Instructions

Economic Evaluation of Education Projects

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ECONOMIC EVALUATION OF EDUCATION PROJECTS

Instructions

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PREFACE

This course is based primarily on a workshop titled "Educational Costs, Efficiency and Sector Strategy" sponsored by the Agency for International Development (AID) in February 1984. Participants in the workshop included managers, evaluators, and training officers in AID. The success of the workshop confirmed the need to appreciate and understand economic evaluation of educational programs for a larger audience in AID. This self-study course is the product intended to satisfy that demand.

Relevance of the Subject

Whether we like it or not, we are constantly facing situations of limited resources. We always want more than our resources permit. Thus choices have to be made. In development we are constantly required to make choices among proposed projects, to decide whether projects should be continued, and to decide what projects should be replicated.

How do we go about making these choices? Choices can be made based on political, social, and economic reality. Further, decisions about projects can be based on political, social, or economic evaluations. Both political and social evaluations are important, but are beyond the scope of the self-study course. In this course we will focus on the economic aspect of the evaluation process.

The importance of economic evaluation can be illustrated with an example. Given two programs which are designed to enhance the managerial skills of small business owners, the effect of Program A on the small business owners seems to greater than that of Program B. Should we then <u>automatically</u> choose Program A over Program B?

The answer is an emphatic NO. Even though the impact of the programs has been considered, we still need to consider the program costs and then evaluate them accordingly. First, we must determine whether the costs of Programs A and B are within the budget (this will require a cost-feasibility analysis). Second, we must determine which of the two programs produces the greater result for the lower cost (a cost-effectiveness or cost-benefit analysis will address this question). That is the essence of economic analysis of educational programs.

In most developing countries the demand for educational interventions is increasing and the funding is decreasing. Given this situation, it is critical to have the ability to analyze costs as we assess and evaluate education programs and projects.

Although economic evaluation is the focus of this course, it should never be thought that economics is the only factor in evaluating projects or programs. It is only one of many factors that must be considered. Attention should always be given to the needs of the specific country, political contraints, and overall development goals.

As we will emphasize throughout the course, we must remember the limitations of cost analysis. No mechanical process or criterion can replace informed judgment. Listed below are criteria that must be considered in selecting the best alternative. Note that cost analysis covers only a few concerns in the selection process. In some decision-making processes, cost-effectiveness, cost-benefit, or cost-utility analysis may be the single most important criterion. However, the weight given to each factor will vary from country to country, sector to sector, and project to project.

Some Criteria for Selecting Among Alternative Projects

- problem is a "critical" one
- number of poor people affected is large
- number of people affected is large
- geographic area affected is large
- project will increase income
- project will increase employment
- project will increase productivity
- project will enhance general public welfare
- women's status will be enhanced
- project aims at institutionalization and self-support
- project will maximize use of local institutions
- cost is low in relation to benefits that will accrue
- use of local labor is maximized; capital investment is minimized
- project falls within an overall national development plan of host government
- host government willing and able to fund at least 25 percent of project cost
- host government wants project
- target population wants project
- target population will actively participate
- impact on ecology and environment is minimal
- project will provide direct relief of people's misery

Determining Preferred Projects

Normally, a project is preferred which plans to achieve its purpose at the minimum total cost, with the maximum participation by host country counterparts and organizations. Sometimes a project purpose is economic; it is to achieve the maximum rate of return, or a minimum cost-benefit ratio. In such instances, the consideration of a discounted stream of cost and benefits may help to determine the most desirable project.

Many assumptions must be made about future cost, future benefits, the social and economic climate, and future developments in the international and national economies. Hence, calculated rates of return and predicted cost-benefit ratios themselves incorporate numerous assumptions. While economic projects should not be considered below some minimum calculated rate of return, it does not follow that projects which exceed the minimum or even higher rates will necessarily contribute to achieving AID development objectives. One should not draw a direct cause and effect relationship between a predicted low cost-benefit ratio and the achievement of AID development assistance.

By the time a project is proposed for financing, there is an implicit assumption that it represents the best alternative. In turn, it is assumed that addressing the problem represents the best alternative for fulfilling the overall development objectives. The country's CDSS and the U.S. Congressional Mandate for AID are basic policy guidelines for establishing objectives for selecting projects.

Basically, the designers or planners expect the project will result in certain desired changes in host-country development. Because of host-country socioeconomic uncertainties, and because there is no proven development theory on which predictions can be based, the designer must regard the design as a set of hypotheses, with reasonable probability based on cost analysis. The evaluator, in turn, attempts to validate or disprove these hypotheses. Objective evaluative data either reinforces confidence that the hypotheses were correct or provides an opportunity to revise them.

Need for Thorough Design

Design should be both thorough and rigorous. The feasibility and cost-benefit analyses must be nearly exhaustive. It is wasteful to devote a great amount of effort to project design, only to modify the project based on subsequent findings. Because resources for development are limited, it is important to be as careful as possible in laying the groundwork for a successful project, including thorough cost analyses. However,

since we cannot perfectly diagnose the present nor predict the future, we must learn as we go. Empirical knowledge, derived from careful evaluation beginning in the planning stage, is invaluable in conserving resources and avoiding problems.

Outline of the Course

GOALS

This course is designed to teach you the fundamental concepts and methods of economic evaluation. It will give you opportunities to make practical applications of the methods to development projects.

ORGANIZATION

The course will be organized into two parts. The first part introduces basic economic concepts which will be essential for learning economic evaluation. These concepts focus on the cost aspect of evaluation. We will go over the different modes of cost analysis, namely cost-benefit, cost-effectiveness, cost-utility, and cost-feasibility. We will then bring in the ingredient approach to gain some understanding as to how programs can be costed out in a systematic fashion.

The second section builds on the understanding of these concepts and also expands to include some finer points of economic concerns of educational evaluations. This section takes us through a few steps of the planning process and demonstrates how economic evaluation can assist several aspects of planning: sector assessments, cost-feasibility analysis, cost-effectiveness analysis, and cost reduction.

EXPECTATIONS

This is primarily an introductory course to economic evaluation of educational programs. Upon the completion of this course, you are expected to be educated consumers of this type of evaluation and informed decision makers, but you are not expected to be bona fide economists. In fact, you may not be called upon to complete this type of economic analysis but you undoubtedly will be supervising the work of a contractor who is doing it, writing a scope of work for an evaluation proposal, or working with a host country counterpart to interpret an assessment. Those of you who have economic training might find the materials relatively easy, but the course will help you articulate the issues of economic evaluation more succinctly, especially to people who have no formal training in the field.

APPLICATIONS

Even though this course focuses on economic evaluation of educational programs, the material covered is easily transferable across social programs. The conceptual framework of cost analysis is readily applicable to the evaluation of projects in health, agriculture and other areas of economic development with little or no modification in the methodology.

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Melanie Sanders, MA

ACKNOWLEDGMENTS

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We wish to thank those who have allowed us to include their works in the course either in whole or in part. They include Victor Cieutat, Gary S. Fields, Henry M. Levin, Robert W. McKeekin, Robert G. Myers, and Donald R. Winkler.

Important assistance with the computer software came from Jose Dominquez-Urosa of the World Bank, and Jim Defay.

At AID we wish to thank Jim Hoxeng, Charles Reed, and Max Williams for directing and reviewing the project. At Pragma, Carol Pearson was a constant source of encouragement and sound advice. And for varying degrees of editorial and secretarial assistance we wish to thank Caroline Curtis and Keri Merritt.

STUDENT INSTRUCTIONS

The "Economic Evaluation of Education Programs" course materials come in three additional sections: (1) Part I: Cost Analysis Concepts, (2) Part II: Cost Analysis in Educational Planning, and (3) the instructions for the computer software. A copy of Henry M. Levin's book Cost Effectiveness: A Primer is also a part of the course and can be found in the plastic envelope in the binder. In addition, your mission will receive a video cassette with an introduction to the course and a software package for financial analyses to be used with Lesson 6. Please see the videotape before proceeding with the course; the manual will instruct you when to use the software.

The course is self-contained--all the information you need to understand the concepts will be sent to you. The manual will instruct you when to use the Levin text and when to return to the manual. Lessons are arranged either with questions at the end of the chapter or interspersed throughout. When questions occur within the text of the chapter, rather than at the end, they will be presented as Set A, Set B, Set C, etc. Answers will be listed at the end of the lesson, using the same order. This system has been used to divide the longer lessons into more workable segments.

Work at your own pace, aiming for 50-65 minute segments if possible. Except for the two essay questions, all the work will be self-graded. The sample answers are intended to give a basic correct response to the question. There can be some variations. However, if you find that your answers are not along the same general lines as the sample, or are quite obviously in error, please go back and review the material suggested. If you still have problems you may:

a. consult with others at your mission who are taking the course;
b. consult the glossary at the back of this pamphlet; or
c. use the "Request for Help" forms contained in the side pocket of the binder.

When an answer is described as subjective, it means that there is a broad range of possible correct answers and that your own experience and judgment are required to find an appropriate answer.

You will be required to answer two essay questions, one after Part I and the other after Part II. These are the only questions that will be mailed in for formal grading, but feel

free to communicate with us any time you have a question. The essays are not intended to be "closed book" exercises, but to encourage you to combine your own practical knowledge and experience with the material you have learned in the course. They are meant to be challenging, comprehensive, and broad enough to stimulate your memory and your interest. Please photocopy your answers and keep one copy on file in case of a problem with the mail. Pre-addressed envelopes are provided for mailing the essays.

The reviewer will make a careful evaluation of your essays and return them to you. Be sure, therefore, to include your name and pouch address on the essays. Please mail the first essay immediately after completing it.

There is no fixed date for completing the course; however, we recommend that it be completed in six months. If after one year's time the course has not been finished, we will presume that you do not intend to complete it. Upon completion of the course, you will be issued a "Certificate of Study".

You may keep all the materials in the binder including the Levin book, but the video cassette and the computer software are the property of the Mission.

We hope you find the course informative, challenging, and enjoyable.

ESSAY ASSIGNMENT 1

Introduction

You are a member of a special advisory committee for the Prime Minister of developing country X. The Office of the Prime Minister contracted an international consulting firm to undertake a comprehensive study on the issue of educational investment. Now that the study has been completed, an executive summary of the full report has been circulated among the committee members. You are asked by the Prime Minister to prepare a brief paper of eight to ten pages, double-spaced and typewritten, to comment on the assumptions, interpretations of the facts, and the policy recommendations of the report.

The Executive Summary

In order to compare the profitability of the educational investment with other social investments, the consulting firm has elected to use internal rate of return (IRR)* as a yardstick. The following table is a summary of their IRR findings of different levels of education as compared with other developing nations and other advanced, industrial countries.

Average
IRR to Different Levels of Schooling
(1975-1983)

	Private Returns			Social Returns		
	Prim.	Sec.	High	Prim.	Sec.	Higher
LDC X	29	19	24	27	16	13
Other Developing	20	17	17	16	14	10
Advanced	NA	14	12	NA	10	9

From the summary table, the firm goes on to make the following policy recommendations:

1. Top priority should be given to primary education since the social rate of return is the highest among the three levels of schooling.

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* The IRR's take into account unemployment rates both in foregone earnings and potential future earnings.

2. The IRR's of secondary and higher education are above the "average" rate of return of 10 percent to physical investment, thus secondary and higher education are also socially profitable investments and should be pursued along with primary school expansion.

3. A large discrepancy still exists between the private and social returns to investment in higher education. Since there is a greater private return at this level, it is recommended that there be a greater private investment in higher education. It is thus recommended that a tuition fee should be imposed on those in higher education and less public funds be invested in higher education.

Scope of Assignment

You are specifically asked by the Prime Minister to revie the recommendations of the consulting firm relative to hi concerns. If you think that the recommendations of th consulting firm are noteworthy, substantiate your arguments. I the concerns of the Prime Minister are still valid in light c the IRR data, please state explicitly the problems with th recommendations. The Prime Minister's major concerns are liste as follows:

I. He is especially puzzled by the fact that while the current unemployment rates are high for graduates of all levels, and particularly high among illiterates and primary school graduates, the IRR has remained relatively high and stable over the years. Thus he questions the utility of using IRR as a yardstick to judge the future investments in education. Should society give top priority to financing primary education in the future, given the social rate of return to primary education is the highest among IRR's to other levels of schooling?

II. He is concerned with the different utility of IRR to individuals and to society. You are asked to articulate the differences in the individual and social perspectives.

III. Even if the "average" rate of return to physical investment is about 10 percent, should society single-mindedly invest in education in the pursuit of economic development? Why or why not?

IV. Both developing and advanced nations have undergone a massive expansion and popularization of education in the past few decades. The social rates of return to

different levels of education have not improved at the same magnitude as the expansion. Does that mean a massive investment in education will not always result in drastic improvements in the rates of return and consequently the profitability of social investment in education?

V. Does the large discrepancy between private and social rates of return to higher education justify the imposition of tuition fees on college students?

VI. It is observed that the general level of education in advanced countries is higher than that in the developing ones. Does this reinforce the argument that top priority should be given to educational investment if "economic development" is to be pursued?

You should remember that how you address the assignment will depend on your definition of "economic development". Therefore it is important for you to define economic development as precisely as possible so that it will be clear to the reader what your assumptions and premises are. In addition, please state your arguments succinctly and logically. Where possible, cite principles that we have covered in the course and cite your reference sources.

ESSAY ASSIGNMENT 2

Purpose

To make a practical application of cost-effectiveness analysis. You will complete an exercise in analyzing the cost effectiveness of alternative teacher-training projects.

Objectives

To become familiar with one way in which cost analysis can be applied to your work. To achieve this end, you will consider a case study. The objectives of the case study exercise are:

1. to increase understanding of cost-effectiveness concepts and their applicability in the education sector, and

2. to provide experience in discounting, adjusting costs and relating costs to non-monetary indicators of benefits or effectiveness.

Instructions

This exercise presents information on two alternative teacher training projects in a hypothetical country. Tasks required are to identify the costs of each, adjust the costs to reflect the true value of foreign exchange, and calculate the present value of the cost streams. The exercise then calls for comparing the projects on the basis of costs per unit of output. Submit a copy of your memorandum to the course instructor. The memoradum should be from eight to ten pages in length.

COST EFFECTIVENESS ANALYSIS OF ALTERNATIVE TEACHER TRAINING PROJECTS

R.W. McMeekin
International Bank for Reconstruction and Development

One of the more flexible and useful economic tools is cost-effectiveness analysis, which can be applied to compare alternative investments (projects or programs) even though their "products" cannot be measured in monetary terms. This exercise illustrates an application of cost-effectiveness analysis: a comparison of alternative teacher training projects.

Exercise

You are a member of a project preparation mission to the Republic of Erehwon. Among other problems common to low-income countries, Erehwon has an acute shortage of trained primary school teachers. At present, the shortfall is made up by untrained teachers--often dropouts with only nine years education or less--who have temporary appointments in the teaching service.

The Government has indicated its interest in a project to expand teacher training and eliminate the shortfall, currently about 5,000 teachers but projected to reach 7,000 in a few years. Earlier efforts toward developing a project have not produced agreement on the nature and magnitude of what is needed.

The main problem is a controversy within the Ministry of Education. The Primary Education Division recommends an in-service upgrading scheme that will improve the skills of the untrained teachers and begin to have an impact within three years. The Teacher Training Division, however, insists that what is needed is a new teacher training college to augment the existing colleges, which are already overcrowded.

Your mission is to review the project proposals the two agencies prepared and recommend which project design should be chosen. You are to conduct a project analysis and indicate which project is more cost-effective, using the attached materials.

RELEVANT EXCERPTS FROM THE MOST RECENT WORLD BANK COUNTRY ECONOMIC MEMORANDUM FOR EREHWON

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16. There appears to be no change in the conditions that have resulted in a shadow price of foreign exchange well below its true scarcity value. Current analyses indicate that the premium on foreign exchange should be approximately 50 percent. Predictably, this imposes a serious drag on efforts to stimulate exports. For purposes of investment analysis, it would be desirable to adjust foreign exchange costs upward by 50 percent in order to give a realistic picture of costs and benefits associated with an investment....

(Review on shadow price: When the scarcity of foreign exchange is below its true scarcity value, it means that the value of the local currency set by the Government of Erehwon is above the true value recognized by international financial community. For example, an item to be exported has a price tag of 100 Erehwon dollars. At the official exchange rate set by the government it will cost, for example, $10 U.S. But the true value of 100 Erehwon dollars might only be $5 U.S. Therefore, at a price tag of $10 U.S. set by the official foreign exchange rate, the price of Erehwon goods is not attractive in the world open market. Predictably, this will impose a serious drag on export efforts. To reflect a realistic picture of costs and benefits of an investment in a world market, we need to adjust the foreign exchange rate accordingly.

***

21. In spite of high unemployment and widespread poverty in the rural areas, the investment climate in Erehwon continues to be favorable. Recent studies of private investments in agro-industry, light industry and service enterprises indicate real rates of return on the order of 15 percent. This is consonant with prevailing interest rates in Erehwon's investment capital market, after adjustment for inflation.

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47. The problem of declines in educational quality, as indicated by scores on the national examination to enter Grade Seven, is most probably due to the prevalence of untrained teachers (17 percent of the primary teaching force and increasing). Output of trained teachers is limited by two factors:

(a) limited intake capacity at the Teacher Training Colleges (TTCs), and
(b) limited candidates of good quality to enter teacher training after grade nine.

Untrained teachers are hired from among the Grade Nine completers who fail to qualify for Grade Ten academic places.

EREHWON
MINISTRY OF FINANCE

MEMORANDUM

nuary 4, 1982
le Ref: FPS/2/764/002

From: Permanent Secretary, Ministry of Finance

To: Permanent Secretary, Ministry of Education

Subject: Proposed Teacher Training Project

I understand that there is a professional difference of opinion over the design of a teacher training project. As you know, a mission will arrive soon to complete the project preparation phase. It is embarrassing to this Government for the mission to find that there is still no agreement between your Divisions on an approach to training teachers; an objective upon which I assume both agree.

The mission will conduct a project analysis when it arrives. In order to facilitate this, please have your Divisions indicate the main characteristics of their respective projects, their expected outcomes in terms of teachers prepared, and their costs. Please estimate, in addition, what portion of the capital or developmental costs will be paid in foreign exchange. Please submit to me by close of business on the 15th of this month (one week before the mission arrives) your summary statements. I implore you to be brief, but kindly substantiate your estimates or indicate what assumptions you have made in preparing them.

EREHWON
MINISTRY OF EDUCATION

MEMORANDUM

From: Director, Primary Education

To: Permanent Secretary, Ministry of Education

Subject: Proposed Teacher Training Project

In response to your request for information for a reply to t Permanent Secretary of Finance (FPS/2/764/002), I am pleased submit the following:

1. The project will involve in-service upgrading of over 8,0 untrained primary teachers now in service. Teachers will screened and selected for the course. They will spend thr years in training, leading to a full teachers' certificate. T components of the course will be:

(a) Vacation courses: for two of the three vacations each year, in-service trainees will spend a total of eight weeks at the teacher training colleges (empty during school vacations) receiving intensive face-to-face instruction in both substantive courses and teaching methods.

