with the explicit purpose of improving the skills of educational planners in the analyses of data summaries and reports and the generation of tentative policy recommendations. The experience of this activity to date suggests that the goal of developing improved reasoning skills is attainable but that intensive initial training needs to be supplemented by continuing on-the-job reinforcement.

What this project activity has shown, and what experienced educational advisors can attest, is that the present skills of educational managers and analysts are underutilized not just because of specific skill shortages in technical areas but because of a lack of training and experience in data-based argument. The high intellectual skills possessed by many of these managers adds to their frustration as they recognize that more can be done to convert data into information and to transform educational information into a basis for the reform of educational policies and practices. Objective and data-based argument is not arbitrarily judged to be a superior means of analysis to anecdotal, personal, and subjective argument. It is deemed, however, to be a prerequisite to the application of the manager's or other decisionmaker's personal and subjective views. Without objectivity, data, and logic, no complete and open discussion of present conditions and future alternatives can occur.

No system of applying logic or intuition can guarantee that "truth" will be discovered; however, the approach posed here maximizes the probability of a "correct" decision by increasing the basis for discussion and democratizing the access of participants to the discussion. The use of data and logic is not a substitute for the experience of managers but is a necessary complement in the effort to make educational decisionmaking more effective.

Finally, educational managers must receive training in the application of skills,concepts, and logic to the requirements of their jobs. This training takes place best on-the-job and can consist of on-going counterpart relationships or of recurrent reviews of decisionmaking. In either case the objective of the training is to stress alternatives and justification. What are the alternative sources of data used, why were some selected and others not selected, and why was the data interpreted in the way it was? The discussion of these points increases the managers' sensitivity to the existence of alternative sources, procedures, and conclusions through demanding that the managers be able to justify their decisions.

Managers who realize that their decisions must be justified will be more careful and deliberate in making decisions. The training process must guard against excessive delays caused by concern that decisions will be criticized during review. Two points must be established within the organization in this regard. First, a decision must be

judged in terms of the time frame allowed for the decision. A quick imperfect decision often will be preferable to one which is the "right" decision but is derived too late to be implemented. Second, the organization needs to limit personal accountability for the effects of decisions. Except in cases of direct culpability because of individual carelessness or lack of effort, the decisions made should be seen as a product of the decision system and therefore a responsibility of the organization and not just of the individual.

Given the current nature of decision practices in most countries, the latter requirement will not be fully realized. The use of individual scapegoats to deflect criticism from the organizational unit (or from the government) remains a bureaucratically and politically popular technique in both developing and developed nations.

However, to the extent that data and logic allow past decisions to be justified and the decision process to be democratized, it will be more difficult to assign fault for bad results to a single individual or unit. This process of facilitating decisionmaking is itself facilitated if senior administrators and, in the case of government, politicians also have been exposed to the benefits of using data and logic in the ways proposed here.

Finally, as with all education, training of managers is not a finite but a recurrent (if not constant) activity. The information system must be designed so that increased training allows the managers to alter their information demands and so that changes in data availability or information technology can encourage new forms of training. Information quality and decision-making quality should be allowed to improve concomitantly; an imbalance between the two will result in a negation of the quality of either kind.

III. CONSTRAINTS ON AND FACILITATORS OF EFFICIENCY ANALYSIS USE IN EMIS DEVELOPMENT

To understand the policy relevance of efficiency analysis it is necessary first to understand the role that efficiency analysis can play in the EMIS operations of an educational institution or system. Four alternative situations may occur from the collection and assimilation of educational data within an efficiency framework. First, the analysis may be used to evaluate existing policies and practices and to develop new ones. Second, it may be used to support policies and practices that already have been determined bureaucratically or politically. In this second instance, efficiency analysis use would not affect educational activities immediately or directly. When results reinforced what the senior decisionmakers wished to do anyway, the results would be used. In such cases, all data and analyses are valued not in terms of their ability to inform new decisions but in terms of their ability to justify existing ones.

Third, efficiency analysis and data may have no effect at the level of policy or practice other than to be added to the educational data base. In this situation, senior decisionmakers are unconcerned with the data results, whether the results are favorable or not. However, the data and analyses still have the potential to affect individuals' perceptions at the technical and lower administrative levels of the institution or system. Fourth, the data and analyses may be ignored at both the decisionmaker and technician levels. This situation often will lead to the discontinuance of efficiency analysis and of the supportive data collection and assimilation functions. However, the inertia of some EMIS structures is such that it is not impossible that efficiency data, like much current education data, will continue to be collected (and even reported) without any evidence of its being applied to any purposeful outcome.

The question of which of these four situations will occur in a given country or educational institution is a function of the relative strength of the constraints on, versus the facilitators of, efficiency analysis within the EMIS. Ultimately, all data and information use will be determined by the characteristics of suitability (relevance to perceived issues), understandability (the capacity of decisionmakers to comprehend the data and information), accuracy (the degree to which the data and information correspond to other indicators of reality, internal consistency, and past predictive value), and timeliness (the temporal correspondence of availability with need). For efficiency analysis results, four main constraints and four main facilitators have been identified that will affect the perceptions of these characteristics by decisionmakers.

A. Constraints

The first and most serious constraint on the use of efficiency analysis within an EMIS is the lack of understanding by decisionmakers of the terms, concepts, and decision criteria used in such analysis. Although based on logical decisionmaking models, efficiency analysis appears intimidating to those unfamiliar with its specialized terminology. Only through decisionmaker training, of the types described above, can this constraint be overcome. Obviously, to achieve the desired participation in training one will have to overcome reluctance on the part of decisionmakers to engage in such training. The high opportunity costs of their time and their own initial inability to value the possible benefits will discourage the willingness of some individuals to participate in such training.

To overcome this second-order constraint will involve a marketing effort on the part of the agencies or organizations that desire such training. This marketing effort will be supported by some of the facilitators to be discussed later. However, in developing nations, national planning units and donor agencies can combine efforts to encourage greater receptiveness to the training opportunity; the first to produce the demand on EMIS operations to use efficiency analysis and the second to provide scarce resources

and training opportunities. Increasing the ability of decisionmakers to understand efficiency analysis will enhance greatly the probability of its incorporation within the EMIS and its use in determining future policies and practices.

The second major constraint on efficiency analysis within an EMIS is the cost of data collection and assimilation. Those efficiency measures that depend upon qualitative or observational techniques will be especially hard to justify for systems with a shortage of data system resources. The solution is that each EMIS must begin with a core set of measures emphasizing those cost and effectiveness indicators that are affordable within its budget. The initial emphasis should be on the easily quantifiable and immediate versus the qualitative and distant. But it should be recognized that this system is a foundation for the EMIS, not the capstone. As soon as possible, a set of recurrent, observational studies of specific problem areas should be initiated as a parallel activity to the basic educational census.

The core EMIS information can be supplemented further by special studies of cost and effects of programs that require immediate attention but do not require or justify recurrent study. Project analyses would be an exemplary case of such studies.

In every case, a cost-utility analysis must underlie each decision to add, maintain, or delete a form of data or analysis within the EMIS. The administrative head of the EMIS, supported by an advisory committee consisting of information technicians and educational decisionmakers, ultimately must be the locus of responsibility for this cost-utility analysis. Such analyses also can be the basis for requests for additional funding of the EMIS.