(b) Distance education: following the successful Lesotho model of in-service upgrading by radio, we will prepare and conduct additional instruction for teachers on the educational station of Radio Erehwon. We anticipate a technical assistance contract to help us plan the radio course and develop materials.

(c) Field observation, follow-up and evaluation: the supervisory staff of this Division will observe in-service trainees in their classrooms to see whether they are putting into practice the lessons learned. They will answer trainees' questions, provide advice and support, and ultimately provide field evaluation information to be used in certification.

(d) Assessment: at the end of the course, trainees will be assessed to see whether they are worthy of a full certificate.

2. We estimate that 85 percent of the in-service teachers will complete the three-year up-grading course. Table I spells out the numbers we expect to be involved in the project. A total of over 7,000 teachers will be trained, which corresponds to our estimate of the number of teachers who will be needed by 1992.

3. The in-service approach to meeting the urgent need for trained teachers has the following advantages over construction of another Teacher Training College:

(a) since there is no lag for construction, we will begin to benefit from the project sooner;

(b) costs are much lower; and

(c) the project can be varied in a very flexible way to meet changing needs.

TABLE 1

IN-SERVICE TEACHER EDUCATION PROJECT BACKGROUND DATA

Year	Enrollment a/	Completers b/	Development Costs c/ Local	Foreign Exchange	Sub-Total	Recurrent Costs d/	Total Costs
1983	-	-	100,000	200,000	300,000	-	300,000
1984	1200	-	300,000	150,000	450,000	960,000	1,410,000
1985	2300	-	-	125,000	125,000	1,840,000	1,965,000
1986	3320	1020	-	125,000	125,000	2,656,000	2,781,000
1987	3320	1020	-	125,000	125,000	2,656,000	2,781,000
1988	3320	1020	-	-	-	2,656,000	2,656,000
1989	3320	1020	-	-	-	2,656,000	2,656,000
1990	3320	1020	-	-	-	2,656,000	2,656,000
1991	3320	1020	-	-	-	1,840,000	1,840,000
1992	1200	1020	-	-	-	960,000	960,000
		7140					

a/ Assumes 3 years' training: two of three vacation periods each year (total of 8 weeks per year) will be spent at the Teacher Training Colleges; distance teaching will be provided by radio and correspondence; school inspectors will provide in-service observation, follow-up and evaluation, aided by senior certified teachers.

b/ Assumes 85 percent of the in-service teachers will remain in the program to completion.

c/ Major components of development costs: technical assistance for the distance teaching component (broadcast planning, materials preparation, administration); vehicles for in-service observation of teachers; radio receivers.

d/ Major components of recurrent costs: bonuses for TTC teachers who teach during vacations; payments to specialist consultants for vacation courses; distance teaching broadcast and materials costs, and travel. There are no significant foreign exchange costs in the recurrent costs.

EREHWON
MINISTRY OF EDUCATION

MEMORANDUM

From: Director of Teaching Training

To: P. S., Education

Subject: Documentation on Teacher Training College Project: Response to FPS/2/764/002

This Division feels strongly that the best approach to overcoming the serious teacher deficit and eliminating temporary untrained personnel from the teaching force is to increase capacity for pre-service teacher education. Accordingly we propose construction of a new TTC with capacity for 3,000 students (1,500 per year for the two year course).

By 1992, the Minister's target date for eliminating the deficit, this would produce over 10,000 teachers (see Attachment A). This would be sufficient to replace the untrained teachers as well as provide trained science and mathematics teachers to replace those certified teachers who are now teaching these courses without specific science and math qualifications.

We understand your concern about the high capital cost of another TTC. This construction is essential, however, because the existing institutions are seriously overcrowded and cannot be expanded. Attachment A shows the costs of this project with the detail requested by the P.S., Finance.

The TTC project is, we believe, preferable to an in-service upgrading project for the following reasons:

(a) The educational qualifications of entrants to the TTC will be far superior to those of the untrained teachers, who, for the most part, failed to pass the Grade Ten entrance exam (or the Grade Six exam!).

(b) The quality of the instruction in a two-year full- time course is much higher than 24 weeks of vacation courses plus radio teaching.

(c) The new TTC can focus upon training science and mathematics teachers, which is our most urgent need. The untrained teachers presently in the classroom do not have the educational foundation to become science and math teachers on the basis of in-service training.

In short, we would urge the P.S., Finance to take the higher quality of the TTC's outputs into account in weighing the two projects proposed.

Attachment A

CONSTRUCTION OF NEW TEACHER TRAINING COLLEGE ESTIMATED COST AND OUTPUTS

	Costs (in thousands of dinars)				Outputs	
Year	Total Capital Costs a/	(of which, foreign exchange)	Recurrent Costs b/	Total Costs	Total Enrolled	Number of Graduates
1983	3000	(1000)	-	3000	-	-
1984	5000	(2000)	-	5000	-	-
1985	1000	(750)	1875	2875	1500	-
1986	-	-	3750	3750	3000	1500
1987	-	-	3750	3750	3000	1500
1988	-	-	3750	3750	3000	1500
1989	-	-	3750	3750	3000	1500
1990	-	-	3750	3750	3000	1500
1991	-	-	3750	3750	3000	1500
1992	-	-	1875	1875	1500	1500
						10,500

a/ Capital costs have been estimated based on the costs of recently-constructed secondary schools of comparable size, with adjustments for full boarding facilities, different provision of science laboratories, and inflation.

b/ Based upon D1250 per student year. This is the approximate recurrent cost per student year at the existing Teacher Training Colleges (all local costs).

EREHWON
MINISTRY OF EDUCATION

MEMORANDUM

From: Chief of Planning

To: P. S., Education

Subject: Teacher Training Proposals from Primary and TT

There are several observations I wish to make on the submissions from Primary Education and Teacher Training.

First, I am concerned about the pay-off from the in-service project the Primary Education Division proposes. Can the untrained teachers improve enough as a result of the course to justify the project's cost? If not we will be stuck with them for fifteen or twenty years, drawing higher salaries and educating our children poorly. How well can the program evaluate what the teachers have learned?

On the other hand, the TTC project has very high costs and it is very traditional. Two problems bother me here: (1) entrants to the TTCs are themselves those who couldn't gain access to the Grade Ten Academic Stream, and (2) our research shows that about 30 percent of TTC graduates now fail to become teachers or leave after one year. They use the TTC certificate as a credential to get jobs as clerks. The untrained teachers will more likely stay in the rural villages where they were recruited.

The in-service project is modeled on the very successful Lesotho example. This is fine, but do our people have the capability to reproduce such a major project here? Can technical assistance fill the gap?

In summary, I have reservations about both projects. The Ministry of Finance will discount the costs and worry about premiums on foreign exchange, overlooking important points about quality and feasibility.

The Problem

1. Decide which proposed project should be selected.

(a) Assume that both projects have a ten-year life.

(b) Adjust for the premiums on foreign exchange by multiplying the foreign exchange component of each project by 1.5.

(c) Calculate the present value of the costs of both projects, using a 15 percent rate of discount. "Year 1" should be 1983.

(d) Consider the estimated benefits of the project and calculate the cost per unit of benefit of

- completers/graduates of the two programs,
- serving teachers, assuming 30 percent wastage after the formal Teacher Training program.

(e) Consider the effect on project selection of applying a weighted factor to take into account the qualitative differences between the two projects (e.g. increase the benefits of the formal training alternative by 50 percent, or double them to account for the greater value of science and mathematics teachers).

2. Be prepared to discuss this analysis. Do you think it is complete and persuasive? Are there other alternatives that should be considered?

GLOSSARY

accounting cost--the cost that appears either on the budget or in the expenditure statement. (See Lesson 3 in the manual.)

annualization cost--the true yearly cost of a good. (Lesson 4)

average cost--the cost per output. (Lesson 4)

capital cost--the cost incurred for goods and services having a useful lifetime that expands beyond the time of the purchase. (Lesson 4)

cash subsidies--monetary contributions to the project from sources other than the sponsor. (Lesson 5)

cost--the monetary values of all resources associated with any particular intervention. (Lesson 3)

cost analysis--a comparison of benefits (effectiveness or utility) to costs. (Lesson 1)

cost-benefit analysis (CB)--comparing interventions whose objectives can be readily converted into monetary terms. (Lesson 2)

cost-effectiveness analysis (CE)--comparing interventions with simple comparable objectives. (Lesson 2)

cost-feasibility analysis (CF)--method of estimating only the costs of an alternative to determine whether there are sufficient resources to implement the project. (Lesson 2)

cost-utility analysis (CU)--comparing interventions with multiple comparable objectives. (Lesson 2)

cost worksheet--a format for breaking down the cost of ingredients according the distribution of the cost burden, i.e., total cost, cost to sponsor, cost to other government agencies, contributed private inputs, and imposed student and family costs. (Lesson 5)

depreciation--the effect of a given period of use on the value of a good, often measured in terms of one-year increments; to arrive at a depreciation cost, divide the total replacement cost by the number of years in use. (Lesson 4)

discounting--the method for calculating the present value of a good. (Lesson 4)

distribution of cost burden--determing who will pay for each ingredient in a project. (Lesson 5)

distribution of outcomes--dispersing the overall results among the populations that are affected to see how each shares in the benefits and effects. (Lesson 6)

economic cost--monetary value plus the value of what is forgone by selecting a particular activity. (Lesson 3)

economic goods--resources in limited supply and with an unlimited demand for them. (Lesson 1)

economics--a social science that examines the rational behavior of individuals who interact through market exchanges. (Lesson 1)

economy of scale--when the fixed costs are utilized to their fullest. (Lesson 4)

estimation under uncertainty--where the ingredients under consideration (1) have values that are not based on any reliable standard; and (2) have a wide range of values. (Lesson 5)

equilibrium price--a price where the quantity demanded is equal to the quantity supplied. (Lesson 4)

elasticity--the impact that price has on demand for a given good. (Lesson 10)

experimental cost--value of the resources incurred during project development that will not be incurred during the full-scale project. (Lesson 3)

external efficiency--the suitability of curriculum to post-program activities, employment opportunities, advanced education and training, continual intellectual growth, and full participation in society as a concerned citizen. (Lesson 8)

fixed cost--costs that remain unchanged up to a very high level of output. (Lesson 4)

free goods--resources that are available in usable form and in sufficient quantity to satisfy all desires. (Lesson 1)

ingredient--individual resources needed for each component of the intervention. (Lesson 4)

internal efficiency--process-related elements; i.e., organization, scope and sequence of topics, and suitability of the content to the environment. (Lesson 8)

internal rate of return--the percentage increase or decrease in income which society realized on its investment in a given area. (Lesson 6)

marginal cost--the addition to total cost resulting from the addition of one more unit of input. (Lesson 4)

market price--the monetary value placed on a good or service when there is a perfectly competitive market for it. (Lesson 4)

merit goods--those products and services which are of inherent value to society and which merit scarce public resources because the private sector does not provide enough of them. (Lesson 1)

multiple outcomes--more than one result of the intervention or set of alternatives. (Lesson 6)

multiyear costing--estimating the cost of the project over several years, taking into consideration inflation and addition or subtraction of ingredients from year to year. (Lesson 5)

opportunity cost--the value of all the resources utilized had they been assigned to their most valuable alternative use. (Lesson 3)

optimization--achieving a solution in which cost is minimized and benefits are maximized. (Lesson 1)

<u>pareto optimal</u>--positive gains of individuals at the expense of no one else. (Lesson 1)

present value--current monetary value of a future stream of costs and benefits. (Lesson 4)

primary audience--the clientle who requested the information; generally, the decision maker. (Lesson 7)

quantitative efficiencies--measurable with numbers and most often related to student flow, i.e., repetition and wastage, student/teacher ratios, and the use of classroom space. (Lesson 8)

rational behavior--when consumers choose the most appropriate means to achieve given ends. (Lesson 1)

recurrent cost--expenditures that occur more than once during the life of the project, e.g., teachers' salaries, maintenance. (Lesson 4)

scarcity--a condition in which limited resources are in unlimited demand. (Lesson 1)

secondary audience--an additional group who will draw upon the analysis but will not be responsible for the decision. (Lesson 7)

sector assessment--a preliminary overview of needs of a sector to identify priority areas, obtain baseline information for more detailed analyses, and encourage coordination of assistance from all donors. (Lesson 8)

sensitivity analysis--considering the high, medium, and low cost estimates of an ingredient when a variety of estimates is proposed. (Lesson 5)

shadow price--the monetary value of an good or service that does not have a competitive market price. (Lesson 4)

utility rating--an assessment of the value, usefulness, or contribution to social happiness of the project. (Lesson 6)

utility score--a summary of utility ratings. (Lesson 6)

variable cost--a cost that depends on the size and scope of the project. (Lesson 4)

Part I

Economic Evaluation of Education Projects

Agency for International Development Washington, DC 20523

ECONOMIC EVALUATION OF EDUCATION PROJECTS

Part I
Cost Analysis Concepts

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LESSON 1
INTRODUCTION

OBJECTIVES

To demonstrate a relationship between the concerns of economics and the concerns of education; to understand the role of cost analysis in economics and in selecting education projects.

READING

Levin, Henry M. Cost-Effectiveness: A Primer. Sage Publications, 1983, pp. 10-17

Chapter 1 "Introduction to Cost Analysis'
* Purpose
* Goals
* Importance of Cost-Effectiveness Analysis

INSTRUCTIONS

Begin the lesson by reading "Introduction to Economics" in this manual. Next, turn to the reading in the Levin primer. Finish the lesson by completing the exercises at the end of the lesson in this manual. The answers follow the exercises.

INTRODUCTION TO ECONOMICS

Definition

Economics is a social science that deals with the production, distribution, and consumption of commodities and services. It is the study of the rational behavior of individuals who produce, distribute, and consume commodities and services. Rational behavior is the appropriate choice of means to achieve given ends. Economic rationality refers to a basic assumption made by economists that individuals are primarily motivated by self interest and will seek, as their major objective, the maximization of their economic positions. If, for example, a consumer is rational, he will consume the highest quality and quantity of an item at the lowest possible cost.

Central Questions

The three basic problems facing any economic society are what, how, and for whom economic goods and services are produced. More specifically:

- What commodities should be produced, and in what quantities?
- How should goods be produced?
- Who should be the producers?
- What combination of resources should be used?
- What kind of technology should be employed?
- For whom should the goods be produced?
- How should they be distributed?
- What principles should determine the distribution of goods?

Thus production, distribution, and consumption are the three central concerns of economics.

SCARCITY AND CHOICE

Understanding these three economic concerns requires understanding the basic assumption of scarcity of resources as well. In economics, scarcity refers to a situation in which there is less than enough of a given good to satisfy the demand

Instructions

Before answering the following questions, read pages 10-17 of Cost-Effectiveness: A Primer by Henry M. Levin. Levin will expand on the definition of cost analysis and its importance in education evaluation. He will also discuss the purposes and goals of the primer which parallel the purposes and goals of this manual.

Exercises

1. The study of economics addresses three basis questions: what will be produced, how, and for whom. Restate these three questions relating them to specific concerns of decision makers in education.

_____

_____

_____

2. What is one of the basic assumptions of economics? Is this assumption valid in the economics of education in developing countries? In AID-funded education projects?

_____

_____

_____

3. Education is not a free good, but an economic one that is limited by both human and financial resources. How can cost analysis help assure the most efficient use of these limited resources?

_____

_____

_____

_____

4. State the case for using cost-effectiveness analysis.

5. Why should politicians, administrators, and evaluators be concerned with a cost-effectiveness analysis?

6. How can a knowledge of cost analysis help you in your specific field?

Answers

Review the page listed for the questions answered incorrectly.

1.	What types of education programs should receive priority? How should the projects be funded? Who should receive the greatest attention, pre-primary, primary, secondary, higher, or nonformal students?	Manual, page 2
2.	Most, if not all, resources are limited. Yes, monetary and human resources are limited in developing countries and in AID.	Manual, p. 3
3.	Because resources are limited, one must make decisions about the most efficient ways to employ them. Cost analysis will force you to compare alternatives and then help you to choose the most cost effective alternative.	Manual, p. 3
4.	It may help evaluate the investment potential of education and it may help gauge the consumption value of education vis-a-vis other alternative uses of resources.	Manual, p. 4
5.	Because it can help make better government decisions and serve as a useful method for choosing among competing alternatives in the light of budget contraints. It may also (a) serve as an important source of persuasion; (b) lead to a more efficient use of educational resources; (c) reduce the cost of reaching particular alternatives; and (d) expand what can be accomplished for any particular budget or other resource constraint.	Levin, pp. 10-11
6.	It can help create greater awareness of cost, efficiency, and effectiveness; help develop better decision making abilities; and assist in the selection of projects which are most cost efficient, thus saving resources that could be used for other projects.	Subjective

LESSON 2
MODEL OF COST ANALYSIS

OBJECTIVES

To compare and contrast the concepts of cost-effectiveness, cost-benefit, cost-utility, and cost-feasibility analysis; to be able to select, based on the nature of the analytic task, which type of analysis is most appropriate.

READINGS

Levin, Chapter 1, pages 17-30
* Cost-Analysis Approaches in Evaluation and Decision Making

Chapter 2, pages 41-45.
* What Type of Analysis to Use?
* Is a Cost Analysis Needed?

INSTRUCTIONS

After reading the assignment from the Levin primer, address the following exercises.

Exercises

1. Complete the matrix:

	Characteristics	Advantage	Drawback
CF			
CB			
CE			
CU			

2. For each of these situations, determine which of the four cost analysis modes is most appropriate:

a. The Ministry of Education wishes to increase the earnings of students who terminate their formal education after secondary school. Accordingly, it seeks to answer the question of whether it should expand vocational education offerings for students who are presently in the general education program.

_____

b. The national university wishes to accommodate budget cuts by reducing some of the elective course offerings. A reduction in the budget of $60,000 has been targeted.

_____

c. The Ministry of Education wishes to consider the introduction of computers into the secondary schools. However, it is not clear that the budget is adequate.

_____

d. The secondary schools are seeking approaches to improving the science skills of its students. Proposed solutions include: (1) smaller class sizes with more stress on science assignments; (2) hiring university students to act as tutors; or (3) developing more specialized science courses.

_____

e. Both computer-assisted instruction and smaller class sizes are being considered as ways to improve the mathematics competencies of youngsters in the secondary schools. The Ministry of Education wishes to ascertain which alternative is most preferable.

_____

3. Describe a project from your experience that required (or could have required) (a) a cost-feasibility analysis; (b) a cost-benefit analysis; (c) a cost-effectiveness analysis; and (d) a cost-utility analysis. Be sure to describe the purpose of the cost analysis or verifiable objectives of the projects.

a. Cost-feasibility _____

_____

_____

b. Cost-benefit _____

_____

_____

c. Cost-effectiveness _____

_____

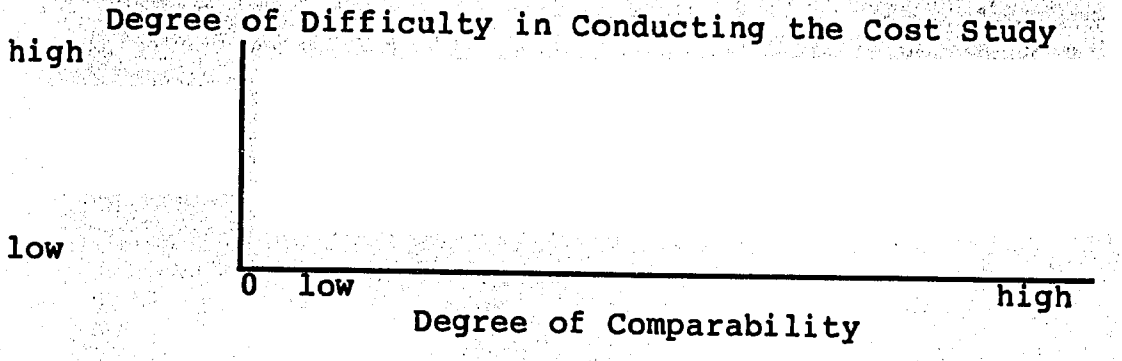
_____

d. Cost-utility _____

_____

_____

4. Where would you place the four different modes of cost analysis in the following chart?



5. Complete the tables and answer the questions for each of the three examples below.

a. Which of the three hypothetical adult literacy projects has the preferred CB ratio? _____

Alternative Approaches	Costs	Benefits	Net Benefits	C/B
A	$200	$275	_____	_____
B	150	125	_____	_____
C	400	600	_____	_____

where: A is a computer-assisted instruction program;
B is a self-instructed program; and
C is individualized instruction with peer consultation

b. Based on the C/E ratios, which of the four remedial mathematics programs is most cost effective? _____

Alternative Approaches	Cost/Student	Effectiveness (Test Scores)	C/E
A	$275	25	_____
B	125	5	_____
C	180	20	_____
D	75	15	_____

where: A is group instruction with individualized sessions;
B is self instruction with educational technology;
C is group peer instruction; and
D is peer consultation.

c. Which of the intructional strategies has the preferred C/U ratio?

	Instructional Strategies A	B
Prob (raising math performance by one grade level equivalent	.5	.2
Prob (raising reading level by one grade level equivalent	.5	.8
Utility of raising math performance by one grade level equivalent	6.0	6.0
Utility of raising reading performance by one grade level equivalent	10.0	10.0
Utility Score B=(.2)6 + (.8)10=9.2	____	9.2
Cost	$400	$414
C/U Ratio	____	____

Answers

ır every question that you find you have answered ıcorrectly, review the pages listed.

	Characteristics	Advantage	Drawback
CF	estimates only the costs of alternatives	determines which alternatives are within budget	does not consider outcomes of alternatives
CB	objectives have to be readily converted into monetary terms	comparable across all areas of social services	data requirement most stringent
CE	objectives must be identical and singular	no requirement for monetary values; lends itself well to comparison	requires considerable evaluative data; common measure of effectiveness must be used to assess
CU	objectives may be multiple	data requirement least stringent; incorporates subjectivity, uncertainty, and large number of outcomes	not comparable across evaluation studies

2. (a) cost-benefit — Levin, pp. 21-26
   (b) cost-utility — Levin, pp. 26-30
   (c) cost-feasibility — Levin, p. 30
   (d) cost-effectiveness — Levin, pp. 17-21
   (e) cost-effectiveness

3. The following are examples of possible answers: — Subjective

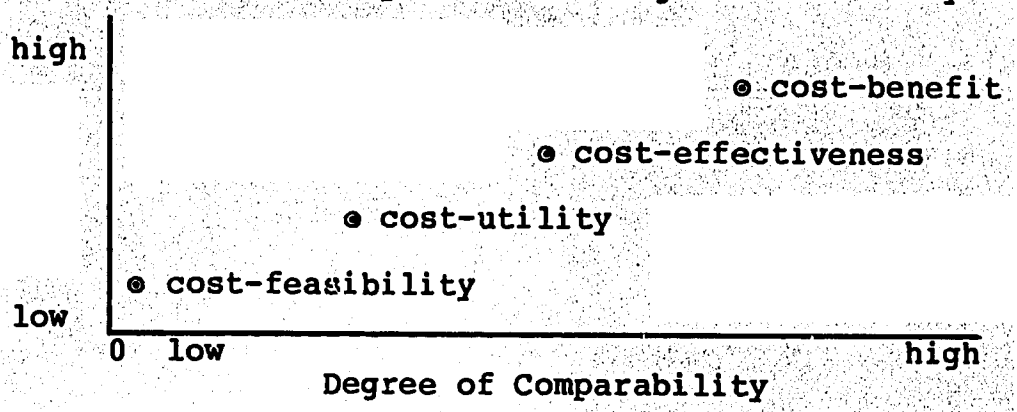
a. cost-feasibility--Another mission in the regions asked if your mission would consider being involved in the Regional Development Training Project. Your Mission Director does not know how much, if any, money is available for such a project. He asks you to conduct a cost analysis and report back to him. Your report to him is a cost-feasibility analysis.

b. cost-benefit--The HRD division of your mission is writing a project paper for a Training for Employment Project. The purpose of the project is to develop an appropriate, efficient system for improving the employability of private-sector managers. The team members cannot agree on which components will best meet these objectives. You offer to help settle the dispute by conducting a simple cost-benefit analysis that will compare all the alternatives.

c. cost-effectiveness--The Rural Primary Education Improvement Project is near completion. You must determine whether to propose a follow-on project. The needs in the rural sector still exist but you are not sure if this project is the most cost-effective approach to addressing the needs. To help make your determination, you will compare the costs and results of the Rural Primary Education Improvement Project and the costs and results of two similar projects in the region.

d. cost-utility--You are a member of the mission's committee that will determine funding levels for projects in the education program. Since there are not identical objectives among the projects, you suggest that the committee conduct a cost-utility study.

4.



5. Levin, p. 20

a. Alternative "C" has the preferred (lowest)C/B ratio.

	net benefits		C/B	
A	$275-200=	$75	200-275=	0.727
B	$125-150=	-25	150-125=	1.200
C	$600-400=	200	400-600=	0.667

b. Alternative "D" has the preferred C/E ratio.

		C/E
A	275-25=	$11
B	125-5=	25
C	180-9=	9
D	75-15=	5

c. Strategy "B" has the preferred, or lower, CU ratio.

	A	B
Utility Score	8	9.2
Cost	$400	$414
C/U Ratio	$50	$45

LESSON 3
DEFINITION OF COST

OBJECTIVES

To understand that there are non-financial costs for interventions which are not included in budgets; to be able to list specific costs associated with specific types of interventions.

READING

Levin, Chapter 3, pages 48-51
* The Concept of Costs

INSTRUCTIONS

Before you go further in the manual, read pages 48-51 in the Levin book. Levin will introduce the concept of costs and describe the inadequacy of budgets for cost analysis. After reading from Levin, return to the manual and read about several types of costs.

COST

In the most general sense, cost can be defined as the value of resources associated with any particular activity. The actual cost of the activity, however, is not always represented by the monetary value of the resources. The cost of an activity takes into consideration several other factors. The following discussion addresses the other factors and introduces the variations of cost.

Accounting cost generally refers to what appears either in the budget or in the expenditure statement of an organization. Most organizations will be interested only in what the costs are to them. This usually includes only the costs by functional line items, not grouped by project. Such practice may distort the yearly cost of an ingredient. For instance, if a learning center of a secondary school is equipped with microcomputers donated by a private firm, the cost of these microcomputers will, of course, not be recorded in the accounting statement of the school. The accounting statement therefore will not represent the total cost of the learning center.

Economic cost, on the contrary, is a more encompassing concept than accounting cost. It focuses on the true cost of an undertaking from the standpoint of society. First, economic cost of a particular project includes all the resources associated with the execution of that project. Second, the worth of these resources is determined by their monetary value if they were used in the most productive application. Using the previous example, the economic cost of the learning center will include all donated microcomputers, and account for the market value of this equipment as part of the true cost to the learning center. Even though the secondary school does not pay for the microcomputers, someone has paid for them and they are still a cost to society and thus part of the true cost of the learning center.

Opportunity cost of using resources in a certain way is the value of what these resources could have produced if they had been used in the best alternative way. For example, consider the case of the student who must decide whether a college education is worth the cost. In determining the "opportunity cost" of attending college, the student must include the amount of money he could make if he were working (this is the opportunity cost of the student's time) as well as the cost of tuition, fees, and books. See page 48-50 of the Levin book for further explanation.

Experimental cost refers to the cost of a project that is in the developmental phase. No matter how precisely the costs are measured, they will not necessarily represent the costs involved when a full-scale program is implemented. There will be differences between developmental costs and actual operating costs. Even the cost of administration will differ quite dramatically. In addition, experimental procedures cannot always exploit the "economy of scale" and experience accrued from daily operations.

Exercises

1. Define economic cost.

_____

_____

2. State five reasons why cost analysis in education canno depend primarily on budgets to ascertain the costs o interventions.

_____

_____

_____

_____

_____

3. What are the costs associated with each of the followin situations?

   a. It takes a full day at the passport office to renew your passport.

   _____

   _____

   b. Your failure to keep hotel receipts results in an inability to claim full per diem on your most recent TDY.

   _____

   _____

   c. A major portion of the lawn and shrubbery is destroyed during an outdoor party held at the Mission.

   _____

   _____

d. AID conducted a month-long training program for Ministry of Education manpower planners and half of them entered private industry after successfully completing the program.

_____

_____

e. A rise of crime and vandalism at the Skills Training Center requires that the master carpenter be used to patrol the workshops both during day and evening classes and thus can teach fewer classes.

_____

_____

f. Your Mission has required you to take this course.

_____

_____

Answers

1. Economic cost includes the value of all the resources associated with the project. The value of the resources is determined by the monetary value if they were used in their most productive application. Levin, p. 48

2. Five of the reasons why cost analysis cannot depend on budgets are: Levin, p. 50

   a. Budgets often do not include all resources, e.g., volunteers.

   b. Budgets do not include resources previously purchased, e.g., buildings.

   c. Typical budgets charge the cost of major items only in the year the cost was incurred. Charging all the renovation costs to one year's budget will distort the true costs.

   d. The costs of any intervention are often embedded in a budget that covers a much larger unit of operation. Determining the cost of a new reading program is difficult when the teacher's salary is included in the salary "line-item" classification instead of classified with other costs of the reading program.

   e. Budgets generally represent plans for how the resources will be spent rather than the actual expenditures.

3. a. passport fees; the value of what may have been completed had you stayed in the office or at home Subjective

   b. the cost of the hotel room that you must cover or the value of the time you may spend trying to obtain a receipt

   c. the resources required for the party and those required for restoring the lawns

d. the resources to conduct the training program and the value of the skills gained during the training that were lost to the government when the employees left

e. hiring additional faculty to cover the master carpenter's class--at a higher salary than hiring a patrolman

f. the cost of correspondence course and and the value of your time and energy that could be used for other work

LESSON 4
INGREDIENT APPROACH

OBJECTIVES

To present one approach to estimating cost, the ingredient method; to learn how to place cost values on each ingredient in order to obtain an estimate for annual cost of interventions.

READINGS

Levin, Chapter 3, pages 51-59
* The Ingredients Method
* Specification of Ingredients

Levin, Chapter 4, pages 62-74
* Purpose and Principles of Cost Valuation
* Methods for Valuing Ingredients

INTRODUCTION

Estimating the total cost of an intervention may appear to be an overwhelming task since there are so many individual costs that must be considered. The task, however, may become easier if we can divide it into smaller tasks. If we can describe the intervention in terms of the individual ingredients (i.e., human or capital resources) that are required to achieve the stated goals, the task of estimating costs becomes more manageable. This method is called the ingredient approach.

SET A
THE INGREDIENT METHOD

Instructions

After reading pages 51-59 of the Levin book, answer the following questions regarding the methodology for identifying and specifying ingredients.

Exercises, Set A

1. What is the fundamental question in the ingredients approach to estimating cost?

_____

2. List the five categories for dividing ingredients into common properties.

a. _____

b. _____

c. _____

d. _____

e. _____

3. Describe the three considerations that should be recognized in identifying ingredients.

a. _____

b. _____

c. _____

4. Consider the purposes of the following projects. List a specific ingredient for each category that is likely to be required.

a. To provide at least four years of quality basic education to all children in the rural areas and to implement an education reform for grades 1-8 of the same rural areas.

(1) Personnel: _____

(2) Facilities: _____

(3) Equipment: _____

(4) Materials/Supplies: _____

(5) Miscellaneous: _____

b. To develop a model technical-vocational urban school for poor youths, their immediate families, and other adults who do not have access to education or employment.

(1) Personnel: _____

(2) Facilities: _____

(3) Equipment: _____

(4) Materials/Supplies: _____

(5) Miscellaneous: _____

c. To establish a quality program of graduate management education, training, and research at a local university.

(1) Personnel: _____

(2) Facilities: _____

(3) Equipment: _____

(4) Materials/Supplies: _____

(5) Miscellaneous: _____

d. To improve the administrative and human resource capabilities within selected units of four priority ministries.

(1) Personnel: _____

(2) Facilities: _____

(3) Equipment: _____

(4) Materials/Supplies: _____

(5) Miscellaneous: _____

5. In Chapter 4, Levin described the "nonbudget" costs associated with each of his ingredient categories, e.g., the replacement cost of donated equipment. With each of the following ingredient categories, list one or two possible nonbudget costs.

a. Salaries

_____

b. Travel and Transportation

_____

c. Allowances (per diem, insurance. . .)

_____

d. Equipment, Vehicles, Materials, Supplies

_____

e. Participant Training

_____

f. Other Direct Costs (medical, communication)

_____

SET B
PLACING VALUE ON INGREDIENTS

Instructions

Now that we have learned to identify and specify ingredients, we will learn some principles for placing values on ingredients. This will help determine the total cost of the intervention.

First, read Chapter 4 of Levin. This chapter will (1) describe the purposes and principles for determining the values of ingredients; (2) determine methods for placing values on specific types of ingredients; and (3) derive an estimate of the total annual cost of an alternative.

Next, return to the manual. We will expand on the principles of market and shadow prices. We will also introduce other principles of cost valuation.

Concepts

Review the following concepts:

equilibrium price: a price that can be maintained; a price where the quantity demanded equals the quantity supplied.

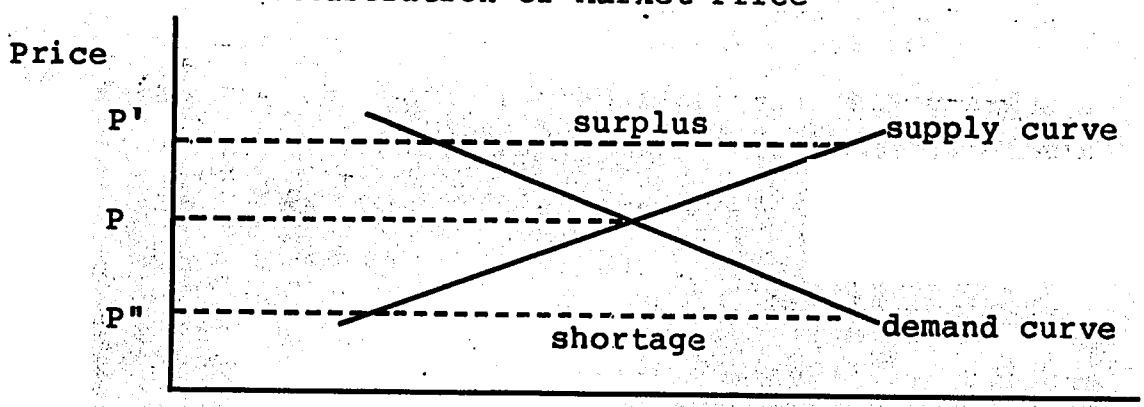
market price: the equilibrium price of the market in a competitive economy; the value of that good.

shadow price: the actual cost of a resource that does not have a competitive market price; opportunity cost of that resource; the value of the resource in its best alternative use; the adjusted market price which reflects the true benefit or cost to the economy, e.g., the difference between the market (subsidized) price of fertilizer and the world price the government must pay.

In the illustration, let your finger follow the supply curve as it inclines. Why does the supply curve incline as it goes away from the origin? A supply curve is simply a representation of how suppliers will behave. More of them will be willing to supply a service, a commodity, or a product when the price is increasing. When the price is increasing, the quantity supplied will also be increasing. The reverse is true for the demand curve. Consumers, in general, will demand more of the same good, when the price decreases, other things being equal. When the supply curve meets the demand curve, the quantity supplied will equal the quantity demanded. This is the point of equilibrium. For example, when the number of teachers supplied equals the number of teachers demanded, we have an equilibrium price. This is the true market value of a teacher.

In situations in which institutional regulations govern the price structure, we will have either surplus or shortage. For instance, because of union bargaining, the price of teacher is P', or P prime, which is greater than P, the market price. At P', more people are willing to supply their service as teachers than the schools can afford to hire. Therefore, we have a <u>surplus</u> in which the quantity of teachers supplied is greater than teachers demanded. Since P', is greater than P, the equilibrium price which teachers should have in an open market, the teacher's salary is an overestimation of the true cost to the economy. On the other hand, given the rigidity of government pay schedules, we often find that teachers in developing countries are paid at P", or P double-prime, which is smaller than P. At price P", the number of teachers supplied is less than demanded by the school system. This is the <u>shortage</u> situation. P" may appear to be the market price of teachers, but if the system is expected to expand, P" should not be used as the expected cost per teacher. If a shortage exists at price P", how can the supply of teachers be expected to increase at the same price? A more realistic estimation of pricing the teachers would use the shadow price, P.

Illustration of Market Price



Teachers Labor Market in Country X

P = market price of teachers at equilibrium
P" = price in a shortage situation
P' = price in a surplus situation

Exercises, Set B

6. Of what value is it to know the equilibrium price of a good or service in estimating or evaluating project costs? Why is the market price not sufficient?

_____

_____

_____

Additional Factors

It is useful to know the principles of shadow and market prices. These principles help us determine methods for placing values on specific types of ingredients. There are, however, additional factors that must be considered in the valuation of ingredients. In the following pages we will review these factors which include:

Capital costs: goods and services paid for in a single year, but used for additional years. The most common capital investment is the construction cost of a building. Capital costs, however, do not necessarily refer to equipment or facilities only. For example, the effect of training coordinators of a project can last over five years, although the training is paid for in one year. In this case the training cost can be treated as a capital cost.

Recurrent costs: costs incurred for goods and services that are used as they are bought. When the life of an investment for the project is one year or less, the cost of such investment is a recurrent one and the cost of such investment will appear in every year of the project. Usually personnel cost is a major portion of the recurrent costs. It should be noted that if the life of equipment or supplies is less than one year, the cost of such equipment will be treated as a recurrent cost, e.g., pencils.