The third constraint on the use of efficiency analysis within an EMIS is the concern over suitability, accuracy, and timeliness of efficiency information. As the discussion on cost and effectiveness measures illustrated in detail, the more suitable the efficiency measure, the more problems it may pose in terms of accuracy or timeliness. The closer a cost or effectiveness measure approaches a conceptual ideal the more difficult it may be to operationalize and to measure accurately and the more time its collection and assimilation are likely to require. The result of this condition is to reduce the ability of efficiency analysts to justify their results to other educationalists.

Once again there is no facile solution. The analyst must balance the utility of a more sophisticated and precise measure of cost or effectiveness against the disadvantages in terms of (1) financial expenditures on collection, validation, processing, and interpretation and (2) time delay from the request for information until it is available. Efficiency analysis is unique in this regard. It not only provides a basis for organizing an EMIS by specifying types of data that ideally should be selected, it also provides

criteria for devolving from the ideal to what is practical given an EMIS organization's human, physical (equipment and facilities), and financial resources.

The final major constraint on efficiency analysis is the concern over redistribution of organizational power. This is a special case of the general data phenomenon that as data increase, those who control and/or understand the data gain influence. This can be manifested in terms of both a horizontal and vertical restructuring of power. Horizontally, a director of educational statistics may increase his or her influence at the expense of directors of other "line" divisions within an organization (the latter would be the heads of such units as primary education, teacher training, and vocational/technical programs). If the other directors do not have the skill to assess data and to summarize and interpret data reports, these officials will have a less effective impact on the decision process within their organization.

The result may be that the interest of the units headed by these directors will be less well represented. In the short run this could lead to greater dependence on those quantitative measures that are the common products of statistical units; in the long run the effects will be to undervalue all experiential and qualitative insight and to elevate the head of the data unit to a position of "first among equals" if not to a de facto superiority over the other directors.

Vertical realignments of power can be caused to the extent that data--and especially data generated by efficiency analysis--is understood by junior administrators but less well understood by their superiors. The senior officials, if they are not able to ignore such data, may become increasingly deferential if not overtly dependent on their subordinates to explain the data and analyses and for guidance in extracting recommendations. This process of dependence may be gradual but will culminate in the creation of a technocratic level within the organization that has an influence on the final decisions that far exceeds that indicated by the placement of the technocrats within the organizational chart.

B. Facilitators

To offset the influences of these constraints, four specific facilitators of increased use of efficiency analysis have been identified. The first, and least subtle, is the self-interest of the units who collect and assimilate data. The vested interest of such units is to increase the demand for and use of their production. These units, and their personnel, normally will be a constant source of lobbying efforts to promote a greater role for all data in the educational unit's or system's decisionmaking processes. There is no stronger indicator of bad management than a statistics unit that passively awaits requests for data or suggestions of new types of data that may be generated. While one appropriately may be suspicious of excessive self-promotional zeal on the part of data

units, excessive passivity is an issue of even greater concern. The ideal situation is a data unit that hopes to expand its influence by improving the characteristics (applicability, understandability, accuracy, and timeliness) of the educational information it produces while showing appropriate responsibility in terms of data costs.

A more generic facilitator within educational organizations of the use of efficiency analysis is the desire for managers to have a means to depersonalize the decisionmaking process. As was explained earlier, bureaucratic systems have evolved patterns of individual responsibility for bad decisions as a means of protecting the credibility of the overall bureaucracy. However, the individual decisionmakers can attempt to protect themselves only by presenting evidence that they based their decisions on accepted data and decision criteria. Thus, the increased availability of data facilitates this depersonalization of culpability.

The third facilitator is related to the above in that it is characterized by the tendency of decisionmakers to promote creation of a common data base for decisions. The advantage for such a common data base is that it facilitates more general participation in decisions while focusing the discussion on data interpretation. Rather than having five different opinions on the probable number of students or of the ratio of boys to girls, the debate can concentrate on the meaning for policy and practice of the accepted figures on enrollments and gender proportions.

Finally, an important impetus toward efficiency analysis specifically and better data generally is the need for the EMIS to attain or maintain parity with other information systems. This need can be formalized by government as in the case where the agency responsible for national planning sets data requirements for all administrative units in government. Alternatively, the pressure may be less formal but equally powerful if the education unit or ministry finds itself at a disadvantage in policy or finance debates because of the lack of persuasive efficiency data comparable to that possessed by competing units or ministries. The international agencies, especially UNESCO, have had a role in the past in promoting standardized data collection. If such agencies increased the relevance of these standard systems by reorganizing them around the efficiency principles, the systems could be disseminated widely with a significant positive effect on individual national data operations.*

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* The potential for such reorganization was reflected by the degree of interest in the recent OECD conference on educational indicators (Washington, D.C., November 3-6, 1987). The range of views presented are suggested by the papers presented by the U.S. Department of Education, C.E. Finn, Jr., T.N. Postlethwaite, A. Purvis, and K. Eide.

The net effect of the aforementioned constraints and facilitators of efficiency analysis within EMIS structures will vary from nation to nation and even among educational units within a single nation. However, the overall trend is clearly discernible: the educational data base is increasing in quantity and quality and so are the information processing systems. The ultimate constraint and facilitator is the nature of human capacities: the capacity of the information technicians to improve the four characteristics of their data and its affordability and the capacity of decisionmakers to use the data effectively. Ultimately, these capacities will determine the structure of the overall EMIS and the role of efficiency measures and indicators within it.

In the next section a brief summary of the earlier discussions will be presented. This will be followed by a list of general recommendations that deal with how national governments and donor agencies can increase the role of efficiency analysis in the review and formulation of educational practices and policies so as to promote greater individual benefits and enhanced systemic efficiency.

CHAPTER SEVEN

SUMMARY AND PROPOSALS

I. SUMMARY

For a variety of cultural and political reasons most education and training programs have been organized as public or private non-profit activities. The goals of these activities are rarely clearly specified, if even defined, and, in any case, may be expected to vary depending upon the interests of the multiple stakeholders in the human resource development enterprise. Moreover, there remains a limited understanding of the objective functional relationships that exist within and among the four stages of educational production -- inputs, process, outputs, and outcomes.

The result of the imprecision in the knowledge of goals and the inadequacy of the understanding of the individual educational variables and their compound relationships is to make management of education an exceedingly difficult task for the student and parent, for the institutional administrator, and for the public planner or policymaker. Because most educational decisionmaking is conducted in a context of diffuse and uncertain incentives, educational management has been characterized by a lack of consensus as to goals and standards. All educational managers operate in an environment that subjects them to short-term political and social pressures that may compromise their attempts to achieve long-term resource utilization, socialization, and human capital development goals. The current problem in education, in both developed and developing nations, is not just the present state of systemic ineffectiveness in the accomplishment of goals and the common inefficiency in the use of public and private resources. The greatest source of concern should be that there are so few current incentives that will encourage managers and users of education to improve the system and its individual institutions.

The concern over this issue is great for two reasons. First, education and human resource activities are, next to police and defense operations, the single largest category of public expenditure in most countries and an increasingly important part of private expenditure in many countries. The current size of the expenditure on education will be under great pressure in the remainder of this century both from population increases and demands for more and better trained workers. The extent of the social demand effect is indicated by statistics such as those from Africa that project that, in the next two

decades, 110 million new students will have to be absorbed by educational systems that already have been overextended by the 50 million new students of the last two decades.*

The second source of concern relates to the potential effect of continued educational inefficiency on the operation of the economies and societies in the developing world. Much of the economic, social, and political progress of the last quarter-century exists on an extremely fragile base. More than any other social institution, education will determine whether that base is reinforced or eroded. Improvements in the quality and the equality of educational opportunities in the developing world can be assured only by efficiency enhancement activities.