Annualization costs: estimation of the yearly cost taking into consideration depreciation and interest on the remaining or undepreciated value. The elements required to calculate the annualized cost of a capital good are:

a) replacement value of the good;
b) life of the good; and
c) approximate interest rate to obtain the opportunity cost of having resources invested in the undepreciated portion of the good.

The formula for calculating the annualization cost is:

$$a\ (r,\ n) = \frac{[r(1 + r)^n]}{[(1 + r)^n - 1]}$$

where: a = annualization cost
r = interest rated
n = lifetime of asset for depreciation

The following table facilitates the calculation of the annualization figure. Rather than using the formula to arrive at annualization cost, one would simply multiply the cost of the ingredient by the appropriate annualization factor as found on the table. For example, to calculate the annual cost of an $800 desk, with a lifetime of 10 years, and an interest rate of 15 percent, you would multiply the cost by the annualization factor:

cost x annualization factor = annualized cost

The annualization factor, in this case, can be found by locating the point at which 15 percent intersects 10 years on the annualization factor chart.

$800 X 0.1993 = $159.44

Thus, the annualized cost of the desk is $159.44.

Table 1: Annualization Factors for Determining Annual Cost of Facilities and Equipment for Different Periods of Depreciation and Interest Rates

n	5%	10%	15%
1			
2	0.5378	0.5762	0.6151
3	0.3672	0.4021	0.4380
4	0.2820	0.3155	0.3503
5	0.2310	0.2638	0.2983
6	0.1970	0.2296	0.2642
7	0.1728	0.2054	0.2403
8	0.1547	0.1874	0.2229
9	0.1407	0.1736	0.2096
10	0.1295	0.1627	0.1993
11	0.1204	0.1540	0.1911
12	0.1128	0.1468	0.1849
13	0.1065	0.1408	0.1791
14	0.1010	0.1357	0.1747
15	0.0963	0.1315	0.1710
16	0.0923	0.1278	0.1679
17	0.0887	0.1247	0.1654
18	0.0855	0.1219	0.1632
19	0.0827	0.1195	0.1613
20	0.0802	0.1175	0.1598
21	0.0780	0.1156	0.1584
22	0.0760	0.1140	0.1573
23	0.0741	0.1126	0.1563
24	0.0725	0.1113	0.1554
25	0.0710	0.1102	0.1547
26	0.0696	0.1092	0.1541
27	0.0683	0.1083	0.1535
28	0.0671	0.1075	0.1531
29	0.0660	0.1067	0.1527
30	0.0651	0.1061	0.1523

Exercises, Set B, cont.

7. The construction cost of a reading room is $5,000.00. Can you calculate the cost of using the room for one year? Why or why not?

_____

8. If the life of the reading room is 25 years, calculate the annual costs at interest rates of 5, 10, and 15 percent respectively.

@ 5 percent: _____

@ 10 percent: _____

@ 15 percent: _____

9. A personal computer costs $4,000.00 and will be obsolete after 5 years. The estimated salvage value at the end of 5 years is 20 percent of the original purchase. What is the annual cost of using a personal computer based on 10 percent interest? (Hint: You must first calculate the value of the usable portion of the computer during the first five years.)

_____

10. Supposing that a new reading program requires 10 such microcomputers to be housed in the above (see exercise 8) constructed reading room. What is the yearly cost of the facility and equipment of the program based on a 10 percent interest rate?

_____

11. Determine the annualized value of each of six computers whose total value is $30,000 and have a life of 5 years. Use the interest rate of 10 percent.

_____

12. Calculate the annualized value of a donated facility that would cost $250,000 to replace and has a life of 20 years. Use the interest rate of 15 percent.

_____

SET C
OTHER COST FACTORS

Fixed cost is the sum of the basic ingredients needed to operate the program. It is invariant up to a certain level of output. To an extent, the fixed cost ignores the size or scope of the project. For example, one project director is required from the start of a project even when no clients are participating and it is likely that only one project director is needed even when the program is operating at its peak. The cost of a project director is a fixed cost and it does not change as the size of the project changes. Another example can be found in radio education. The initial fixed cost would include the construction of power stations, transmission towers, receiving stations, and recording studios, regardless of the number of people who will eventually participate. As such, many technology-based interventions have a high fixed cost. But this does not mean that only capital investment can be a fixed cost. The example of a project director illustrates that operating costs can also be a fixed cost to the project.

Variable cost depends on the size and scope of the project. For example, the cost of learning material for students depends on the number of students enrolled. Another example will be the cost of hiring teachers. This will depend on the number of students enrolled in the training program. The cost of teachers varies as the number of classes of students varies; it is thus a variable cost. Costs of labor-intensive interventions tend to have more components in variable cost than capital-intensive ones.

Economy of scale is reached when the project is large enough to fully utilize the resources. For example, fixed cost does not depend on the size or scope of the project. However, most projects will not fully utilize the fixed-cost resources at the beginning. In other words, when the number of units is low, the cost per unit is high. It is only when the number of units increases (and the cost remains fixed) that the fixed-cost component is being fully capitalized. Until the fixed-cost component is fully capitalized, the project would have inefficiently used resources, and not achieved economy of scale.

Average cost generally refers to the cost per output. It is usually calculated by dividing the total cost of the project by the number of outputs, e.g., participants. The major problem with the average cost concept is its assumption of linearity. That is, average cost concept assumes that the average cost of the program does not change with the scale of application. It basically disregards different configurations of fixed-cost components for different programs. Therefore, when average cost per unit output is used it has to be at the appropriate level of scale, otherwise it is very misleading.

Marginal cost is the addition to the total cost when one more unit is added. This concept is especially useful when the average cost changes with the scale of application of the program.

Discounting is based on the notion that people would prefer to consume goods and services now rather rather than in the future. If one wishes to know the present-day value of an item to be purchased in the future, he must discount the item by using an appropriate interest rate.

Present value of a dollar spent today refers to the cost forfeited in interest or opportunity that could have been earned if that dollar had been used elsewhere. Therefore the calculation of present value is the opposite of compounding interest. For example, if you were to add an annual 10 percent interest on $1.00, it would be worth $1.10 in a year. The opposite is true when finding the present value; the present value of $1.10 in a year at a discount rate of 10 percent is $1.00.

For present values of a stream of monetary amounts in future years or a single monetary amount in the future, the value must be discounted by an appropriate interest rate. The formula for calculating present value is:

$$P.V. = \frac{Ai}{i=1(1 + r)^{i}}$$

where: P.V. = the present value of a monetary stream A from year 1 to year n;
A = an amount of money in year i;
r = the appropriate interest rate.

In Lesson 6 these concepts will be explained in further detail. The software package included with the course materials will calculate present value for you as well.

Exercises, Set C

13. Choose the concept or concepts that should be considered when assigning a value to the following:

a. The original budget for a basic reading program for grades 1-3 in ten rural schools was $400,000. After careful consideration, the MOE decided to include two additional schools in the project.

1. fixed cost
2. average cost
3. marginal cost
4. variable cost

b. A large secondary school recently purchased fifteen personal computers to begin their newly developed computer-assisted instruction project for mathematics. The science department subsequently realized the value of the CAI and requested that their department use the computers during the afternoon hours (when the math department was not using them).

1. economy of scale
2. discounting
3. marginal cost
4. average cost

c. HRD officers in your Mission are considering a project which will require building centers in five regions. They are not sure whether it is wiser to build all the centers immediately or build one per year.

1. fixed cost
2. discounting
3. marginal cost
4. present value

d. The MOE and the Mission are planning a radio education project. The MOE wants the program to target 10,000 students. Considering the geography of the country, the Mission thinks that 8,000 is the maximum feasible target. One member of the committee thinks the cost difference in the target numbers is insignificant. He reminds the committee of the following:

1. fixed cost
2. variable cost
3. economy of scale
4. discounting

Answers, Set A

1. What resources are required for each intervention? — Levin, p. 52

2. — Levin, p. 54
   a. personnel
   b. facilities
   c. equipment and materials
   d. other program inputs
   e. client inputs

3. — Levin, p. 56
   a. ingredients should be specified in sufficient detail
   b. categories for ingredients should be consistent
   c. accuracy in describing ingredients should depend on their relative importance

4. — Subjective
   a.
      (1) additional teachers
      (2) more school buildings, school maintenance
      (3) educational equipment
      (4) books, pencils
      (5) statistical information service, research planning, teacher training, administrative training.

   b.
      (1) additional staff, volunteers
      (2) learning resource center
      (3) new equipment
      (4) manuals and other resource material
      (5) workshops, teacher training

   c.
      (1) management trainers
      (2) a physical plant, new executive training institute, new center for administrative and economic research
      (3) commodity purchases
      (4) training materials
      (5) technical assistance from a U.S. university, executive training, long- and short-term training for faculty and administration, and student loans

d. (1) training personnel
(2) small office for administrative work
(3) equipment
(4) handbooks and manuals
(5) training, technical assistance, workshops, studies, observation trips

5. a. the salary of the mission officer for time spent backstopping the project

b. the portion of the replacement cost of a donated van from the mission that must be used twice a month to visit the project site

c. the forgone rental income on a U.S. government owned facility because of free housing provided to the project's team leader

d. the portion of the replacement cost of using the embassy's word processing equipment to complete the project's quarterly reports

e. opportunity cost for time spent by the participant to engage in training rather than working job

f. the time it takes to get a medical exam

Answers, Set B

6. "Market price" seems at first like a simple numerical value. But as we have learned in Lesson 4, when drawing up a proposal for a project in the future, you have to take into account that the price of a good or service can change over a period of time. Since you still need to arrive at a price for proposing the project cost, the equilibrium price can be a solution to the problem of not knowing a future market price.

7. No, we do not have sufficient information. We need to know the lifetime of the reading room as well as the interest rate.

8. @ 5% $5,000 x 0.0710 = $355.00
@ 10% 5,000 x 0.1102 = 551.00
@ 15% 5,000 x 0.1547 = 773.50

9. $4,000 x 80% = $3,200

(80% represents the usable portion during the five years)

$3,200 x 0.2638 = $844.16

10. $551 + $3,200 = $3,751

11. $30,000 x 0.2638 = $7,914

$7,914 - 6 = $1,319

12. $250,000 x 0.1598 = $39,950

Answers, Set C

13. a. average cost, marginal cost, variable cost

b. economy of scale, average cost

c. discounting, present value

d. fixed cost, variable cost, economy of scale

LESSON 5
ESTIMATION OF COST

OBJECTIVES

To learn to analyze costs; to summarize costs using a cost worksheet; to illustrate how to estimate costs under uncertainty; and to review cost estimation for multiyear projects.

READING

Levin, Chapter 5, pages 80-99

* Using a Cost Worksheet
* Allocating Costs Among Constituencies
* Estimating Costs Under Uncertainty
* Multiyear Projects

INSTRUCTIONS

Before beginning the exercises in the manual, read pages 80-99 of the Levin Primer. This will provide you with the appropriate background to complete the exercises.

Exercise 1, Set A

Country X is planning to implement a radio education project as part of the Improving Efficiency in Education Program. We will describe the project and identify the ingredients that would be necessary for such a project. You will be asked to calculate the annual cost estimates for each of the ingredients, based on the methods set forth.

PERSONNEL

The Project Paper calls for a three-year Team Leader who has a Ph.D. and fifteen years of experience in education and significant exposure to radio. It is likely that this person will require the maximum salary of $67,940, fringe benefits, and travel and transportation allowances. For the purposes of this example, we will assume no family members will accompany either the team leader or the short-term consultants.

There will also be three short-term consultants (one a year, each for three months, twenty days per month). They are expected to have at least a M.A. and five years of experience. Their daily wage will probably not exceed $140, with additional fringe benefits, and allowances.

At the beginning of each academic year, twenty volunteers will be needed for five days to distribute the workbooks and radios to the participating classrooms. Each volunteer's time is estimated at $20.00 per day.

Fringe benefits of 30 percent represent the current average for this category of expense.

Estimated Salary for 1 Year

a.	Team Leader	$ _____
b.	Consultant #1	_____
c.	Consultant #2	_____
d.	Consultant #3	_____
e.	Total Salaries	_____
f.	Fringe Benefits	_____
g.	Volunteers	_____
	Total Salary	_____

FACILITIES

The cost of a facility to house the radio equipment is estimated at $50,000. The estimated life of the facility is twenty-five years. The renovations have a life of fifteen years and require an investment of about $10,000. At 15 percent interest, what is the annualized value of the facilities?

Annualized Cost of Facilities

a. Building $ _____

b. Renovations $ _____

Total Facilities $ _____

EQUIPMENT

The following new equipment must be purchased. Again, the estimated interest rate is 15 percent. With the guarantee agreements, maintenance costs are included in the purchase price. After the three year life of the project, the equipment will be purchased by the GOX for the appropriate depreciated value.

a. (2) aural studio-transmitter link, transmitter and receiver with self-contained power supplies. Estimated value for each set is $9,500 with a life span of ten years.

b. (2) audio gain rider, includes compressor, adjustable recovery delay, clipper control, switchable low-distortion treble AGC, power supply, and calibrated meter. The value of each set is $2,200 and should last for five years.

c. (2) audio limiter, includes all-pass network, compressor, adjustable clipper, output low-pass filter power supply, and front panel calibrated meter. Each set costs $2,100 and will last for seven years.

d. electronic equipment including recorder/reproducer open reel tape recorder; monitor, full track recorder/reproducer portable tape recorder with accessories; cassette deck; electronic generator; cartridge tape; and spare parts for all equipment. Total price is $12,000 and average lifespan of the equipment is seven years.

e. miscellaneous equipment including connector kits; antenna; transmission line; grounding kit; hoisting grip; wall feedthrough; cable tie kits; receiver; transreceiver; and spare parts. Total cost is $13,000 and the average lifespan is eight years.

Annualized Costs of Facilities

a.	$ _____
b.	_____
c.	_____
d.	_____
e.	_____
Total Equipment	$ _____

SUPPLIES

The project will require an initial purchase of 5,000 radios at $30.00 each. This includes several sets of batteries. The radios will be used by each classroom for the entire three years.

Supplies for curriculum development are estimated to cost $8,000. This is not considered to be a recurrent cost.

Reproducing the workbooks and purchasing pencils for each year is estimated to cost $800,000.

a. Radios	$ _____
b. Supplies	_____
c. Workbooks	_____
Total Supplies	$ _____

MISCELLANEOUS

The costs of energy for heat, lighting, and power are estimated by averaging the current requirements for other buildings of this size. The average is $2,000 per year. The additional cost of theft insurance on the building and equipment is $1,800 per year.

Prior to arriving in country, the Team Leader needs five days of training in the U.S. as do the three consultants. The cost of training for each day (the Team Leader and Consultant #1 would be trained together the first year) is $300.

Transportation needs to be provided for each of the four staff members. The average cost of a roundtrip airline ticket is $1,000. The Team Leader will return to the U.S. each year. The consultants will each be provided with one roundtrip ticket. Additionally, the program will need to purchase one motorcycle for traveling to various sites. Cost of the cycle is $2,000.

Annual Miscellaneous Costs	
Energy	$ _____
Insurance	_____
Training	_____
Transportation	_____
Total Miscellaneous	$ _____

TOTAL ANNUAL COSTS

Personnel	$ _____
Facilities	_____
Equipment	_____
Supplies	_____
Miscellaneous	_____
Total Costs	$ _____

Exercise 1, Set A, cont.
Distribute Ingredient Costs and Cash Subsidies

Fill in columns 1 and 2 of the worksheet on the following page.

The total costs represent the value of all the ingredients required for the project. However, the total cost will not be paid completely with AID funds. The host government has offered to cover the cost of the facilities and the renovations. Rather than providing the funding in total, they will make three equal annual installments.

The project will be implemented with assistance from two additional sources: the Peace Corps will supply volunteers to distribute the workbooks and materials; and a U.S. organization that will subsidize the project with a single outlay of $75,000 cash. There will be no fees imposed to students.

Given this additional information, please complete the other columns of the worksheet.

Exercise 1, Set A

Worksheet #1 for Estimating Costs of Radio Education

Ingredients	Total Cost	Cost to Sponsor	Cost to Other Government Agencies	Contributed Private Inputs	Imposed Student and Family Costs
Personnel					
Facilities					
Equipment					
Materials					
Others (specify)					
Value of Client Time and Other Client Inputs					
Total Ingredients Cost					
User Fees	-( )		+( )		
Other Cash Subsidies		-( )	+( )	+( )	
Net Costs					

Exercise 2, Set A
Estimating Costs Under Uncertainty

In estimating the cost for the radio education project there were significant disputes about the actual cost of the antenna that would be needed for the radio broadcasts. Since this was the first time a single radio station was attempting to reach the given target areas, there was no standard upon which to base the estimates. Because of this, there was quite a range of estimates for the antenna. The estimate given on the previous worksheet represented the midpoint between the two most extreme estimates. With the information below, conduct an informal sensitivity analysis to determine whether, through changing the cost assumptions, the radio approach remains the most cost effective.

	Radio	Computer	Traditional
Low Cost Estimate (per 200,000 students)	$470,000	$95,000,000	$2,500,000
Medium Estimate	$489,545	$95,000,000	$2,500,000
High Estimate	$540,000	$95,000,000	$2,500,000
Effectiveness (Average Test Scores)	25	50	10
Cost Effectiveness Ratios			
Low Cost	___	___	___
Medium Cost	___	___	___
High Cost	___	___	___

If the cost assumptions change for the radio approach, does it remain the most cost-effective approach? Why or why not?

_____

Is it necessary to inform decision makers about the results of the sensitivity analysis? Why or why not?

_____

Exercise 3, Set A
Multiyear Project

So far we have calculated the annualized cost of the radio education project. However, to request funding, we must have a "life of project" (LOP) cost estimate. To calculate the entire cost of the project over its projected life, we must adjust the cost of the second and third years for inflation.

According to recent trends, inflation in Country X is expected to rise at the rate of 30 percent in each of the following five years. Based on the rate of inflation, the assumption that all costs will rise, and the previously calculated annualized costs, determine the LOP cost.

Year 1	$ _____
Year 2	_____
Year 3	_____
Total Cost	$ _____

Exercise 4, Set A
Alternative Expenditure Patterns

The manufacturer of the radio equipment is willing to accept payment in full at time of purchase or divide the payments over the LOP. Calculate the savings you will incur as you accept their offer to allow yearly installments. You will need to use the "present value" formula to calculate.

Year	Pattern 1	Pattern 2
1	$1,620,395	$489,545
2	0	538,500
3	0	592,350
Total	$1,620,395	$1,620,395

Calculate the present values of the above patterns of expenditure.

To calculate present value:

$$PV = \frac{C}{(1 + r)^{t-1}}$$

Where PV = present value
t = time (i.e., 3 years)
r = discount rate (15 percent)
c = cost ($1,620,395)

	Pattern 1	Pattern 2
PV (rate=15%)	$ _____	$ _____

What is the dollar difference between making three yearly installments rather than one payment in full? $ _____

Exercise, Set B

5. Complete the worksheet on the following page. Use a project either from Lesson 5 (Exercise 4) or a project with which you are more familiar (terminated, on-going, or proposed). First, state the purpose of the project and briefly describe its components.

A. Project purpose:

B. Project interventions or components:

Exercise, Set B, cont.

Worksheet #2 for Estimating Costs

Ingredients	Total Cost	Cost to Sponsor	Cost to Other Government Agencies	Contributed Private Inputs	Imposed Student and Family Costs
Personnel					
Facilities					
Equipment					
Materials					
Others (specify)					
Value of Client Time and Other Client Inputs					
Total Ingredients Cost					
User Fees	-( )		+( )		
Other Cash Subsidies		-( )	+( )	+( )	
Net Costs					

Answers, Set A

1. PERSONNEL

a. Team Leader	$67,940.00	(max. annual salary
b. Consultant #1	8,400.00	(140 x 20 x 3)
c. Consultant #2		(only one consultant per yea
d. Consultant #3		will be employed)
Total Personnel	$76,340.00	
e. Fringe Benefits	22,902.00	(76,340 x .30)
f. Volunteers	2,000.00	(20 x 20 x 5)
Total Salary	$101,242.00	

FACILITIES

a. Building	
$50,000 x 0.1547 =	$7,735.00
b. Renovations	
$10,000 x 0.1710 =	1,710.00
Total Facilities	$9,445.00

EQUIPMENT

a. $9,500 x 2 = 19,000 x 0.1943 =	$ 3,787.00
b. 2,200 x 2 = 4,400 x 0.2983 =	1,313.00
c. 3,100 x 2 = 4,200 x 0.2403 =	1,009.00
d. 12,000 x 1 = 12,000 x 0.2403 =	2,884.00
e. 13,000 x 1 = 13,000 x 0.2229 =	2,898.00
Total Equipment	$11,891.00

SUPPLIES

a. Radios	
5,000 x $30.00 = $150,000 x 0.4380 =	$ 65,700.00
b. Supplies	
8,000 x 0.4380 =	3,504.00
c. Workbooks	
800,000 x 3 = 2,400,000 x 0.4380 =	1,051,200.00
Total Supplies	120,404.00

MISCELLANEOUS		
a. Energy	$ 2,000.00	
b. Insurance	1,800.00	
c. Training	4,500.00	($300 x 5 days x 3 yrs)
d. Transportation	6,000.00	(6 x $1,000)
Total Misc.	$14,300.00	

TOTAL ANNUAL COSTS	
a. Personnel	$ 101,242.00
b. Facilities	9,445.00
c. Equipment	11,891.00
d. Supplies	1,120,404.00
e. Misc.	14,300.00
Grand Total	$1,257,282.00

Answer 1, Set A

Worksheet #1 for Estimating Costs of Radio Education

Ingredients	Total Cost	Cost to Sponsor	Cost to Other Government Agencies	Contributed Private Inputs	Imposed Student and Family Costs
Personnel	$101,242	$99,242		$2,000	
Facilities	9,445	0	$9,445		
Equipment	11,891	11,891			
Supplies	1,120,404	1,120,404			
Miscellaneous (specify)	14,300	14,300			
Value of Client Time and Other Client Inputs					
Total Ingredients Cost	1,257,282	1,245,837	9,445	2,000	
User Fees	-(0)		+(0)		
Other Cash Subsidies		-(25,000)	+(0)	+(25,000)	
Net Costs	$1,257,282	$1,220,837	$9,445	$27,000	

2. Estimating costs under uncertainty

Cost-effectiveness ratios:	
Radio:	
low @ 2.35/student	0.094
medium @ 2.45/student	0.098
high @ 2.70/student	1.080
Computer:	
medium @ $475/student	9.5
Traditional Curriculum Revisions	
@ $12.50/student	1.25

Yes, the radio approach remains the most cost effective. Small changes in the cost of the radio program are not enough to make it less cost effective than the other approaches. If the costs and the effectiveness scores were more similar, the CE ratios would be more sensitive to small cost changes.

No, the changes are not significant enough. If the sensitivity analysis resulted in a different ranking among CE ratios, the decision makers should be informed.

3. Multiyear project

Year 1	$ 489,545.00	(taken from worksheet 1)
Year 2	538,500.00	489,545 + 49,955 (10%)
Year 3	592,350.00	538,500 + 53,850 (10%)
Total Cost	$1,620,395.00	

4. Alternative expenditure pattern

	Pattern 1	Pattern 2
PV	$1,620,395.00	$1,227,572.00

$1,227,572.00 was derived from the following calculations:

$$PV = \frac{C}{(1 + r)^{t-1}}$$

$$PV = \frac{1,620,395}{(1 + .15)^{3-1}}$$

$$PV = \frac{1,620,395}{(1.15)^{2}}$$

$$PV = \frac{1,620,395}{1.32}$$

$$PV = 1,227,572$$

The difference between $1,620,395 and 1,227,572 is $392,823.00.

Answers, Set B

5. Answers to this exercise will depend upon the project you choose. If you have difficulty completing the exercise, reread the text.

LESSON 6
OUTCOME MEASUREMENT

OBJECTIVES

To better understand the uses of benefits, effectiveness, and utility measures; to discuss the treatment of multiple outcomes; and to use computer software that will facilitate calculating internal rates of return.

READING

Levin, Chapter 6, pages 108-128

* Benefits and Their Measurement
* Effectiveness and Its Measurement
* Cost-Utility: Concept and Measurement
* Treatment of Multiple Outcomes
* Distribution of Benefits and Effects

INSTRUCTIONS

Before beginning the manual, read pages 108-128 of the Levin Primer. After reading from Levin, return to the manual to read the following discussion of indicators of educational progress then answer the questions. After completing the lesson, turn to the instruction manual for the computer software to learn about calculating internal rate of return, present value, and sensitivity analysis.

OUTCOME MEASUREMENT

In this section, Gary Fields overviews what sorts of dat indicate benefits, effectiveness, and utility of educationa programs. With the Levin and Fields readings, you will b prepared to complete the exercises in the manual and understar the concepts behind the computer software which will b introduced to you.

Assessing Educational Progress and Commitment: Conceptual Suitability of Indicators of Educational Progress and Commitment

Various indicators of educational progress and commitment have been proposed. Here are my assessments of some of them.[1]

School Enrollment Rates. This refers to the fraction of school aged children who are enrolled in school. I believe these rates are the best single indicator of progress. They show how many children actually have access to schools, data which is particularly important at the primary level. This reflects both the existence of spaces in school and parents' ability to pay fees and forego their children's labor. School enrollments are regularly measurable at low cost. Nearly always, enrollment rates are broken down by level of schooling. This breakdown permits us to distinguish between primary education (which many regard as a basic human right and which is most relevant to the target poor) and other levels. Other breakdowns for which data are sometimes available are by sex and by geographic location. These breakdowns may reveal alarming instances of inequality of opportunity. In the case of geographic breakdowns, however, even in countries where the poor are concentrated in particular geographic areas, there is no assurance from regional data that in fact the poor in poor areas are the recipients of education. An even better breakdown of school enrollment rates would be by socioeconomic status (SES) of parents, since SES distribution is a much better indicator of the extent to which the

---

[1] In addition, other indicators, not treated here, include number of teachers, teacher-student ratios, dropout rates, and breakdowns of enrollments by age.

recipients of education are the poor. But SES is an elusive concept which is not easily measured.[2]

Enrollment rates are also meaningful indicators of commitment. Care must be exercised in interpreting enrollment data as a sign of commitment, though, since it is hard to tell whether the commitment is by private individuals seeking personal gain for themselves and their children or by a concerned public sector. For many reasons, some of which have nothing to do with society's commitment to education for the poor or lack thereof, high SES parents are more likely to acquire more education for their children.

Recipients of Non-Schooling Education. These numbers indicate the participation of the population in less formal educational programs. Included here are recipients of apprenticeships, adult education, on-the-job-training, extension, and other forms of continuing education. Rarely are these broken down below the national level. Conceptually, these are good measures of progress, since they show how many people have access to learning opportunities outside of schools. There is some difficulty of interpretation since non-schooling education may either complement or substitute for schooling, and this may vary from one country to another. There is also a measurement problem in defining who is a recipient. Nonetheless, this is a promising area where little has been done up to now.

School Completion Ratios. These are calculated as the percentage of the labor force or adult population who have completed various schooling levels. As a measure of progress, these are valuable in showing the stock of educated persons. Of particular interest is the proportion of primary school completers. Breakdowns by location and sex are often tabulated. The limitations of completion ratios are that they are restricted to formal schooling attainments and are very slow to change, even if rapid progress is being made for the young generation.

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[2]An additional difficulty: SES data can probably not be reliably gathered from school data but would require a supplementary household survey.

Literacy and Numeracy Rates. These refer to the proportion of adults who can read, write, and perform simple arithmetic operations. These reflect the cumulative acquisition of skills. Although these measures are often used for evaluating poverty groups, the measures are limited because they are relevant only at a basic level. Conceptually, literacy and numeracy are not easily defined, which leads some observers to reject these measures. But literacy and numeracy rates can be and should be used as indicators of progress.

Educational Expenditure and Finance Data. These data tell what quantity of private resources and how much of the government's budget and national income are spent on education. They also indicate how the educational system is financed (e.g., out of tax revenues, student fees, etc.). Expenditure information is the single best indicator of commitment to education, though it is not entirely free of difficulties. One need only look briefly at the position of the United States at the top of the spending scale to realize that school expenditures depend in large part on a country's ability to pay. For intertemporal comparisons within a country, information on total expenditure needs to be supplemented by other data to show that more spending results in better-quality or higher-quantity education rather than, say, using the additional education budget to raise salaries of existing teachers without expanding enrollments. For international comparisons, observers must remember the great differences across countries in public versus private financing, central government versus state and local responsibility, private versis parochial schools' importance, and to tuition and fee variations.

Conceptually, school finance data may also be good indicators of commitment, e.g., abolition of fees, reliance on more progressive taxes, equalization of quality across districts and regions. But users of school finance data must be sensitive to secondary effects, e.g., if the public sector assumes a greater share of school costs, who pays the taxes to finance the government? Of course, the determinants of any public finance system are many and complex. It is unlikely that school finance information will be readily tabulated in an internationally consistent form.

Rate of Return to Education. The rate of return to education is the percentage increment in income which society realized on its educational investments. Among those who have faith in markets and in the technical prowess of economists, it is said that social rates of return to education are guides to the efficiency of resource allocation patterns. In this view, educational systems are thought to be performing efficiently when social rates of return are equalized across various education levels, since it is inefficient for a dollar invested one place to earn more than a dollar invested elsewhere. But to more agnostic analysts like myself, a high rate of return to education might mean any number of things: (i) that society is wisely spending resources in a high payoff area; (ii) that more expenditure is needed until diminishing returns drive the marginal rate of return on education down to the social discount rate; (iii) that the apparently high social rate of return to education is a mirage due to unjustifiable wage premia received by highly-educated workers; or (iv) that the rate of return to education may be high privately but not socially, because the better-educated are hired preferentially, bumping less-educated persons into lower-level jobs or into unemployment. Because of these ambiguities of interpretation, I do not see that data on rates of return to education, taken by themselves, are of much use as an indication of either progress or commitment in the field of education. However, rate of return analysis may still be helpful in evaluating education's past costs and benefits and in planning educational systems for the future.

SOCIAL OUTCOMES

Social Returns to Education: Central Planning and Local Planning Perspectives

In addition to the present-value method, social rate of return is used for social cost-benefit analysis. This too relies on the notion of time discounting. However, it is done differently. Instead of using a specified interest rate (r), the rate of return method finds the discount rate for which the present value of costs equals the present value of benefits. This is known as "internal rate of return" (IRR) or "rate of return" for short. If I could invest $100 today and receive $110 a year from

now, I could calculate that the rate of return on my investment is 10 percent. In this example, in which we have only one year lag between the time of investment and the payoff date, the rate of return is given by:

$$\text{rate of return on investment} = \frac{\text{income next year}}{\text{income this year}} - 1$$

To evaluate education projects which involve many periods, the idea is the same (sum of the costs and benefits in each time period appropriately discounted), but the arithmetic is a bit more difficult. Use the same principle, i.e., equate the present value of costs to the present value of benefits:

$$C_o + \frac{C_1}{1 + r} + \frac{C_2}{(1 + r)^2} + \ldots \frac{C_t}{(1 + r)^t} =$$

$$B_o + \frac{B_1}{1 + r} + \frac{B_2}{(1 + r)^2} + \ldots \frac{B_t}{(1 + r)^t}$$

The internal rate of return is that particular value of r which makes the left hand side of the equation equal to the right hand side. Having found r, use the following internal rate of return decision rule:

> If the internal rate of return (r) is greater than the market rate of interest (i), then the project under evaluation is economically worthwhile otherwise it is not.

Exercises

It is not important that you be able to calculate IRR usin the formula. For the purposes of this course, it is onl important that you gain a general understanding of the theor and be able to use a software package that will do th calculations for you. After completing the following exercises go the supplemental instruction manual and software package fo IRR.

1. List and define two challenges to cost-benefit analyses.

_____

_____

_____

_____

2. According to Levin, what type of educational interventio lends itself best to a CB analysis?

_____

3. Under what condition is a cost-effectiveness analysis appropriate?

_____

_____

4. Define "utility" and discuss some advantages of using the cost-utility approach.

_____

_____

_____

5. Discuss the disadvantages in using the CU approach.

_____

_____

6. Your mission recently sponsored a new vocational training center. During the second year of operation, it was found that an increasing amount of the graduates were displeased with the results of their training; however, not all of the complaints came from the same type of training programs. The disatisfaction was so great that it was determined that only those programs which could most enhance the overall earning power of the graduates would continue.

What would be the usefulness of conducting a cost analysis? How would you measure the cost? How would you measure the benefits? How should your results be used to make a decision?

7. Discuss an education evaluation with which you are familiar. Describe the problems that were addressed and the alternatives that were considered. What measures of effectiveness were used? Were there other measures that could have been used?

8. A recent sector assessment indicates that grades 1 - 6 in your country have an increasing dropout rate. The increased dropouts are concentrated in rural areas. The following solutions have been suggested:

a. Provide school lunches and transportation.

b. Improve the quality of instruction through teacher training.

c. Revise the curriculum to make it more relevant to rural life.

You are asked to design a cost analysis that can evaluate these alternatives. What type of analysis will you use and why? How will you measure the cost of each? How will you measure the outcomes of each? What will be the criterion for your decision?

_____

_____

_____

_____

_____

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_____

_____

9. Your mission is considering an extension of a current education administration project. The follow-on project would add a component. The following components have been proposed:

a. program and policy planning;
b. curriculum and educational materials development;
c. research and evaluation; and
d. administrative structures and practices.

Outline procedures for a CU analysis that will assist the mission in choosing the best component to add to the project.

Answers

1. (1) time period--most analyses are done over a short period of time; this makes it difficult to accurately measure the long-term impact of the program; (2) comparisons--it is difficult to select an appropriate control group and to monitor all factors that may have an impact. Levin, p. 112

2. Interventions that produce labor market outcomes; interventions that can be evaluated in terms of the additional earnings generated among participants by their training or education. Levin, p. 113

3. Cost-effectiveness analysis is appropriate when one is trying to choose from among competing alternatives that would accomplish the same goals. Levin, p. 114

4. Utility refers to the measurement of the degree of happiness or satisfaction provided by an intervention. It has the advantages of flexibility, time, and few information requirements and restrictions. Levin, p. 117

5. The primary disadvantage is that it is so subjective. This makes it difficult to design a system to rate alternatives and a system to obtain overall utility ratings for each alternative. Levin, pp. 117-121

6. The purpose of an analysis would be to compare the costs of each program with its benefits. To determine the total cost, you must consider the cost per student of the training and the forgone earnings of the participant during training. Benefits could be assessed by doing a follow-up survey to see how graduate's wages were affected by their increased skills. Levin, p. 108

The overall benefit of each program would be the additional earnings per graduate relative to what would have been earned without the training. Poor

placements will be reflected in unemployment or underemployment, which will result in low annual earnings for graduates.

After collecting the cost and benefit data you can calculate a CB ratio for each program. The programs with the highest CB ratios would be the first eliminated.

7. This answer depends on the evaluation you chose to discuss. If you have any difficulty answering the questions, return to the text. — Subjective

8. A cost-effectiveness analysis would be most appropriate. The CE analysis would allow you to compare costs per student to enrollment rates. The costs of the programs could be easily determined by the ingredient approach to cost analysis (i.e., with a worksheet). — Levin, p. 113

Outcomes will be a bit more difficult to estimate. There appear to be two possible approaches: (1) through a survey to determine how many of the previous dropouts would have continued their schooling if, for example, school lunches and transportation had been provided; (2) by a survey of other similar schools which have attempted the same changes to determine how the changes have affected enrollment rates. The criterion will be the lowest CE ratio, according to your estimates.

9. (a) Set up a simple utility scoring system. — Levin, p. 116

   (b) Ask those involved in the current project to evaluate the components using the utility scoring system.

(c) Calculate an average utility score.

(d) Estimate the additional cost for each component.

(e) Carry out the CU analysis, setting up a ratio between the utility score and the estimated costs.

(f) Choose the component with the lowest CU ratio.

LESSON 7
THE DECISION FRAMEWORK

OBJECTIVES

To understand the decision-making process and how cost analysis can be used to make decisions.

READINGS

Levin, Chapter 2, pages 34-41
* Identification of the Problem
* What are the Alternatives?
* Who is the Audience?

Chapter 5, pages 99-103
* Costs and Decisions

Chapter 7, pages 132-44
* Use of Results
* Using Reports that Provide Cost Analyses
* Checklist for Evaluating Cost Analysis Reports
* Design and Implementation of Studies--Next Steps
* Incorporating Cost Analysis into Evaluation Designs

INSTRUCTIONS

First turn to the Levin primer to read from Chapters 2, 5, and 7 regarding the use of cost analysis in decision making. After Levin, return to the manual, read "Decision Making in Cost Analysis" and do the exercises.

DECISION MAKING IN COST ANALYSIS

Cost analysis must be considered early in the design stage and through the evaluation stage. Since budgets do not usually reflect the true costs of the ingredients, we should attempt to account more fully for the resource ingredients from the beginning. Data are normally collected for evaluation during the functioning of the project prior to the evaluation process. Similar procedures should be extended to cost analysis. Cost analysis procedures should be constructed in the evaluation designs prior to the evaluation process. One must be aware always of possible cost implications. It is equally important, for example, that cost analysis be considered during the implementation stage so to be prepared for a final evaluation just as it is important to consider implementation costs during the design stage.

Cost analysis has important uses, however we must not overvalue its usefulness. No matter how precisely the analysis data were collected, they are just estimates. Futhermore, the data collected it is absolute, for it is always affected by the subjective evaluations of the individuals who collected it.