Every human resource system has three financing alternatives when faced with increasing social and economic demand (Windham, 1986). These are: (1) to obtain new levels and sources of funds; (2) to accept poorer quality and/or reduced access; and (3) to increase the efficiency with which existing and future resources are used. The first alternative will not be available in many countries and almost all developing nations will find the increase in resources over the next quarter-century to be less than commensurate with the demands placed on the educational system. The second alternative is explicitly unacceptable but implicitly utilized by an increasing number of nations who are politically pressured to allow social demand for education to expand beyond the level where quality of instruction can be maintained or equality in access promoted further.

If the first alternative is unavailable and the second should be unacceptable, then efficiency enhancement activities cease to be simply a means of controlling costs and become instead the central organizing operations for the planning, delivery, and evaluation of education and training programs. Only by emphasizing more efficient use of present and future resources (financial and human) can educational systems provide more and/or better opportunities for personal and social improvement. A delay in implementing efficiency reforms will not simply increase the problem, it will reduce significantly the probability that the problem can be solved. The risk is not just that funds will be wasted or that government budgets will be strained; a failure of the education system that is concomitant with the current high level of social and economic

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* Durujki (1978) notes that: "To force the pace of educational development leads to one absolute certainty. Standards of scholastic attainment begin to fall and continue in a downward trend until, paradoxically, education for all becomes education for none."

aspirations of parents and children can lead only to economic disfunction and social distress. These dire warnings are not the products of the generic pessimism of the economist's "dismal science;" rather, they are a simple extension of phenomena that already may be perceived in the large majority of developing nations in Asia, Africa, and Latin America.

Also, it should be stressed that it will not be appropriate for the developing nations to await models and examples from the developed nations before beginning efficiency reforms. The wealthier a nation, the more foolish and wasteful it can afford to be. The inefficiencies in education in developed nations are more politically tolerable because these nations both have more financial resources (current and projected) with which to disguise their inefficiency and lower social demand pressures (because of slower population growth) that would expose the inefficiencies.

Developing nations will have to establish the examples of efficiency enhancement that eventually will be copied by the developed nations. This makes the marketing of efficiency proposals more difficult since developing nations are more accustomed to importing rather than exporting social experiments. Also, the developing nations have a legitimate basis in their historical experiences for distrusting attempts by developed nations to test reforms in the developing world that they are not willing to test in their own societies. These barriers to efficiency enhancement are real but must be overcome. Most difficult, these barriers must be overcome before the educational situation deteriorates beyond what even efficiency reform can do to salvage it.

The major purpose of this monograph has been to provide a context within which debate, planning, and monitoring of efficiency reforms can take place. In addition to introducing the economic terms and concepts related to educational production and efficiency, an attempt has been made to discuss the state of policy analysis concerning many of the variables, measures, and standards presented. As noted in the original introduction, this presentation has attempted to balance the apparent precision of economic theory with the complexity and uncertainty of administrative practice. While the result may involve a sacrifice of both some of the more refined aspects of economic theory and the details of daily educational administration, some individuals still may question the need for the degree of both abstractness and complexity that remain. The simple fact is that the major barrier to efficiency analysis does not lie in mastering the supportive economic concepts. These concepts -- and the derived terms and models -- are generally logical and easy to master; anyone not willing to make the effort to master them deserves to be disqualified from a major decisionmaking position in education.

However, the true complexity of efficiency analysis originates in the nature of education itself; specifically, the variety of types and levels, the extraordinary variability among determinants and effects, and the requirements for subjective

judgment conducted within a context of multiple stakeholders with differing and, at times, mutually exclusive goals and values. The presentation here has been designed to clarify the use of the economists' concepts, terms, and models and to explain the inherent complexity of educational decisionmaking and the appropriateness of subjective judgments. Educational decisionmakers cannot avoid responsibility for the judgments they make concerning educational costs and effects; however, by using the efficiency tools presented here they can minimize the arbitrariness of their decisions and assure themselves of being able to provide a clear, if ultimately subjective, rationale for the decisions that have been made.

The discussion of the research literature has been designed to characterize what educational researchers believe they know about educational production and efficiency. The criticisms presented of this research have had the purpose of emphasizing the more "efficient" alternatives for research designed to promote efficiency enhancement in education. Efficiency research must be planned and judged by the same standards of cost containment or effect maximization that the researchers apply to the educational system itself.

In summary, the efficiency concept has been asserted to be a useful metaphor for educational analysis even though educational activities have few characteristics that are analogous to the technical production systems that originally gave rise to efficiency concepts. Applied to education, the efficiency metaphor cannot be used to create a self-regulating, self-sustaining set of controls similar to those of classical competitive economic markets. In education, in both the public and private sector, efficiency analysis must be incorporated as a device for bureaucratic or individual decisionmaking. In both the bureaucratic and individual case, there are three requirements for effective decisionmaking: (1) training in decisionmaking logic generally and in efficiency analysis specifically; (2) improved information on educational costs and effects; and (3) the promotion of sets of incentives that encourage the use of both better decisionmaking skills and the improved information.

For individual decisionmaking the incentives already exist in terms of the individual's self-interest. These incentives will be increased as more countries choose or are forced to implement more user-financing of education. Improved bureaucratic incentives are more difficult to generate or promote. However, as the financial and human resource problems of nations increase with time and senior policymakers themselves become more sensitive to the issues of efficiency, the bureaucratic incentives for the use of better decisionmaking skills and improved educational information should be realized.

As this discussion has stressed, the current interest in efficiency issues will not prove to be a transient phenomenon in educational planning and management.

Although the efficiency concepts have sometimes been misapplied and resistance to them -- for the wrong reasons -- continues, the efficiency approach to education offers the most inclusive and articulate means of designing and evaluating plans, operations, and proposed reforms of education at both the system and the institutional level. Economists and financial analysts will have no license to impose their opinions on curriculum specialists, trainers, teachers, or administrators but all of these individuals should be under increased responsibility to present justifications for their activities within the framework of probable costs and effects. Such analysis must shift from an ad hoc condition to a prerequisite for consideration or continuation of an educational activity. A cooperative and supportive relationship should develop between the efficiency specialist and the educational professionals with residual differences more a matter of variant conclusions than of disparate assumptions.

It has been asserted here that the efficiency principles are a singularly appropriate means for organizing the training of decisionmakers and the design and operation of educational management information systems. This was done in full recognition of the limits on the proper definition and measurement of many of the efficiency concepts in terms of education variables. Also, it has been stated here that the more refined and conceptually appropriate an educational efficiency variable becomes, the more difficult the variable will be to operationalize and to interpret. The conclusion reached is that efficiency analysis is a cumulative process that can provide some immediate answers but has its greatest value in providing better long term answers as efficiency information evolves. Supporting this point is the equally important assertion that educational efficiency analysis must be based on multiple indicators. Multiple indicators of efficiency allow for an internal check of quality and interpretability and at the same time are responsive to the varying perspectives of multiple stakeholders in the educational process.

The efficiency approach will require a change in how educational decisionmakers are trained and how educational data are collected and used. While tradition and ease of collection will always be legitimate considerations, educational management information systems must be reoriented more away from the interest of data collectors and to the needs of data users. The principles of efficiency analysis, as discussed here, can help assure that this happens.