Second, there are times when our cost comparisons do not produce significant results. Given similar results in cost evaluation analysis, we should examine institutional, organizational, or human factors which might make one alternative easier to implement than the other. As a rule of thumb, if the present program is slightly inferior to a radically different program, we would rather go with the existing program because we are sure that it can deliver the promised results. The rationale is that the existing program is a proven one while the new one has not been tested in this particular organizational setting. There is a host of other factors which cannot be quantified, but which actively affect the operations of the programs.

Exercises, Set A

1. What explanations could be used for the problems in each of the following cases?

   a. The scores of secondary students have been declining over the past five years.

   _____

   _____

   b. The Private Enterprise Management Center is progressively less successful in placing its participants.

   _____

   _____

   c. Recent data suggest that the radio-based education program is not reaching all the targeted population.

   _____

   _____

2. With each of the three cases above, describe the method you would use to identify the most likely source of the problem.

   a. _____

   _____

   b. _____

   _____

   c. _____

3. Describe the reason that cost-feasibility analyses should precede CB, CE, and CU analyses.

_____

_____

Exercises, Set B

4. What does a marginal cost (and effectiveness) analysis indicate?

_____

_____

5. What is the main problem of scale?

_____

_____

_____

6. The final evaluation of a recently completed nation-wide computer-assisted education project is in its final draft. The evaluation will be sent to your counterparts in other bureaus. What advice and cautions would you give them in considering how to apply the evaluation to their region?

_____

_____

_____

Exercises, Set C

8. Take a specific CE study, from the manual or your own experience. Use the checklist below to assess that study.

a. What is the decision framework?

_____

_____

Answers, Set A

1. Possible answers are: Subjectiv

a. changes in curriculum, changes in test instruments, reduced homework assignments, and reduced teacher certification standards.

b. a less favorable job market; a declining training program; and acceptance of less skilled and motivated participants.

c. the percentage of the targeted population who received radios; the quality of radio reception; the appropriateness of the times of broadcasts; and the level of interest of the targeted population.

2. This answer depends on your answers to the previous question, but for the sample answers: Subjective

a. interviews with teachers regarding curriculum and homework assignments; conduct a longitudinal review of test instruments and certification standards.

b. interviews with employers; review of the training curriculum and the application forms of participants.

c. survey the targeted population.

3. Because a CF analysis determines which alternatives are within the boundaries of further consideration. Levin, p. 100

Answers, Set B

4. Additional costs and additional results that are associated with each additional increment or add-on. Levin, p. 101

5. The main problem of scale is the cost of individual components (variable costs) may change as the scale of the project changes. If the components have Levin, pp. 101-2

fixed costs, scale variance is not a problem. For example, the larger the scale of an intervention, the greater the advantages of alternatives with large-fixed cost components.

6. The most important point to stress is the generalizability of a national study to individual school projects. You should also state ways in which the results were unique to the countries circumstances, suggesting the transferability of the results to other regions. Levin, p. 137

Answers, Set C

7. Your answer to this question depends upon the project you chose. If you have any difficulty answering each of the questions, return to the manual. Subjective

Part II

Economic Evaluation of Education Projects

Agency for International Development Washington, DC 20523

ECONOMIC EVALUATION OF EDUCATION PROJECTS

Part II
Cost Analysis in Education Planning

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Agency for International Development
Training and Development Division
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LESSON 8
COST ANALYSIS IN EDUCATION SECTOR ASSESSMENTS

OBJECTIVES

To become familiar with ways in which we can use economic evaluations in the planning phase; to define the role of sector assessments in educational planning; and to define the role of economic evaluation in education sector assessments.

READING

There is no required outside reading for this lesson. All the material you need is included in the manual.

INSTRUCTIONS

In this lesson you will answer the questions as you go through the material rather than waiting until the end. As you read the material, answer the questions which follow.

The answers are at the end of the lesson. If you cannot answer the questions correctly, reread the section immediately before the questions.

INTRODUCTION

An education sector assessment may be used to identify specific problem areas within the country. For example, the assessment may address the need to increase literacy, reduce repetition, minimize per student costs, and improve methods for measuring academic performance. The assessment not only seeks to identify the country's education problems, but also to determine the magnitude of the problems, the causes, possible solutions, and the costs and benefits of the solutions. When compiled, these studies can be used to determine strategies, policies, programs, and projects.

In addition to analyzing problem issues, an assessment may also address the country's educational problems according to level or type of education. The assessment may, for example, focus on pre-school education, primary education, secondary education, higher education, nonformal education, vocational skills training, management training, or participant training. In the following study each level of education and training is assessed according to access, relevance, and efficiency. The efficiency analysis further considers academic performance, dropout rates, repetition, and per student costs.

In the section that follows, Victor Cieutat defines the relationships between cost analysis, sector assessments, and educational planning. As you read, look for the sort of cost information that is obtained through a sector assessment. Also, look for ways in which cost information from sector assessments can be applied to educational planning.

Definition and Application of Sector Assessments

An education sector assessment is a preliminary overview of the need in formal and nonformal education to: (1) identify a coordinated set of priority areas for the investment of internal and external resources; (2) focus attention on constraints affecting these investments; and (3) encourage coordination of donor assistance. It is meant to replace a project-oriented approach to planning with a comprehensive orientation to use the limited resources available more efficiently for human resource development.

The sector assessment has four basic applications. First, through the involvement of host government officials in its preparation, the assessment will focus their attention on the sector approach. This is especially important because more efficient use of limited resources has become

increasingly critical for developing countries over the past few years. A second application will be to obtain baseline information to permit a more detailed analysis of sectoral needs, constraints, issues, and priority areas for a comprehensive program of development in the education sector. Third, this program is intended to encourage coordination of assistance from all donors. And last, the assessment will serve as the initial version of a continually updated guide to manage all activities in the education sector.

The immediate beneficiary and most significant user of the sector assessment will be the host government. The assessment also will benefit the local USAID mission, other donors, and AID/W. The local USAID mission will benefit by having a basic structure developed for a program of continued and coordinated assistance in the education sector. Other donors will have a way to focus their assistance on priority areas, where their effectiveness will be improved. AID/W will have similar benefits, and in addition will be able to assist in the establishment of a network of developing countries dedicated to a strong sectoral approach to program planning in education.

Approaches to sector assessments will vary with time, country, and sector. Educational sector assessments may address any or all of the following issues:

1. external efficiency
2. internal efficiency
3. access and equity
4. relevance
5. administration and supervision
6. cost and financing

Of the above issues, all may involve some sort of cost analysis. The external and internal efficiency issues, for example, may require data from a CB or CE analysis. For the relevance issue, a CB or CU analysis may be employed to consider the external efficiency of the programs in relation to the demands of the labor market.

Exercises, Set A

1. Why are sector assessments conducted?

_____

_____

2. List three uses of cost information obtained through a sector assessment.

a. _____

b. _____

c. _____

USES OF SECTOR ASSESSMENTS

Instructions, Set B

In the following pages you will learn more about the use of cost analysis in sector assessments. The section on "Planning and Managing an Education Sector Assessment" is particularly valuable in learning the cost issues of efficiency. Here Cieutat discusses two sector assessment issues that make use of cost analysis. Remember, however, that despite its potential application, cost is not always a consideration for all issue areas.

As you read the following, consider ways in which you can apply the results of sector assessments to educational planning. Also, consider the type of people who would find sector assessments useful in their planning.

Revisions and Institutionalization of Sector Assessments

A significant outcome of an intensive education sector assessment is an initial comprehensive program to use both internal and external sources more efficiently. A second and equally important outcome is the encouragement of an approach to resource allocation which recognizes and encompasses the dynamic, evolving, and interactive nature of a nationwide educational system. Thus, the recognition and acceptance of the continuing need to build upon and update the sector assessment is a critical element

in the introduction of this approach to educational planning and allocation of resources.

An important outcome of an education sector assessment, and its subsequent revisions, is the institutionalization of a system-oriented approach to resource allocation and coordination. A prime objective is the introduction of this perspective and capability to the planning agencies of the host government. A significant requirement, therefore, is that host government officials work closely with the assessment team from the beginning. This association should start with the identification of issues and the analysis of basic data, and extend through all revisions and updates. A collegiate association with donor-provided specialists will assist professional planners through the implementation stage.

A second outcome will be the institutionalization of this approach within a network of cooperating countries, encouraging a sharing of expertise, common experiences, approaches to similar problems, and staff. Such a network, if encouraged and supported by the donors, could help to establish this approach on a regional basis.

Exercises, Set B

3. Imagine you have just completed a thorough educational sector assessment. You will now disperse copies among people whom you think will use them for determining strategies and designing projects. To whom will you give copies?

_____

_____

_____

_____

_____

_____

4. You will attach a memorandum to each copy. In the space below, draft the memorandum to your counterpart in the Ministry of Education. You will need to justify why the assessment was conducted (be sure to relate the country's limited resources to the assessment's emphasis on cost analysis) and how the information can be applied to planning.

PLANNING SECTOR ASSESSMENTS

Instructions, Set C

The following reading by Victor Cieutat was written for AI in May 1983. The complete version recommends guidelines fo planning and managing education sector assessments for th developing world. This excerpt describes two issues tha Cieutat recommends for thorough assessments, external an internal efficiency analyses. Included in the complete pape are six additional perspectives: system orientation, nationa goals, education and training goals, access and equity administration and supervision, and costs and financing According to Cieutat, "Consistent application of this mode o inquiry will provide a comparative and useful approach to suc assessments, and can help bring about the formation of a networ of cooperating countries that will be able more easily to shar ideas, experiences, and skills in planning and managin education and training systems."

As you go through the reading, look for methods that coul be considered during the planning process to improve th efficiency of educational programs.

Planning and Managing an Education Sector Assessment

EXTERNAL EFFICIENCY

External efficiency means the relevance of linkages between education and training and the many following activities of program participants. This includes employment opportunities as well as more advanced education and training, continuing intellectual growth, and full participation in society as a concerned citizen.

Note that curriculum has elements of internal efficiency as well as external efficiency. Those concerning external efficiency are related to the suitability of linkages to post-program activities. For example, do skills taught in a program to prepare paramedical workers for rural areas include those required to treat the most common diseases and injuries which can be handled there in a cost-effective way? Aspects of the curriculum related to internal efficiency, as discussed below, include process-related elements such as organization, scope and sequence of topics, and suitability of the content to the environment.

A basic and pervasive problem in planning external efficiency for education and training

systems, and in evaluating such systems, is predicting employment needs in a dynamic and rapidly evolving economy. It is difficult to predict accurately the types of knowledge and skills required and the numbers of workers. The following paragraphs examine problems of measuring external efficiency for the various sub-sectors of the assessment.

External efficiency for basic education is the least complex. Where the curriculum content does not adequately cover basic skills in literacy and arithmetic, a program of curriculum reform can be very effective. In many cases, however, the curriculum is generally suitable and investments in the improvement and expansion of primary education are justified. This is usually supported by the high social rate of return often found for investments in primary education, and because some basic education is required for all further training. Improvement at the primary level is required for external efficiency to be increased at all other levels.

The quality of secondary academic education varies widely among developing countries. There are some situations where improvement in quality is a higher priority than expansion. A major difficulty in evaluating external efficiency of secondary academic programs is the dual and contradictory function expected of them. Parents and students generally regard a secondary education as an entry qualification for higher education, regardless of the small number of graduates who will have this opportunity. Most secondary school graduates, in fact, go directly into the job market.

This dual and contradictory expectation, compounded in many cases by the lack of suitably qualified teachers, often hinders progress toward both goals. Institutions of higher education frequently spend much of their resources on teaching remedial courses for students who were not adequately prepared in academic subjects at their secondary schools. Also, the traditional academic courses lack relevance to the job market and fail to prepare graduates for employment.

Diversified secondary education has been instituted to solve this problem in a number of countries. Results have not been promising. A major difficulty has been the low motivation of students and parents, who do not view vocational streams as being the path to academic advancement and good jobs. A

second difficulty has been the complexity and expense of diversified secondary education. Problems with obtaining suitably qualified teachers and purchasing specialized equipment, plus the high costs for a technical faculty and for maintenance of the equipment, make this a reasonable approach to education relevance in only a few select situations.

Vocational/technical education, at the secondary and postsecondary levels, has been established in many countries to make education more relevant to job opportunities and to assist with economic development. In evaluating such programs, the assessment team should remember the basic problem of external efficiency cited at the beginning of this section. How well do these schools match their program content to the predicted needs of the economy for particular knowledge and skills and to the required numbers of workers in each occupation? Particular attention should be paid to linkages between the programs and employers in the public and private sectors. These linkages should provide vocational/technical programs with information about the evolving needs for employees in various skill categories. Are students being trained to repair radios and mechanical watches where mass produced and inexpensive transistor radios and digital watches have made replacement cheaper than repair? Are equal numbers of electricians and engineers being trained where there are many more job opportunities for electricians than for engineers? Are physicians being trained where there are more social benefits and employment opportunities for paramedical workers?

In evaluating the external efficiency of vocational technical programs the usefulness of teaching broad categories of skills should be examined. This training may prepare graduates for a wider range of employment opportunities, if it is assumed that on-the-job training for the specific skills is a responsibility often met by individual employers. Such an approach can broaden employment possibilities. It also can reduce program costs, as instruction can focus on a more narrow range of topics.

Training programs for extension workers in agriculture and health also should be examined carefully. Do the programs offer practical experience in these areas or a predominantly academic orientation? Are there packages of information and supplies specifically designed for the programs and

are they used as the basis for training? Are there enough supplies available for the packages to be effective? Is there a suitable incentive system to keep graduates working in the field? Is there sufficient logistic support for program supervisors to be effective?

INTERNAL EFFICIENCY

Internal efficiency means the extent to which available resources are used to produce the maximum desired effects under given conditions. This encompasses quantitative efficiencies related to student flow (e.g., repetition and wastage), student/teacher ratios, distance teaching, and the use of classroom space. Internal efficiency also includes quality of learning as reflected in some aspects of the curriculum (e.g., organization of content, scope and sequence of topics, and appropriateness of the content to the environment), instructional systems, the effectiveness of teachers (e.g., training and supervision), and the suitability and availability of teaching materials. These factors are all discussed in this section.

When resources are limited, as they are in all developing countries, improvements in education and training can be made through better use of existing resources. This perspective of internal efficiency should be used to examine the structure and strategies of each sub-sector. Unit costs per graduate or trainee, and quality of the instructional program, should both be evaluated in regard to possible improvements. Unit costs for program completers are expressed in monetary terms or instructional time (e.g., $3,000 or nine pupil-years to produce one primary school graduate). There are several ways these costs can be reduced.

In formal school systems, wastage associated with dropouts and repetitions is often a major component of high unit costs. In addition to its effect on unit costs, wastage also has undesirable implications for equity because the students most penalized tend to be in rural areas, from lower socioeconomic classes, and female. Strategies that reduce repetitions and dropouts, therefore, can improve internal efficiency as well as equity.

Since some research suggests there are no clear advantages to having students repeat grades, and there are possible adverse effects on attitudes and self-concept, changes in repetition policy offer one

possibility for improving internal efficiency. Although in many cases school leaving may be attributed to economic factors, one problem may be parental attitudes on the value of education. A media campaign might improve the educational level of females, as some societies place a higher value on the education of males. Although repetition and wastage costs are high, they may be necessary to improve equity by allowing historically disadvantaged groups to participate in school systems where there are limited resources for remedial assistance.

Unit costs can sometimes be reduced by the use of higher student/teacher ratios, as these costs are especially sensitive to class size. Since increases in class size do not appear to lower the quality of instruction, within some limits, this option should be examined carefully. There are situations, of course, where increases in class size are not possible. In remote rural areas, for example, a single school often serves all school age children within walking distance. In such cases it is important that expense should not be confused with inefficiency.

The use of multiple shifts can significantly lower unit costs, especially if the same teachers are used for a second shift. An incentive increase for an available teacher is much less than the cost of an additional teacher, both in terms of salary and training expenditures. But as with increasing class size, there are some situations where multiple shifts are not possible.

Distance learning, based on radio with support by printed materials and instructional facilitators, is another way to reduce unit costs. This may be especially useful with extension programs in agriculture, health, and nutrition.

Reductions in unit costs alone will not improve internal efficiency. The quality of instruction deserves particular attention. The assessment should especially emphasize this aspect, as there is a tendency in many developing countries to place undue emphasis on increasing the numbers of graduates and program completers and to neglect instructional quality. This is not surprising, of course, given the compelling social and political pressure to produce graduates. Variables related to instructional quality include some aspects of the curriculum, the instructional system, teaching materials, teacher training, supervision, and achievement testing.

A well developed and clearly formulated curriculum is the foundation of an instructional program. The curriculum should be evaluated carefully by the assessment team, because it is often more like a table of contents with a list of instructional topics than an instructional guide. It should specify the basic skills in all content areas related to the program purpose. The sequence of the topics should be based on a logical progression through content of increasing and related complexity. If an adequate curriculum does not exist, this would be the most reasonable place that a plan for improving internal efficiency might begin.

The instructional system is the coordinating structure that brings all elements of the teaching process to focus on a common set of program objectives. Many opportunities exist for improving instructional systems in most developing countries. Since educational planning generally emphasizes structural aspects of education and neglects process-centered components, applications of appropriate and low cost instructional technology often can bring about significant improvements in learning.

Computer based instruction and audiovisual systems using slide-tape methods or video cassettes, while not yet appropriate for most primary and secondary levels in developing countries, may be very cost-effective for highly centralized instruction of relatively small groups. Examples might include management training, vocational/technical training, and extension agent training.

Teaching materials are not generally available in suitable amounts, and increasing their supply can significantly improve achievement. In practically all situations in developing countries the single most cost-effective action that can be taken, especially given the usual shortage of suitably qualified teachers, is to increase the supply of textbooks. Related to this is the importance of teachers' editions especially prepared for teachers with minimum formal teacher training.

Support materials are also in short supply in most cases. This ranges from simple items such as pencils, paper, and chalk in many rural areas to the lack of technical equipment in vocational and technical training institutes. In all cases, providing more instructional materials can greatly

increase the efficiency of existing investments in buildings and teachers.

Extension programs in health and agriculture often are ineffective because they lack suitably prepared packages of information for extension agents. This problem is often compounded by shortages of materials such as medicines, fertilizers, and simple tools, and of related printed support posters, pamphlets, and other items.

Another aspect related to quality of instruction is teacher training. Programs for the preparation of teachers often emphasize instructional time rather than acquisition of skills. The introduction of competency-based instruction into teacher training institutes is an excellent example of a way to make more effective use of existing resources.

Supervision of teachers and extension agents is not often done effectively. Shortages of qualified staff and transportation difficulties are common problems. Investments which improve supervision in these areas can be very cost-effective.

TESTING EFFICIENCY

It is difficult to quantify and monitor the quality of instructional programs without suitable achievement testing of the participants. In cases where there are centrally administered examinations, these should be evaluated with respect to reliability and coverage of course content. Such examinations are often given at the completion of primary school. When professionally developed and administered, these examinations can serve as a very effective means of educational quality control. They also can be used as a rough guide to identify schools or regions where achievement is relatively low and where selective allocations of additional educational resources can be made to correct imbalances in educational opportunity.

Objective measures of competence are rarely found outside the formal school system. Introduction of such measures into training programs for managers and extension agents, in place of certification based only on attendance, can improve the internal efficiency of such programs.

The preceding discussion of factors affecting costs and quality of instruction should serve as a guide to the assessment team in identifying areas of emphasis. Recommendations should not be made in all

of these areas. Instead they should be tailored to specific local needs where the greatest internal efficiency improvements can be made with the minimum allocation of additional resources or the reallocation of existing resources.

Exercises, Set C

5. The mission and host government are trying to design a project that will improve the external efficiency for higher education. Suggest challenges and contraints they should consider in their planning. What are some possible approaches to the issues?

_____

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_____

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_____

6. A newly proposed secondary education project has been rejected because of its internal inefficiency. Suggest three possible ways to reduce the unit costs.

a. _____

b. _____

c. _____

7. Before a hypothetical Rural Primary Education project can receive Ministry of Finance funding, it must be demonstrated that the project will improve efficiency in the quality of instruction. Please suggest five areas in which changes could help to improve the efficiency by improving internal effectiveness.

a. _____

b. _____

c. _____

d. _____

e. _____

Answers, Set A

1. Sector assessments are conducted so that specific problem areas within the country can be identified. They also help determine the magnitude of the problems, the causes, possible solutions, and the costs and benefits of the solutions.

2. Cost information obtained through sector assessments can assist in:
   a. setting priorities for investment of resources;
   b. analyzing contraints affecting these investments;
   c. encouraging coordination of donor assistance.

Answers, Set B

3. It would be useful to give copies to any or all of the following:
   a. Host country counterparts
   b. Donor counterparts
   c. Mission Director
   d. Mission Program Officers
   e. Education Officers
   f. AID/W Project Officer

4. Your memorandum may take any format or style you choose. The following is a sample memorandum.

MEMORANDUM

Attached please find a copy of the most recent Education Sector Assessment for Country X. The U.S. Agency for International Development, together with your government officials and other donors, conducted this assessment to provide a preliminary overview of needs in the country's education system. In addition, we sought to determine the magnitude of the problems, the causes, the possible solutions, and the costs and the benefits of the solutions.

We trust you will find this information useful as you address growing education needs in a country with limited financial resources. The suggestions included in the assessment provide a framework for a comprehensive program to use both internal and external sources more efficiently.

We appreciate the contribution of the Ministry of Education to this assessment. We look forward to working with you on a system-oriented approach to resource allocation and coordination.

Answers, Set C

5. One of the most basic challenges the mission and host government should remember in planning external efficiency is the problem of predicting employment needs in a dynamic and rapidly evolving economy. It is difficult to propose projects that will have favorable rates of return, especially when you are unable to predict accurately the future demands for knowledge, skills, and number of workers in various fields.

The Mission and host government will face at least two other significant contraints in their effort to encourage efficiency. First, institutions of higher education could increase their efficiency if they were able to devote more resources to teaching courses of higher education. Their ability to do this would largely depend upon the ability of the secondary schools to graduate students who are better prepared for higher education.

Second, higher rates of return could be achieved through placement of more graduates in suitable employment. This would require that courses be designed to give students skills and knowledge that are demanded in the job market.

6. Three possible ways to improve the internal efficiency by cutting unit costs are:
   a. use higher student/teacher ratios;
   b. use classroom and teachers for multiple shifts; or
   c. use some form of distance teaching.

7. Five areas in which changes can be made to improve efficiency through improvements in internal effectiveness are:
   a. curriculum
   b. instructional system
   c. teaching materials
   d. teacher training
   e. supervision

LESSON 9
COST-FEASIBILITY ANALYSIS

OBJECTIVES

To understand the process and result of conducting a cost-feasibility analysis.

READING

There is no required reading other than that contained in the manual.

INSTRUCTIONS

Because the main purpose of the lesson is to apply the principles of cost-feasibility, you will have the opportunity to estimate cost using the ingredient approach. As you read the material you will be required to use the information in completing cost estimate worksheets. You will also be required to answer questions regarding concepts.

Answers to the questions as well as completed worksheets are at the end of the lesson. Use these to confirm or correct your answers and to help you know what you need to review in the material.

INTRODUCTION

In the previous lesson you learned how a sector assessment is conducted. The sector assessment gives initial evaluations of needs and potential solutions; it proposes projects to meet the assessed needs.

After assessing needs and solutions, the next step in planning is to determine which solutions are feasible given the available resources. A project cannot be implemented if there are not sufficient resources. Therefore it is important to be able to estimate the cost of a project and then determine if it fits within the budget. This information is found through a cost-feasibility analysis.

In this lesson Levin and Woo take you through a cost-feasibility analysis. The first thing they do is estimate cost using the ingredient approach. Using this method, Levin and Woo divide all the ingredients into six categories: facilities and equipment; training; personnel; curriculum rental; maintenance; and miscellaneous. After estimating the total cost of each ingredient for the life of the project, they calculate the annual costs and then the average costs.

With these figures they are able to determine whether the estimates fit within the prescribed budget. Then they would know whether the project is cost feasible.

Levin and Woo take it a step further by estimating the marginal cost of sharing the system with another school and estimating the cost of employing a slightly more advanced system.

As you read the Levin and Woo piece, consider the types of information that are necessary for conducting a thorough feasibility analysis. Then apply the information in the cost estimate worksheets throughout the lesson.

After completing the lesson you will not only have a better understanding of how cost-feasibility analysis fits into the whole idea of economic evaluation, but also how conducting such an analysis will assist you in planning educational programs.

AN EVALUATION OF THE COSTS OF COMPUTER-ASSISTED INSTRUCTION

Henry M. Levin
Louis Woo

Abstract

The purpose of this paper is to estimate the costs and cost feasibility of utilizing computer-assisted instruction (CAI) for compensatory education. Cost data were collected from an experiment on the effectiveness of CAI that had been established in Los Angeles, California and sponsored by the National Institute of Education. Based upon the resource ingredients approach to measuring costs, it was found that up to three daily 10-minute sessions of drill and practice could be provided for each disadvantaged child within the 1977-1978 allocation of funds from Title I of the Elementary and Secondary Education Act of 1965. If the computer system were shared between two schools, the higher costs would permit only two daily sessions.

Costs were also estimated for a more advanced CAI system, and somewhat surprisingly the costs were in the same range. This reflects the very heavy cost of "software" that does not seem to decline with more advanced technologies. It is possible that the latter technology will be found to be more effective at the same cost level. However, because comparative effectiveness data between the CAI approach and other instructional strategies are not readily available, such cost-effectiveness comparisons will have to be deferred until some future date.

Text

Various technologies such as educational radio, educational television, and computer-assisted instruction (CAI) have been proposed in recent years as partial solutions to both the problems of rising educational costs and the failure of the educational system to impart basic skills to disadvantaged youngsters. The logic of the cost-saving aspects of educational technologies is conditioned heavily on the assumption that the high labor costs of education can be reduced by substituting relatively lower cost capital inputs without sacrificing education results. The view that certain educational technologies can

improve the quality of educational results for disadvantaged youngsters is based on the fact that approaches such as CAI can be individualized to take into account the particular strengths and deficiencies of the learner.

These assumptions about the comparative advantages of replacing some portion of traditional classroom instruction with a more capital-intensive educational technology would seem especially pertinent in the case of CAI. Recent technological breakthroughs in computers, particularly the advent of minicomputers and inexpensive memory devices, have expanded both the capability and flexibility of computers and have reduced their costs considerably. Also, CAI permits a large variety of methods for individualizing instruction according to the actual performance of the learner. For example, a computer-based curriculum can be automatically designed to provide additional problems in any area in which a student is not performing according to some preset standard. It can also be arranged in particular sequences of instructional tasks that emphasize a student's special needs.

Despite the promise of educational technology in improving educational outcomes and reducing costs, there is little supporting evidence of a rigorous nature for either the relative costs or educational results.[1] In response to this evaluative deficiency, the National Institute of Education decided to undertake an experimental study of CAI in order to evaluate its effects on the improvement of reading, language skills, and arithmetic operations of elementary school children. The experiment was initiated in the fall of 1976 and was designed by the Educational Testing Service (ETS) and implemented in the Los Angeles Unified School District (LAUSD). Known as the ETS/LAUSD Study on Computer-Assisted Instruction and Compensatory Education, the study was intended to ascertain the effects of a particular

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[1]The best studies in CAI are Jamison et al. (1976 and 1970). However, cost effectiveness analyses of other technologies can be found in Instructional Science (1975). See Carnoy and Levin (1975) for a critique of the methodologies of these studies.

computer-based instructional system and curriculum on student test scores in three subject areas as well as the costs for replicating this particular system.

The research design was constructed to ascertain educational effectiveness by test scores in reading, arithmetic, and language arts at different elementary grade levels. The evaluation was to determine the effects of 10-minute daily sessions of CAI on student achievement. Comparisons of test results for disadvantaged students are being made according to the number of daily sessions of CAI, the subjects in which CAI sessions were given, and the number of years in which students received CAI. The studies of effectiveness are intended to reveal the educational impact of this particular CAI approach across subject areas, grade levels, amounts of exposure, and different types of students (race, sex, ethnicity, and socioeconomic status).[2]

The evaluation of the effectiveness of this CAI approach does not address the issue of costs. Given the focus on the educational needs of disadvantaged students, two questions arise pertaining to costs. The first question is based upon the assumption that funding for special educational services for disadvantaged students is derived primarily from special categorical aid for that purpose, such as Title I of the Elementary and Secondary Education Act of 1965. Therefore, it is important to know if CAI can be provided within the budget that is available for these compensatory educational services. Second, it is important to know if the CAI approach can improve the educational proficiencies of disadvantaged students at costs that are similar to or less than those associated with other instructional alternatives.

The first issue is one of cost feasibility. If the costs of this CAI approach exceed the funds available for instructional purposes for disadvantaged youngsters, it will not be within the boundaries of feasibility. The second issue is one of cost effectiveness. Even if CAI can be provided within the

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[2]Preliminary findings are reported in Holland, Jamison, and Ragosta (1980).

present budgets for compensatory education, it should be adopted only if it provides better results relative to its costs than do existing alternatives.

Cost feasibility can be examined by evaluating the costs of CAI and ascertaining whether they are within the budgetary allocations provided for compensatory education by Title I of the Elementary and Secondary Education Act of 1965 or by various state and local compensatory programs. Cost effectiveness comparisons can be made only by comparing both the results and the costs of the CAI approach with the results and costs of other instructional alternatives.

Although this study can establish the CAI costs, it is not designed to pursue its effects. However, the overall CAI experiment on which this study is based will provide rather sophisticated estimates of test score results associated with student exposure to different amounts of CAI in different subjects. Accordingly, the costs that are estimated in this study can be combined with the experimental effects of CAI for cost effectiveness comparisons with other instructional approaches.

In this paper we will estimate the cost of replicating the ETS/LAUSD system in other school settings. In doing this we will limit costs only to those associated with the delivery of CAI, while omitting costs that are tied uniquely to the experimental status of the present system. We will be concerned with the costs of introducing this particular CAI approach into schools outside of the present experimental situation. At the same time, we will be concerned with modifications of the experimental CAI that might affect costs. In particular, there is a later version of the present computer that is more advanced. The cost implications of the newer computer will be examined after exploring the costs of replicating the present experimental approach.

In this paper, we first describe the present CAI system and its configuration in the ETS/LAUSD schools. Second, we outline the costing methodology used in this study. Third, we estimate the cost of replicating the present CAI system. Fourth, we evaluate the cost feasibility of adopting this CAI system for compensatory education as well as the cost implications of a more advanced system.

Exercises, Set A

1. In the first two pages, Levin and Woo make efforts to assure that you are all starting with a common understanding. They do this by outlining their assumptions. List two of their assumptions and briefly describe how changing these assumptions might change the cost estimates.

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_____

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2. Given limited resources and the expressed focus on educational needs of disadvantaged students, Levin and Woo address two types of cost analysis that should be considered. What are they?

a. _____

b. _____

3. The ETS/LAUSD case has unique qualities and therefore the budget figures cannot be transferred completely to other cases. What is unique about this case? What two things must be taken into consideration when transfering the results of the ETS/LAUSD case to other cases?

_____

_____

_____

_____

The System of Computer-assisted Instruction

The purpose of this section is to provide a brief summary of the implementation of computer-assisted instruction in the ETS/LAUSD study. This description is of special importance because each CAI approach and installation is associated with different resource costs and effects. The ETS/LAUSD experiment is based upon a particular computer system and curriculum that have been utilized in a specific way. Therefore it is important to provide some description of the system and its application. It is equally important to bear in mind that the evaluation of this particular CAI approach with respect to costs or educational effects cannot necessarily be generalized to other CAI approaches. Rather, all results will be limited to the specific CAI application that is being evaluated.

The heart of the ETS/LAUSD instructional approach is the use of the A-16 computer for providing drill and practice instruction for the students. Each student is seated at a terminal that consists of a keyboard reasonably similar to that of a typewriter, and a cathode ray tube (CRT) that is similar to a television screen. Each A-16 can be used to service up to 32 terminals simultaneously. The A-16 contains curricula for all elementary grades for each of the three subject areas: mathematics, reading, and language arts. Each session lasts for ten minutes, although some students may be assigned to undertake more than one session per day.

Each student signs in at his terminal and begins the session where he left off in the previous session. A problem is displayed on the CRT, typically in a multiple-choice or a "fill in the blank" format. For example, the student might be given a problem in arithmetic operations such as vertical addition or subtraction, and he must type in the solution. Or, the student might be asked to fill in the correct form of a verb in a sentence. If the answer is correct, an asterisk is displayed on the CRT; if it is incorrect, the student is so informed. In either case, a new problem is displayed. When a student achieves adequate proficiencies on a particular part of the curriculum--as evidenced by a high enough proportion of correct answers--the system provides problems of the same type at a higher level of difficulty. The curriculum is not designed to introduce new material as much as it is to provide an opportunity to practice concepts that have already been taught.

Two principal personnel assist the students in working with the CAI system. A **coordinator** is responsible for the entire operation in a particular school including: the scheduling of students; the distribution of summaries of progress for each class to the classroom teachers (available from a printer that is attached to the A-16); the security and condition of the equipment; and, the overall supervision of students working at the terminals. The coordinator is assisted by a **teaching aide** who monitors the students and answers their questions or assists them when they are having difficulties.

The ETS/LAUSD experiment was based upon results from four experimental schools and two control schools that did not receive CAI. Two of the four experimental schools were large enough to utilize an A-16 with a full complement of 32 terminals. The other two schools had smaller student populations, so they shared an A-16 through the use of telephone lines and special equipment (multiplexer and modems). Each of these schools had 16 terminals installed so that the shared A-16 was also attached to a total of 32 terminals. The CAI rooms had to be modified to accommodate the special configuration of equipment as well as to assure the security and appropriate climate and humidity for maintaining the computer.

Exercises, Set B

4. In this section Levin and Woo describe CAI in further detail. This summary is based on three additional assumptions that affect the cost and effectiveness estimates. List these assumptions.

a. _____

_____

b. _____

_____

c. _____

_____

Costing Methodology

The concept of costs typically tends to be confusing to evaluators. Often the tendency is to review budgets to estimate the costs of a particular project. But the costs that one finds in a budget or accounting statement are often in error or are misleading for a number of reasons. First, budgets typically show estimated costs rather than actual ones. Second, budgets often indicate costs of resources that will be used over different time periods. For example, although salaries in a given year will cover the labor services during that period, a piece of equipment may be utilized for many years. Yet the cost will be assigned only to the year in which the equipment was purchased, whereas it should be divided over the entire period of use on an annualized basis. Third, costs of contributed inputs are not included in budgets, resulting in underestimating the true costs of a project. Finally, some budgetary costs are distorted because they represent special purchases or transactions that do not reflect the true market values of the transactions.

A more appropriate method for estimating costs is to use the ingredients method.[3] This method is based upon the assumption that whenever resources that have alternative uses are allocated to a particular activity, those resources have a cost to society. The cost is equivalent to the value of the resources in their most productive application. The typical way of estimating these costs is to use the market value of the resource. To obtain the annual costs of an alternative, the costs of various ingredients that are utilized over more than one year are "annualized" in order to charge to each year only the costs for that period. Because other sources can be used to evaluate the techniques of cost analysis within this framework, we will not discuss these techniques in detail.[4]

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[3]Virtually all the issues discussed here are reviewed methodologically in Levin (1975). The best application of costing methodologies in instructional technologies is Jamison et al. (1978).

[4]Ibid. This paper will not include student time as a resource because it is difficult to place a value on this dimension. However, alternative strategies with different demands on student time should take this component into account.

The following steps are necessary for estimating costs, using the ingredients approach.

1. List all ingredients or resources required for implementing the instruction.

2. Estimate the costs of each ingredient on the basis of actual costs or estimated market values.

3. Convert costs into the appropriate categories for analysis such as annualized costs, average costs, or marginal costs.

In this particular case we wish to estimate the costs for replicating the ETS/LAUSD system of CAI in other educational settings, and to evaluate costs under different organizational arrangements.

Exercises, Set C

5. Levin and Woo are not satisfied with a budget or accounting statement for determining cost estimates. List four reasons these documents are often in error or are misleading.

a. _____

_____

b. _____

_____

c. _____

_____

d. _____

_____

6. What alternative approach do they suggest for estimating cost? Why is it better?

_____

_____

_____

CAI Ingredients and Their Costs

Before listing the various ingredients of the CAI system and their costs, the classification and source of the cost information should be mentioned. The classification of ingredients can be done in any way that is functional to the questions that will be raised. For example, one can classify ingredients under personnel, facilities, equipment, and miscellaneous categories. Or one can set out categories of ingredients that represent fixed investments as well as those that represent recurrent cost items. The main criteria are that all ingredients are accounted for, and that the categories are useful for analytical purposes.

The derivation of cost information for the various ingredients will be done in a number of ways. Where budgetary and accounting information are appropriate they will be used. Where such cost data are inappropriate or misleading, other methods of obtaining costs will be utilized. In all cases the sources of the cost estimation will be specified as well as the methods of cost estimation. In this way the reader can ascertain how the costs were derived. It is also possible to modify the assumptions of cost estimation to determine the sensitivity of costs to different premises.

COST ESTIMATES

For purposes of cost estimation, the ingredients of the CAI approach will be divided into six categories: (1) Facilities and Equipment; (2) Training; (3) Personnel; (4) Curriculum Rental; (5) Maintenance; and (6) Miscellaneous Factors. Each of these will be evaluated in turn, and they will be combined in analyzing the overall costs of CAI.

Facilities and Equipment

Equipment and facilities are the first considerations for estimating cost for CAI. In the case of the Los Angeles experiment, the equipment for a school using a single A-16 computer, 32 terminals, and a printer is estimated at about $121,000. The complete breakdown for each type of equipment is shown in Table 1 below. The table also presents the estimates of facility costs. These include the cost of construction of a normal instructional classroom as well as the renovations that must be made to accommodate

CAI.[5] The $18,500 renovation cost includes carpentry work, protective devices, electrical work unique to the CAI installation, and air conditioning. In 1977-1978 the facilities costs were estimated to be about $68,500, and the total value of the equipment and faclities was assessed at almost $190,000 per school.