The preceding is presented as background for three major proposals for the restructuring of educational management and decisionmaking. The proposals that follow are not revolutionary but they are designed to accelerate the evolutionary process engendered by the current fiscal and human resource problems faced by so many countries.

II. PROPOSALS

The research, training, and operational alternatives for advancing the role of efficiency analysis in educational management have been summarized as three major proposals:

1. Training and upgrading of beginning middle-level and senior educational decisionmakers in decision-making principles and in the necessity for and the means of operationalization of efficiency analysis in educational management;
2. Establishment and monitoring of effectiveness and efficiency benchmarks within educational institutions and systems; and
3. Development and maintenance of an educational management information system based on the principals of efficiency analysis.

While detail in these proposals will depend upon the needs and resources of a specific national context, the discussion here will stress the generic framework for each of the three proposals. Also, the relationship among the three proposals will be emphasized. The implementation of a single proposal or any pair of proposals will not have a proportional impact on improving educational management. The proposals are designed to be considered and initiated together.

The issue of the training and upgrading of educational decisionmakers was raised earlier within the context of the administrative capacity discussion. While individual decisionmaking practices of students, parents, and community members in education are of equal importance, the greater feasibility for reform lies in dealing with administrators of the educational bureaucracy. In most countries these individuals control financing and personnel decisions and have a significant constraining or facilitating effect on curriculum and classroom practice.

As mentioned earlier, this training should incorporate both the general principles of improved decisionmaking and the specific concepts of efficiency analysis applied to education. The training program should be organized around four major sets of activities.

First, pre-service training for all educational personnel should include an introduction to basic efficiency concepts and a justification for their central role in educational decisionmaking. This pre-service training would create a common basis for discussion of efficiency issues among teachers and between teachers and administrators. Second, all school and institution or program administrators should receive more advanced training in efficiency analysis as a prerequisite or a concomitant requirement to their assuming new administrative responsibilities.

Third, regional and central middle-level administrators should receive special detailed training in efficiency concepts, decisionmaking, and the use of educational data. Normally, this training should take place at the work site and result in the minimal disruption of ongoing work responsibilities. When time and other resources permit, training of middle-level administrators can involve more extensive three- to six-month courses of full-time training.

Finally, the fourth form of training will involve the most senior decisionmakers in the education and related human resource, planning, and finance ministries or agencies. Here, the focus is less on the details of efficiency analysis and more on the justification for increasing the focus on efficiency principles in their evaluation of reports and proposals prepared by the middle-level administrators subordinate to them.

Various donor agencies have conducted many administrator training programs and some, especially USAID and the World Bank, have promoted efficiency approaches in their administrator training programs. The immediate need is for the collection and integration of these training experiences as a basis for designing a standard set of training curricula for each of the four levels of training.

A joint effort by donors to assist in the design and implementation of such training can be tailored to individual country needs through the participation of host country personnel. The training programs should be closely coordinated with those agencies responsible for educational data collection and policy formulation.

The establishment and monitoring of efficiency and effectiveness benchmarks would appear to be a simple and obvious proposal. However, educational programs and projects often proceed without operational criteria by which the program or project can be judgged to have succeeded or failed. Understandably, there is a normal bureaucratic reluctance to establish performance standards and a preference to state long-term goals and even short-term objectives in the generalized language common to national planning documents.

The danger of operating any system without established standards and benchmarks is quite serious. Problems are not normally detected until an ad hoc review or examination of the system is conducted. Thus, errors or inefficiencies can continue for a substantial time and, most serious of all, become part of the accepted administrative practice of the enterprise. Also, ad hoc assessments or evaluations will not lead to the needed reforms unless part of the reform is the establishment of benchmarks to allow evaluation of the reform effort itself.

Because of the inevitable bureaucratic reluctance to expose programs to review and evaluation, reform can only come through a commitment of the most senior officials of

a system or organization to this new means of operation. Evaluation must not be viewed as a forensic exercise designed to identify culpability and assign blame; rather, it should become a standard procedure for identifying a means for improving the operation of the enterprise and for assigning responsibility for the reform. One of the most difficult tasks that will be faced by those advocating efficiency reforms for developing nations will be the need to reorient evaluative activities from backward-looking investigations of what went wrong to forward-looking examinations of alternative opportunities for improvement. To achieve this will require that the reformers overcome aspects of both bureaucratic tradition and normal human psychology.

Any establishment of educational benchmarks must begin with selection of what are called "objectively verifiable indicators." These are quantitative measures designed to indicate the nature of change, its direction, and extent. A simple example would be female enrollment statistics. Over time or from place to place one can compare the change in enrollments in terms of both their direction and size. A slightly more sophisticated measure dealing with the same topic would be the percentage of female enrollment. As opposed to simple enrollment, the later measure will indicate the change in female enrollments relative to changes in the enrollments of their male counterparts.

This example should suggest two further considerations. First, no system of benchmarks can be meaningful in evaluation unless the original assessment created baseline data to which the later benchmarks may be compared. Even in donor-financed educational projects, where great attention normally is given in the planning and decision process to establishing verifiable standards, the necessary baseline data collection often does not take place during the complex activities of initiating the approved project. Thus, when interim evaluation efforts begin, the evaluators find they have no baseline standard with which to compare their benchmarks. A cynical interpretation would be that the purpose of discussing objectively verifiable indicators is to obtain project approval not to institute an actual monitoring process of project accomplishments. A more generous interpretation would be that external authorities, the funding agency, and/or the government unit responsible for project implementation must take greater responsibility for assuring that evaluation considerations are part of any project's initial concerns. If this is not done, the immediate organizational priorties of project managers will dominate those of their administrative superiors who are responsible for the wider concerns of ultimate project efficiency.

The second further consideration is that the comparison of benchmark with baseline data is only the beginning, not the end of evaluation. This is true in all evaluation but is an especially important point in efficiency analysis. Efficiency evaluation will depend on multiple indicators, on measures of both costs and effects, and will always require a subjective interpretation of the data before policy conclusions

can be reached. It is critically important that the efficiency benchmarks not be used to create a mechanistic evaluative process wherein an educational institution or regional unit has its success or failure measured by a single rate or ratio or even by multiple indicators. The indicators and the analysis are not the same phenomenon; the link between the two is the conceptual understanding the decisionmakers have of the educational process and the values they apply to the data in reaching policy conclusions.

An inherent part of the policy process should be the periodic review and modification of benchmark data. As a data system and its users become more mature, more complex interaction statistics can be introduced. The actual progress of a system will depend on where it begins (in terms of data quality and decisionmaker capacities), the resources made available, and the importance assigned by decisionmakers to efficiency considerations. While substantial variation will occur from nation to nation, Table Twelve presents three possible levels of development the baseline/benchmark system might follow. These stages are not fixed in their detail nor would they necessarily be distinct in their implementation. The initial degree of efficiency detail will be a function of the state of development of the existing educational data system.

The benchmark system will be organized around seven sub-categories of data:

- Student characteristics
- Teacher and administrator characteristics
- Curriculum and educational materials
- Facilities and equipment
- Attainment and achievement data
- Education and training outcomes
- Costs

In the progression from Level I to Level III the data will increase in coverage, accuracy, and interpretability (and, if the EMIS is successful, in timeliness). The interpretability gains will occur in part because of a greater capacity to assimilate data through comparison and contrast of data sets. For example, gender ratios can be combined with teacher characteristics by region and across time to provide a basis for discussions of coincidental effects and possible causality (e.g., more women teachers may encourage greater attendance and retention of female students).

The rate of increase in detail and coverage between levels of development will vary among the seven categories of data. In most countries student, teacher, and administrator data will be emphasized while in others the focus may be on costs or on facilities and equipment utilization. While variation in rates of change in the seven data groups is unavoidable it still is a matter of concern. For example, if cost detail exceeds

TABLE TWELVE

LEVELS OF DEVELOPMENT FOR SYSTEM OF EFFICIENCY-BASED BENCHMARKS

LEVEL ONE

1. Student Data
   - Enrollment by school
   - Gender ratios
   - Progression rates (aggregate only)
2. Teacher Data
   - Distribution by qualifications
   - Distribution by location
   - Student-Teacher ratios
3. Curriculum/Educational Materials
   - Textbook availability
   - Regional and size-of-place distribution
4. Facilities/Equipment
   - Number of "complete" schools
   - Students per school
   - Students per class
5. Attainment/Achievement
   - National examination pass rates
   - Promotion rates
6. Outcomes
   - No data
7. Costs
   - Teacher salaries by qualifications
   - Aggregate budget data
   - Cost per student by level of education

LEVEL TWO (All Level One data plus the following)

1. Student Data
   - Gender data cross-tabulated with size-of-place and region
   - Ethnic distributions
   - Detail by level and type of program
   - Separate repetition and attrition rates
   - Age distributions
2. Administrator and Teacher Data
   - Qualifications distribution including specializations

(*continued on next page*)

(*Table Twelve continued*)

- Age and experience
- Distribution by location
- Students per administrator
- Turnover rates and incidence
- Absenteeism

3. Curriculum/Educational Materials
   - Textbook availability and utilization
   - Availability of support materials
   - Status of curriculum development and dissemination
4. Facilities/Equipment
   - Facilities utilization by level and type of program
   - Equipment availability
   - Distribution of special use facilities
5. Attainment/Achievement
   - Examination scores and pass rates cross-tabulated with student and school characteristics
   - Attainment distributions by student and school characteristics
   - Promotion rates by student and school characteristics
6. Outcomes
   - Earnings data from public employment
   - Employment data (aggregate) by level of education
   - Tracer studies of secondary school and higher education graduates
7. Costs
   - Ingredients approach cost calculated for each level and type of program
   - Unit and cycle costs for all programs

LEVEL THREE (All Level One and Two data plus the following)

1. Student Data
   - Subject or course specializations
   - Attitudinal and behavioral measures
   - Time utilization
2. Administrator and Teacher Data
   - Time utilization
   - Training needs
   - Interaction with community
   - Job satisfaction

(*continued on next page*)

(*Table Twelve continued*)

3. Curriculum/Educational Materials
   - Knowledge of curriculum by administrators and teachers
   - Users' evaluations of curriculum and materials
   - Evaluation of alternative instructional technologies
4. Facilities/Equipment
   - Equipment utilization
   - Needs analysis
   - Maintenance and replacement projections
5. Attainment/Achievement
   - Determinants of educational outputs
   - Determinants of inequalities
   - Analysis of high- and low-achieving schools
6. Outcomes
   - Net present value estimates by level and type of education
   - Studies of graduate attitudes and behaviors
   - Job search rates by level and type of graduate
7. Costs
   - Detailed cost analyses of major programs and alternative technologies
   - Cost projections by level and type of education

information on input quality or on output and outcome effectiveness, this condition can give rise to serious efficiency misinterpretations. The goal of the data benchmark system should be to emphasize a balanced development across the seven data categories so that comparability in detail, coverage, and accuracy promote improved interpretability for policy purposes of the total data system.

Data detail also may be expected to vary by level and type of education or training. Because of the increased level of operating expenses, one may expect a greater availability of cost detail to emerge in the higher education and vocational training subsectors. Because of the political and social importance of concerns with basic educational opportunity, measures of gender, ethnic, size of place, and regional equity in access and retention may be collected in greater detail at the preprimary and primary educational levels. However, even these patterns of data detail by level and type of education will vary from country to country.

The timing of the benchmark system illustrated in Table Twelve also may be expected to vary according to resource availability. Benchmark data will depend most heavily on the annual educational census. Special data collections will coincide with the mid-term and inter-term national planning cycles. In addition to these major activities, the benchmark system can gain supplementary detail from special studies conducted by government and/or donor personnel as part of project planning and evaluation activities. As the earlier discussion of educational process measures illustrated, the introduction of recurrent "special studies" on education (involving both observational and longitudinal studies) also can be a factor in enriching data detail available for educational decisionmakers.

The level of development of the benchmark system should determine the nature of the aforementioned decisionmaker training programs. However, the relationship between data development and training should be such that the training anticipates the increases in future data sophistication. An extra benefit of training that assumes or anticipates improved data is that it will give rise to a demand for such data by facilitating its eventual use.

The creation and development of an efficiency benchmark system have an enormous potential for increasing the sophistication and professionalism of educational decisionmaking processes in developing nations. However, host country personnel are likely to remain skeptical about the benefits of efficiency benchmarks until they see donor projects applying such benchmarks to themselves. It is a matter of special concern when government and donor projects that proselytize efficiency enhancement operate without clear standards for their own effectiveness or cost and effectiveness benchmarks for their own operations.

The final proposal derived from this discussion of efficiency analysis is to advocate creation of an efficiency- based educational management information system. The major types of data to be included in such an EMIS are indicated in Table Thirteen. The data types are organized in terms of the four parts of the educational production process. The development of the efficiency-based EMIS will parallel the three levels discussed above for the efficiency benchmarks. Once again, the state of data development at any point in time for a given nation will be a function of the financial and human resources devoted to the EMIS. In turn, the amount and quality of these resources will be a function of the policy importance assigned to the joint efficiency tasks of cost containment and effectiveness maximization by politicians and by senior policymakers in the education and human resource sector.

The efficiency-based EMIS can only be properly understood within the structure of decisionmaking that is common to the public and private education sectors. This decisionmaking process has five main stages. First is the analysis of the current status of existing policies and practices. Second is the specification of current plans. Third is the identification of currently unmet needs and of emerging problems. Fourth is the drafting of proposals for new policies, practices, or plans. Fifth is the derivation of the required changes in organizational structures and incentives and in the quantity and quality of resources. The last is basically an analysis of the financial consequences of the proposed modification in policies or practices or of the implementation of newly planned educational initiatives.

The EMIS, to be efficient itself, must be able to provide decisionmakers with the data, information, and even analysis that is required during each of these five stages. To fulfill this responsibility, seven steps will need to be followed in evolving from the existing data system to a fully operational, efficiency-based EMIS. These steps are the following:

1. Assess current data collection and assimilation activities in terms of their coverage relative to users' expressed needs and EMIS specialists' recommendations and the adequacy of current levels of data quality (accuracy, timeliness, and interpretability) given present and projected uses of the data;

2. Identify priority needs for new data by comparing projected requirements for data with current status and planned changes;

3. Conduct a cost analysis of new data ingredients with an emphasis on marginal costs of differing data amounts, types, and quality;

4. After using the foregoing to justify supplemental budget requests, analyze how the budget for the EMIS should be allocated;

TABLE THIRTEEN

SUMMARY OF INDICATORS FOR AN EFFICIENCY-BASED EMIS SYSTEM

I. INPUTS

A. Teacher Characteristics
- Formal educational attainment
- Teacher training attainment
- Age/experience
- Attrition/turnover
- Subject specialization
- Ethnicity/nationality
- Subject mastery
- Verbal ability
- Attitudes
- Availability measures

B. Facilities
- School size
- Classroom size
- Students per school
- Students per class
- Classrooms per school
- Classes per classroom
- Availability of special-use facilities
- Utilization of special-use facilities
- Condition of facilities

C. Equipment
- Availability
- Utilization
- Condition

D. Curriculum/Educational Materials
- Availability of textbook and support materials
- Utilization of textbook and support materials
- Articulation of curriculum
- Dissemination of curriculum

E. Administrative Capacity
- Educational attainment
- Administrative training
- Age/experience
- Organizational context and incentives

(*continued on next page*)

(*Table Thirteen continued*)

II. PROCESS
- A. Administrative Behavior
  - Frequency, extent and purpose of external administrative visits
  - Frequency, extent, and purpose of internal administrative visits
  - Nature, frequency, and result of contact with community
- B. Teacher Time Allocations
  - Administrative tasks
  - Instructional tasks
    1. Preparation
    2. Instruction
    3. Review
    4. Remediation
  - Monitoring and evaluation
- C. Student Time Allocations
  - Time on-task
    1. Interaction with teacher
    2. Interaction with peers
    3. Interaction with materials and equipment
  - Time off-task

III. OUTPUTS
- A. Attainment
  - Progression rates
  - Attrition rates
  - Repetition rates
- B. Achievement
  - Examination results
    1. Absolute levels
    2. Averages
    3. Scores relative to other groups
    4. Mastery levels
    5. Achievement gains
    6. Effect sizes
  - School grades
  - Attitudes and behaviors (to be specified and measured for each form)
- C. Equity Effects
  - Range

(*continued on next page*)

(Table Thirteen continued)

- Quartile deviation
- Mean deviation
- Standard deviation
- Distribution among criterion levels
- Lorenz curves
- Gini coefficients
- Group differences

IV. OUTCOMES

A. Admission to further study

B. Achievement in further study

C. Employment

- Initial occupational choice
- Lifetime occupational choice
- Aggregate employment rates
  1. Level
  2. Rate and direction of change
- Job search periods
  1. Extent
  2. Results

D. Earnings

- Initial
- Lifetime probabilities
- Hedonic and equalizing effects

E. Attitudes and Behaviors

- Social responsibility
- Social views and opinions
- Political orientation
- Consumer behavior

F. Externalities

- Increased social mobility and social inclusion
- Change in distribution of earnings and income
- Changes in personal values
- Improved political participation
- Reduced unemployment
- Improved mix of manpower skills
- Enhanced productivity of physical capital
- Increased quantity and quality of research

5. Do annual follow-up analysis of actual data use and identify parts of the EMIS that are underutilized and develop appropriate remedial systems (encouraging more use of the data by social marketing, reducing frequency or extensiveness of data collection, or considering termination of data collection);

6. Develop and implement a means for promoting incorporation of special studies, recurrent analyses, and products of project or program assessments and evaluations into the EMIS structure; and

7. Develop and implement a dissemination plan for the full EMIS that will include the aspects of promoting improved training for educational decisionmakers and establishing efficiency-based benchmarks for all major educational projects or programs.

Once initiated, this seven step cycle should become a recurrent process with ongoing considerations of the cost versus effectiveness of alternative data forms, data quality, report formats, analytical approaches, and dissemination strategies. The maintenance and improvement of the EMIS requires a proactive stance on the part of the EMIS professional staff and administrators.

The status of EMIS development will be the ultimate determinant of the detailed nature of the two other proposals made here for decisionmaker training and establishment of efficiency-based benchmarks. Neither of the other proposals will be any more successful than the EMIS system permits and encourages it to be. It was asserted earlier that for full effectiveness these three proposals must be considered as aspects of a single strategy. At the heart of this strategy, however, is the assumed availability of efficiency data. Thus the EMIS proposal can be fully justified only if both the training and benchmark proposals are implemented concomitantly; however, if a choice must be made or a priority assigned, the emphasis must be on design, implementation, and proper management of an efficiency-based EMIS.

For donors, these three proposals are congruent with three major strategies currently pursued in the education and human resource sector. These are the support for cost containment, the facilitation of widened financial responsibility and greater individual decisionmaking, and the promotion of bureaucratic decentralization of responsibility and authority. The efficiency enhancement proposals presented here are convergent or directly complementary to each of these and the increased efficiency of the education and training activities of the nation will be systematically supportive of the goals of these donor strategies. More important, the efficiency enhancement approach will allow individual nations wider alternatives for what can be done for and by their citizens both within and outside of the education sector.

In the poorest countries the efficiency approach will help stave off the most dire consequences of fiscal constraints and accelerating social demand. In the more advantaged nations the efficiency approach can mean the difference between a degeneration to educational inadequacy and a progression to educational significance in affecting social and individual development. The ultimate product of all efficiency reforms will be judged finally by what happens in the classroom and in the individual student's success or frustration in learning. The purpose of the macro-oriented proposals here for training, benchmarks, and an EMIS based on efficiency analysis is to promote long-term, micro-educational improvements at the level of the school and classroom. The ultimate goal is to assure efficient classrooms--classrooms efficient in providing cognitive and noncognitive learning opportunities in an equitable manner.

By promoting the better use of existing resources and improved plans for procuring and utilizing future resources, education can be transformed from a teacher employment and student containment system to the human resource development system that both the producers and users of the system want it to be. Without efficiency standards educational programs have no clear incentives to promote their success. The proper use of efficiency standards in educational management will promote improved accountability of administrators and more effective utilization of all resources. By avoiding mechanistic and pseudo-objective approaches and by accepting the proper role for subjective judgment in educational decisionmaking and debate, efficiency enhancement ultimately will lead to the enhancement of life chances for individual students, of greater professional satisfaction among teachers and administrators, and of expanded social and economic development opportunities for the nation.

The need now is to proceed with the debate, in a country- specific or even region-specific context, as to what measures, indicators, and standards of efficiency are suitable for each level and type of education and training. Recurrent assessment of these efficiency issues will assure that the debate over educational efficiency encompasses concerns with the widest possible range of goals and means of the educational process. As the debate continues, one can not just hope, but expect, that the better questions asked of education now will yield better answers in the future.

APPENDIX

STATISTICAL MEASUREMENT OF EQUALITY

In this appendix a brief discussion will be presented of some of the alternative statistical measures that can be used to quantify the distribution of educational outputs or outcomes. As noted in the text, however, these statistical measures of equality can be interpreted in terms of equity ("fairness") only by the application of value judgements to the quantitative indicators.

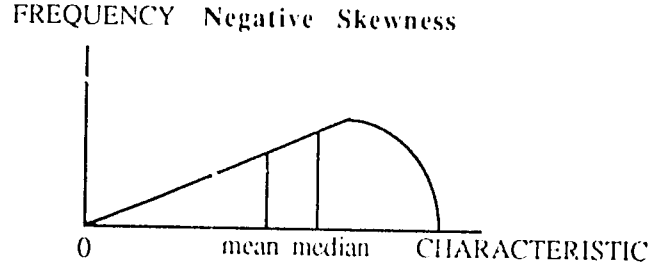
The first of the statistical measures of equality is the range of the distribution. Simply defined, the range is the difference between the largest and smallest values in a distribution. While useful in comparing variability between or among groups, the fact that range deals only with the extreme values of a distribution makes it an unreliable indicator for distributions that involve a small number of observations. However, even in sets that involve a large number of observations, a single extreme value (called an "outlyer") can cause the range measure to misrepresent the extent of the actual variation. For example, one could have two distributions of achievement scores with the identical range values of 20 to 100. However, in one distribution, achievement scores could be spread equally across the distribution while in the second, one person could have scored 20, another person could have scored 100, and all of the other persons could have scored between 65 and 70. The range measure is useful in identifying extreme values but, by itself, does not serve as an adequate indicator of the underlying distribution between the extreme values.

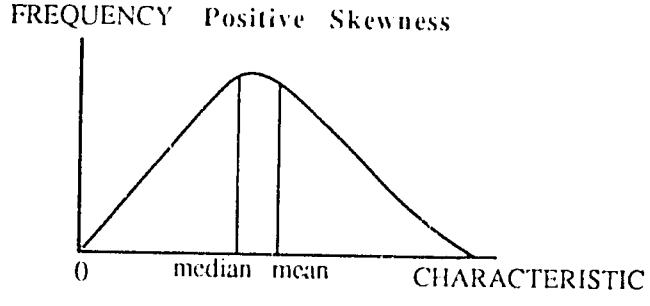
The quartile deviation measure of variability attempts to correct for some of this weakness in the range measure; the quartile deviation is equal to one- half the distance between the 25th and 75th percentiles in a frequency distribution. The 25th percentile (first quartile) of the distribution is that value below which 25 percent of all values lie. Similarly, the 75th percentile (third quartile) is that value below which 75 percent of all values lie (and above which 25 percent of all values lie). The quartile deviation measure emphasizes the 50 percent of scores that surround the median (the second quartile). Since it measures the average distance of the quartile points from the median, it is a better measure of score density than is the range. Also, when a distribution is asymmetrical ("skewed") the comparison of the quartile deviation measure with the median can indicate the direction and amount of skewness.

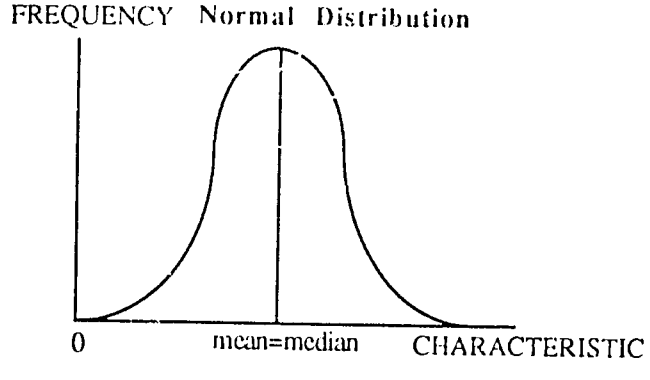
For example, assume a distribution in which the first and third quartile values are 30 and 60 respectively and the median (second quartile) value is 50. The quartile deviation measure is 45 which indicates a probable negative skewness (the mean value for the middle 50 percent of the distribution normally will be to the left of the median value since the range of sub-median values -- 30 to 50 -- is greater than the range of super-

APPENDIX FIGURE ONE

SKEWNESS AND NORMALITY IN DISTRIBUTIONS OF CHARACTERISTICS







median values--50 to 60). If the median value were below 45, positive skewness for the middle part of the distribution probably would exist.*

Appendix Figure One indicates the shape of three distributions: one with negative skewness, one with positive skewness, and one with a normal distribution (no skewness). Note that in the case of the normal distribution the quartile deviation measure, the mean, and the median are all identical.

Both the range and quartile deviation measures are unsatisfactory for many uses because they ignore a substantial number of the values in the distribution (the range ignores all but two values and the quartile deviation measure ignores fifty percent of the values). To improve on these estimates of variability, two further statistical measures have been developed: the mean deviation and the standard deviation. The mean deviation is the mean of all of the deviations of individual values in a distribution from a measure of central tendency (usually the arithmetic mean although it could also be the median or mode). For example, if you have a set of five scores 15,12,10,8, and 5, the mean is obviously 10: $\frac{15+12+10+8+5}{5}$.

The deviation of the individual values from the mean are +5,+2,0,-2, and -5. Summing the deviations without regard to positive or negative sign gives one 14; dividing the sum of the deviation by 5 (calculating the mean of the deviations from the mean of the distribution) gives 2.8 as the mean deviation. In a normal distribution the mean deviation will demark the middle 57.5 percent of all values. A large mean deviation value implies greater variability around the measure of central tendency and a smaller value indicates less variability. It is important to note that the mean deviation is based on all values in a distribution and that all values are weighted equally.

The standard deviation is the most common measure of variability used in research. It is like the mean deviation in that it incorporates all values of the distribution but, unlike the mean deviation, it weights extreme values more heavily than others. This difference in weighing results from the fact that calculation of the standard deviation involves taking the square root of the mean of the square of all deviations. In our

* Because the interquartile generation of the quartile deviation measure involves only the middle fifty percent of values, it theoretically is possible that the probable skewness discussed here may not be reflected in overall measures of the distribution. For example, the quartile deviation measure could equal 45 and the median equal 50 (as in the first case given here) but the mean of the full distribution could be greater rather than less than the median because of a higher incidence of extreme values in the top quartile as opposed to the bottom quartile.

earlier example, the deviation values of 5,2,0,-2, and -5 would become 25,4,0,4, and 25; the mean of these squares would be 11.6: $\frac{58}{5}$ and the standard deviation would be 3.43 (the square root of 11.6). The standard deviation is the measure of variability with greatest reliability (it is less affected by sampling errors) and offers a balance between the range's emphasis or extremes and the quartile deviation and mean deviation emphasis on central values. In a normal distribution a single standard deviation above and below the mean will delimit the middle 68.26 percent of the distribution. Since the standard deviation also is a required component of correlation analysis, it has achieved the aforementioned position of predominance in research. However, all the measures of inequality mentioned here have legitimate uses and the selection of a single statistical measure must be determined by the nature of the underlying distribution and the policy issues one wishes to address.

A more mundane but, at times, appropriate measure of inequality is simply to study a distribution in terms of the incidence (in numbers or percentages) of values relative to certain criteria levels. In education, for example, it is common for teachers to assign letter grades for certain test score levels. One example would be the following:

A	(Excellent)	=	94	-	100
B	(Above Average)	=	86	-	93
C	(Average)	=	66	-	85
D	(Below Average)	=	55	-	65
F	(Failure)	=	0	-	54

Obviously, the linkage of letter grade to score is arbitrary (although some teachers may determine the numerical values through an assumption that the realized test scores will approximate values from a normal distribution) as are the parenthetical value statements next to the letter grades. Sometimes, test results or other scores are divisible into only two classes--pass or fail--with mastery scoring being a special case of such a binary scale.

The point is that once a criteria is created, the distribution of values within the criteria categories becomes a legitimate measure of variation. For example, if a school has a 70 percent pass rate this value can be contrasted with a school goal, past school performance, or the performance of other schools. It is important to recognize that measures of variability in such standards of achievement involve an explicit use of subjective judgement. While all of the equality measures discussed here will require subjective interpretation when applied to policy determination or evaluation, the interpretation of assigned letter grades and similar standards will require subjective interpretation of a measure that is itself subjectively determined. This does not

disqualify the use of these standards as indicators of educational effectiveness but it does suggest that special caution be applied when using them.

The next measure of inequality is a diagrammatic rather than statistical one: the Lorenz curve. Lorenz curves indicate the cumulative incidence of some characteristic relative to the cumulative incidence of the units of observation. Originally derived to study income or earnings inequality, the Lorenz curve compared the cumulative incidence of income or earnings with the cumulative incidence of population. As indicated in Appendix Figure Two, the cumulative percent of income is measured on the vertical axis and the cumulative percent of population is measured on the horizontal. It is common to measure the population incidence from poorest to wealthiest as one moves from left to right on the horizontal axis. Thus, the Lorenz curve of a distribution must always fall on or below the diagonal (the curve would be on the diagonal only in cases of absolute income equality) and be concave to the diagonal.

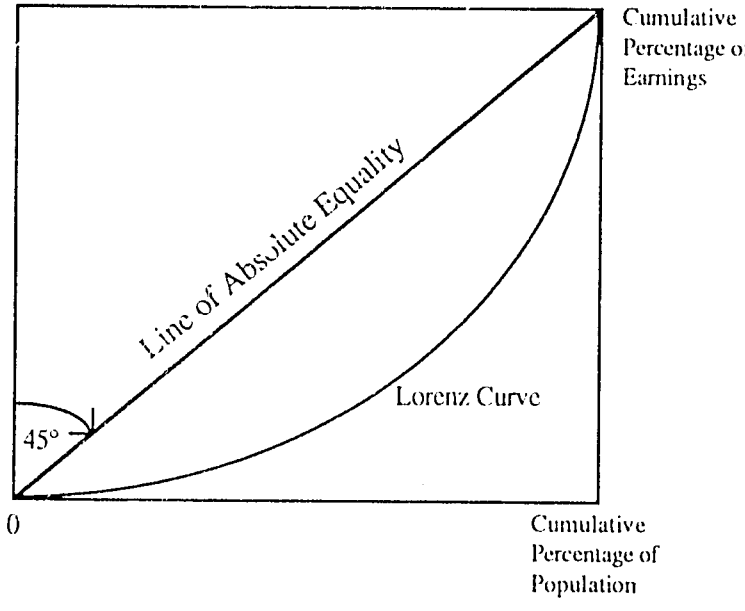
In brief, the Lorenz curve indicates the percent of total income held by various units of the population. For example, except in cases of absolute equality, the poorest 10 percent of the population (on the extreme left of the horizontal axis) must have less than 10 percent of all income and the wealthiest 10 percent (on the extreme right) must have more than 10 percent. The extremes of the curve must touch the opposite diagonal corners of the rectangle since zero percent of the population will have zero percent of the income and 100 percent of the population must have 100 percent of the income.

A single Lorenz curve can be evaluated in terms of its position relative to the 45° diagonal. The closer the curve is to the diagonal the greater the degree of equality, the more distant the curve is from the diagonal the more unequal the distribution. When two or more Lorenz curves are presented in the same diagram it is possible to compare them in terms of relative equality. The curves closer to the diagonal are always the more equal in their distribution of the characteristic being examined.

Lorenz curves have been adapted for a variety of uses in education. The units of observation can be individual students, classrooms, schools, geographical regions, etc. and the characteristics can be any of the input or output measures discussed here or the outcome measures discussed in the succeeding session. Cohn (1979) indicates an adaptation of the Lorenz curve for school finance analysis. He presents the percent of students ranked by wealth relative to percent of total school expenditure on students. This is not a "true" Lorenz curve, however, since the characteristic measured (expenditures) is not the same as is used for the ranking of the students (district wealth).

APPENDIX FIGURE TWO

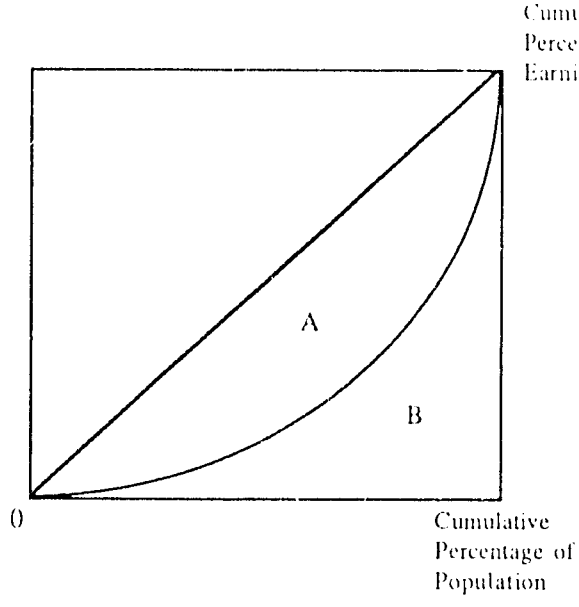
Lorenz Curve of Earnings



Another example of a modified Lorenz curve would be to rank schools by expenditure and relate this to cumulative achievement measures. As in the Cohn example (where one is testing the relationship of wealth to expenditure), one is comparing a determinant (school expenditure) to an effect (achievement). *

It is always preferable to use a more traditionally determined Lorenz curve (where the characteristics used for measurement and ranking are the same) where possible because it increases the ease and clarity of interpretation. One may expect that the most common use of Lorenz curves in educational analysis will continue to be for comparing earnings differences of different educational groups or cohorts.

The final statistical measure of equality to be discussed is the Gini coefficient. The Gini coefficient was derived as a means of expressing numerically the relationships indicated by the Lorenz curve. Gini coefficients should only be used for "true" Lorenz



curves (where the characteristic of incidence is the same as the criteria used for ranking the units of observation) and normally is not appropriate for adaptations of the type made by Cohn.

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* Heyneman and Loxley (1983A) indicate how Lorenz curves can be applied to educational quality/educational achievement analysis among groups.

The Gini coefficient represents the ratio of the area between the Lorenz curve and the diagonal to the area bounded by the diagonal and the lower horizontal and right vertical axis. In the diagram on page 175, the coefficient would be equal to A divided by A+B.

Since the value of A + B is constant for any given Lorenz diagram, the change in the size of A (the total area separating the curve from the diagonal) will determine the size of the coefficient. The further the curve is away from the diagonal, the closer the value of A approaches A+B, and the closer the coefficient value is to 1.0 (absolute inequality). The closer the curve is to the diagonal, the lower the value of A, and the closer the coefficient value is to zero (absolute equality). Thus, a low coefficient value denotes greater equality and a high value denotes greater inequality.

The Gini coefficient can allow for comparison of a larger number of distributions at once and is not limited by the problem of space that one faces trying to draw multiple Lorenz curves in a fixed diagram size. As a result, Lorenz curves now are used more for pedagogical than analytical purposes in the study of inequality.

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This selective, albeit extensive, bibliography is indicative of the range of materials reviewed in the preparation of this document. Because the primary audience for the monograph is not the academic community, citations in the text have been kept to a minimum. However, the preparation of this bibliographic listing is intended to indicate the extent of the debt to, and the degree of influence exerted by, the educational and economic research communities.

It should be noted that the IEES Project is listed as "author" of a series of reports and monographs. The reader should understand that the project is inclusive not just of its four member institutions (Florida State University, Howard University, the Institute for International Research, and the State University of New York at Albany) but incorporates the full membership of its professional counterparts in the member nations (Botswana, Haiti, Indonesia, Liberia, Nepal, Somalia, and the Yemen Arab Republic). The majority of IEES documents are recognized as official government reports in the nations in which they were produced.

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