TABLE 1 FACILITIES AND EQUIPMENT, 1977-1978

Facilities		
Cost of construction of a CAI room	$50,000.00	
Renovation cost	18,500.00	
Total		$68,500.00
Equipment		
One A-16 computer system	$68,120.00	
installation	3,000.00	
32 Hazeltine Modular I terminals at $1,440/ea.	46,080.00	
delivery at $63/ea.	2,016.00	
One Hazeltine Thermal Printer	1,950.00	
delivery	23.00	
Total		$121,189.00
Total Facilities and Equipment		$189,689.00

[5]As school enrollments decline, it is common for some observers to question whether any cost should be attached to newly available classrooms that are no longer needed to service regular enrollments. However, such facilities are not costless as long as they have alternative uses. In fact, there are many alternative uses as evidenced by the expansion of special education programs, rental of rooms to other public agencies, or the closing of schools and their rental or sale.

However, we are not concerned with the total costs of these ingredients as much as we are with their annualized costs. A classroom is assumed to have a life of 25 years, so that only about 1/25 of the cost should be allocated to a particular annual period.[6] The renovations are assumed to have a life span of ten years, and the equipment is estimated to have a life span of six years.[7] In each case we must use a standard approach to convert the overall costs into annualized ones, where the annualized cost represents the depreciation and interest costs foregone on the investment for each year. The annualized cost will depend on three factors: (a) the overall investment cost; (b) the life of the facilities or equipment, or the amortization period; and (c) the rate of interest on the investment that is foregone.[8]

Table 2 shows the annualized values of facilities and equipment costs. The 1979 rate of interest on U.S. treasury bonds of about 10 percent seems to be a reasonable figure for calculating foregone interest on the investment. Refer to the information on Table 1 of this text and the Annualization Factors Table in the Levin primer, page 70, to complete the following table.

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[6]The useful life of school facilities is taken from estimates by LAUSD administrators.

[7]CCC staff gave us a figure of 6-10 years depending on level of utilization and assessments of technical obsolescence. We have used the six-year figure because of the predicted intense use of the equipment. However, extending the estimated life to ten years would have the effect of reducing the overall instructional costs by no more than 2-3 percent.

[8]See Levin (1975) and Jamison et al. (1978).

Exercises, Set D

TABLE 2 ANNUALIZATION OF FACILITIES AND EQUIPMENT COSTS, 1977-1978

Cost Categories	Amortization Period (years)	Cost	Annualization Factor	Annualized Cost 10%
<u>Facility</u>				
Construction of a CAI room	25			
Renovation	10			
Facility subtotal				
<u>Equipment</u>				
Equipment subtotal	6			
Total				

Training

Training costs are composed of two types: direct and indirect. The direct costs are the most obvious ones, consisting of such items as salaries of instructors and costs of materials. The indirect costs refer to the value of the trainees' time. In the case of the ETS/LAUSD project, the direct costs of training were included in the costs of equipment by CCC. However, the indirect ones had to be borne separately. According to the experience of CCC personnel, it is usually sufficient to provide workshops of 1.5 days for coordinators and 0.5 day for teachers. The cost for each teacher and coordinator will vary according to experience, training, and the salary levels in the particular school district. However, in Los Angeles in 1977-1978, salaries and fringe benefits averaged about $20,000 for a school year that was not more than 200 days. This suggests that a pay rate of about $100 per day is an appropriate basis for calculating costs of the time required by teachers and coordinators to obtain training. For forty teachers in an elementary school, the indirect costs of teacher training are about $2,000 for a 0.5-day workshop and about $150 for a 1.5-day workshop for the coordinator. Thus, the total estimated indirect costs of training are about $2,150.

How does this figure translate into an annualized cost, however? It is unlikely that training costs of this magnitude would be required for each year, for the carryover of trained teachers and coordinators from year to year would be rather high. Yet any turnover of teachers will require some training to take place each year, even if it is merely the coordinator taking the teacher away from his classroom duties for half a day for instruction. For example, with a turnover rate of 10 percent per year, about four new teachers would have to be trained each year at a cost of about $200. In fact, after the first year this would be the only cost of training as well as the interest foregone on investments for training in previous years. If we use those two components to estimate costs, the total indirect training costs would be 10 percent of the previous investment in training per year plus the costs of training new teachers. On the average, 10 percent of the training investment over a six-year period would be about $250 and the indirect cost of training four new teachers a year would be about $200 for a total of $450 a year. Whatever the assumptions are about the costs of this component, the overall cost implications

are so small that they will have little impact on the total cost calculations.

Personnel

Personnel ingredients for the CAI demonstration include administrative resources, the CAI coordinator, two teaching aides, and substitutes to cover the absences of the coordinator, as shown in Table 3.

TABLE 3 ANNUAL PERSONNEL COSTS, 1977-1978

Administration	$ 1,965
CAI coordinator	22,500
Fringe benefits on above at 16.7%	4,086
Two teaching aides	5,220
Substitutes	780
Total	$34,551

The function of the administrative personnel is to negotiate the contracts with the companies that maintain the equipment, to arrange payments, and to provide general financial and logistical administration of the project. The annual personnel costs for this function in 1977-1978 were estimated at $1,965 on the basis of previous experience of the Los Angeles schools with these types of projects.

The CAI coordinator is responsible for the overall functioning of CAI including scheduling and coordination of instruction, reports to teachers on student progress, and monitoring of equipment functioning and maintenance. Maintenance is especially important because equipment failures result in the loss of instructional sessions. Accordingly, the coordinator must be aware of problems and their solutions. Further, the coordinator must work closely with classroom teachers to integrate the drill and practice sessions of CAI with classroom work.

In the ETS/LAUSD case, the coordinators were so carefully chosen and so well trained that they needed little administrative supervision from the school principal or other school administrative personnel.

Whether this high level of initiative and independence can be maintained in a replication is problematic. However, based upon the success of coordinator autonomy in ETS/LAUSD, we have not indicated any supervision in the cost estimates. The cost of the coordinators can be determined directly by calculating salaries and fringe benefits. The salary component was estimated at $22,500 and the fringe benefits for that portion of the administrative costs and the coordinator were $4,086. Fringe benefits do not apply to the other personnel categories because of their part-time nature.

Teaching aides monitor the performance of students and assist them in understanding the CAI problems and in solving them. Essentially they circulate among the students offering assistance or supervision when needed. Their rate of pay in 1977-1978 was $4.35 per hour, and it takes two teaching aides working about 600 hours each school year to assist in a CAI room with 32 terminals. This particular arrangement has been considered highly satisfactory by the Los Angeles coordinators. The total cost per CAI room of the two aides is about $5,220 a year.

Since the regular coordinator can take up to twelve days paid sick leave per year, funds must be available for a substitute teacher to coordinate the program. Therefore, provision for up to twelve days of substitute teaching at about $65 a day would cost $780 per year. Based on these amounts, the personnel costs per year for 1977-1978 totaled about $34,551.

Curriculum Rental

The curricula that are used for the CAI approach are rented from CCC, the company that provided the A-16 system. The rental covers the cost of using the three sets of subject curricula in mathematics, reading, and language arts. The cost of the rental is set at $205 a year for each of the 32 terminals in a CAI room, for an annual total of $6,560.

Maintenance

The provision for maintenance of the equipment is arranged through contracts with firms that specialize in such care. Although some of the maintenance is routine and periodic, a major requirement is emergency services to repair malfunctions. The annual cost of maintaining the A-16 computer in 1977-1978 was $6,120 a

year and each of the 32 terminals has a maintenance cost of $300 a year, or $9,600 for all terminals in a CAI room. The thermal printer has a maintenance cost of $360 a year. Thus the total cost of maintenance is about $16,080 a year.

Miscellaneous Factors

Miscellaneous cost factors include insurance, supplies, and the costs of energy and routine maintenance of the classroom. The appropriate insurance costs are those that are incurred directly from the CAI facility and equipment, including the additional insurance costs for theft, fire, and liability. Of these components, it appears that liability insurance is largely unaffected, and the impact on fire insurance costs is not readily ascertainable. However, the additional theft insurance for the equipment was estimated by the Los Angeles school authorities at about $3,000 a year for the computer, 32 terminals, and printer. The use of only the theft component may understate slightly the true insurance costs by omitting the fire component. However, the overall omission is likely to have a relatively small effect on total costs, for insurance represents a very small relative cost item.

The category of supplies, energy, and routine maintenance of the classroom contains many items. Supplies typically include pencils, paper, books, and paper for the printer. Energy and telephone costs and facility maintenance includes: the telephone in each classroom that is necessary for rapid access to maintenance personnel and CCC in case of breakdowns; normal heating, lighting, and power for the equipment; and routine cleaning and maintenance of the classroom. Taken together, these are estimated at about $3,000 per year. Again, even substantial changes in this amount would have little effect on overall costs per student session because of the relatively small magnitude of costs for this category. Each classroom is capable of providing a daily session on an annual basis for over 700 students, so an error of $1,500 is only about $2.00 per session.

Exercises, Set E

Fill out the following summary using the above information to determine the total annual costs for this project.

TABLE 4 SUMMARY OF ANNUAL COSTS

Facilities and equipment	$ _____
Personnel	_____
Training	_____
Curriculum rental	_____
Maintenance	_____
Miscellaneous	_____
Total	$ _____

Average Cost per Session

It is important to know the cost per session on an annual basis for each student. This is the cost for providing one daily session of ten minutes of drill and practice for a full school year to each student. This particular cost figure is important because it enables us to ascertain the cost feasibility of this approach to CAI as a method of providing compensatory education to disadvantaged youngsters. It would also allow comparisons of the amount per session with the average amount of compensatory funds provided by the federal government under Title I of the Elementary and Secondary Education Act of 1965.

The cost per session depends on the number of daily sessions that can be provided by the CAI system on an annual basis. This depends not only on the length of the session but also on the organizational capacity and time required to process each group of student users. There must be time between the end of one ten-minute session and the beginning of the next for one group of students to sign off the system and return to class, while a new group arrives, is seated, and signs on. Finally, the number of sessions will also depend upon the overall reliability of the equipment and its operability during school hours.

In theory, the system could be used for up to 6.5 hours a day during regular school hours, if

sessions began at 8:30 a.m. and proceeded to 3:00 p.m. with no interruptions for lunch. In practice, this would be difficult, for time is needed both at the beginning and at the end of the day to do record-keeping and other instructional tasks associated with CAI. Further, it would be difficult to coordinate classes around the lunch period, and a relief coordinator would be needed during that period. Even five sessions of ten minutes each per hour provide only two-minute transition periods. Accordingly, there are clear limits on the numbers of sessions that can be accommodated. Based upon the actual records for the ETS/LAUSD system, it appears that the range varies from 21 sessions to 25 sessions per day, with a median of 23 sessions. On the basis of these experiences, we can estimate the cost per daily session per student for a school year.

Depending on the number of sessions per day for each terminal, a configuration using the A-16 and 32 terminals in a single classroom can accommodate from 672 to 800 sessions a day. Assuming that the most probable estimate is the median of 23 sessions a day per terminal, 736 sessions can be provided. By dividing the number of sessions by the $100,000 estimated annual total cost for this CAI configuration, we can find out the annual cost per daily session. Fill in the following table with that information.

Exercise, Set F

TABLE 5 AVERAGE COST PER SESSION

Number of Sessions per Day		Annual Cost per Daily Session
Per Terminal	For 32 Terminals	
21	672	_____
23	736	_____
25	800	_____

Cost Estimate for the Shared System

Before comparing the average annual cost of a single CAI system with the level of funding available for compensatory education, it is important to estimate the annual cost per daily session when two schools share an A-16 system. When there is not an

student enrollment base in a particular school to accommodate about 700 daily sessions, a system shared with another school may make the project feasible. It can also be helpful in situations where only a particular grade level utilizes CAI. Of course, by providing multiple daily sessions (for example, two sessions a day), an A-16 can be utilized to full capacity by even 350-400 students. However, in the Los Angeles situation, the design of the CAI experiment meant that in two participating schools there were not adequate students assigned to CAI to fully utilize a 32-terminal system in each school. This situation provides us with the opportunity to ascertain the costs of a shared CAI computer.

Exercises, Set G

The basic configuration for the shared system was that the A-16 computer and 16 terminals were placed in one school, and the other connected to the first school through a leased telephone line. Additional equipment was required in order to operate the sharing arrangement because two classrooms must be utilized for the terminals rather than one classroom. Assuming the facility and renovation costs for the second classroom would be the same as for the first, fill in the facility costs on Table 4.

The additional equipment (two modems and two multiplexers) and their installation have a cost of almost $12,500. Remembering that all equipment costs have an assumed lifetime of six years, calculate the annual equipment cost and fill it in the Table. What is the total annualized cost for facilities and equipment? Fill this in the Table.

With respect to personnel for the shared arrangement, we assume that the administrative cost for making financial arrangements and monitoring contracts is roughly equivalent to the single-school approach. However, an additional coordinator is needed for the classroom in the shared configuration, and additional provision for substitutes is necessary. These are estimated to cost about $26,648 per year. The training cost for the additional coordinator is so small that it is inconsequential (about $150 for the 1.5 day of salary) and will not be included in the total.

Additional costs of maintenance seem to affect only the additional printer at $360 a year; the modems and multiplexers are maintained on the basic CCC

TABLE 6 ADDITIONAL COSTS INCURRED FOR SHARED A-16 SYSTEM, 1977-1978

Cost Categories	Amortization Period (years)	Cost	Annualization Factor	Annualized Cost 10%
Facility				
Construction of a CAI room	25			
Renovation	10			
Subtotal				
Equipment				
Two Modems	6			
Two multiplexers	6			
Installation	6			
Subtotal				
Total Facility and Equipment				
Personnel				
One coordinator				
Fringe benefits on above at 16.7%				
Substitutes				
Subtotal				
Maintenance				
Printer				
Miscellaneous				
Grand Total				

Note: It is assumed that the system is shared by two schools in the same local telephone area. If schools are at a greater distance, the miscellaneous cost category will increase according to the increase in telephone charges.

contract so their costs cannot be easily broken out. Miscellaneous costs include the telephone line between schools, routine maintenance of the facilities, lighting, heating, electric power, and supplies. These are estimated at about $3,000 per year. Insurance costs are not affected by distributing the terminals between the two schools. Use the personnel data miscellaneous data to complete the table.

If the total annualized cost of the single system is approximately $100,000 and it costs an additional $41,000 per year to add a system, the total annualized cost for the shared system is $141,000. Figure the cost per daily session with a shared system.

TABLE 7 ANNUAL COST PER DAILY SESSION USING A SHARED SYSTEM

Number of Sessions per Day		Annual Cost per Daily Session
Per Terminal	For 32 Terminals	
21	672	_____
23	736	_____
25	800	_____

Using the average number of sessions per day, or 23, figure the percentage increase in cost that occurs when the system is shared. _____

Cost Feasibility

The purpose of cost feasibility analysis is simply to determine if the costs of the instructional approach can be accommodated within the limits of the budget assigned for such purposes. In order to answer that question, we will compare the costs of CAI with the level of funding provided for compensatory education by Title I of the Elementary and Secondary Education Act of 1965. Presumably the CAI system that is being evaluated is mainly a remedial program of drill and practice.

In fiscal year 1977, Title I had appropriations of about $2 billion for about 5 million youngsters. Thus, on the average about $400 was provided for each of the students covered by the program. But not all of this amount was allocated to classroom instruction. Some was expended on such items as administration, health, diagnostic, and nutrition services. However, let us assume that about $400 per pupil represents an upper limit for compensatory education in the classroom. Using this as a basis for cost feasibility, $400 would cover about three daily sessions of CAI at $136 per session with 32 terminals to a classroom, or two sessions at $192 under the shared arrangement. This means that all three curricula could be provided under the lower cost configuration, or two could be provided under the higher cost one. It also means that two curricula, for example reading and mathematics, could be provided under the lower cost option, while allowing the remaining $128 per student to be used for other purposes. On this basis, one would conclude that the CAI approach that has been evaluated meets a general cost feasibility test. Therefore, it is feasible to consider this approach within the constraints of existing provisions for compensatory education.

Costs of a More Advanced System

One of the major questions that arises in evaluating the costs of a changing technology is the direction and magnitude of future costs based upon more advanced approaches. This is particularly important in any strategy based upon computers because the technology of minicomputers and memory devices has been developing at a rapid pace with drastic reductions in the cost of any given capability. The longer run situation would thus suggest that at least the cost of equipment at a given performance level

would decline, and it is important to ascertain the impact of these potential equipment cost declines on the overall costs of CAI.

However, before examining evidence on this question, it is important to point out a phenomenon that is typically overlooked in predicting cost changes of techological innovation. The annualized costs of all computer equipment, including the terminals, represents only about 28 percent of total annualized costs, as evidenced by comparing the costs of $27,873 in Table 2 with the total costs of $100,000 for a 32-terminal classroom. This means that even a rather drastic reduction in the 28 percent of the cost accounted for by equipment will amount to a much smaller reduction in the total cost. For example, if the cost of equipment declined by one-third, total costs would decline by less than 10 percent. At the same time, the costs of personnel, maintenance, construction, and other personnel-intensive categories are rising rapidly, at least partially off-setting the potential declines in the cost of computer hardware. Accordingly, it is important to recognize that there will be inherent limits to cost reduction for CAI, even with rapid technological improvements in hardware.

In the particular case of the A-16 system, we were fortunate that CCC had developed a more advanced CAI approach during the implementation phase of the ETS/LAUSD experiment. The more advanced computer is the CCC-17, which can drive about 96 terminals rather than the 32 terminals to which the A-16 is limited. CCC also claims that the CCC-17 is more flexible and productive than the A-16 for a number of reasons. First, it uses special terminals provided by CCC that permit more flexible design and format of curricula as well as a wider variety of interactive feedback responses between the pupil and the computer. Second, the central processing unit has a greater capacity for storing additional curricula and can process curricula of a wider variety than the A-16. For these reasons the CCC-17 may also be more effective for each session than the A-16, although that is ultimately an empirical issue rather than a theoretical one. CCC has provided the CCC-17 for one classroom for the final year of the ETS/LAUSD experiment, hence some empirical data should be forthcoming on this issue.

However, the purpose of this investigation is to ascertain the cost per session of the newer technology. We then may compare the larger CCC-17

TABLE 8 ANNUALIZATION COST FOR THREE SCHOOLS SHARING THE CCC-17 SYSTEM, 1977-1978

Cost Categories	Amortization Period (years)	Cost	Annualization Factor	Annualized Cost 10%
Facility				
Construction of CAI room				
Renovations				
Subtotal				
Equipment[a]				
Computer-related				
Installation				
Subtotal				
Total				

[a]Refer to Table 1 for the details. The amortization period for all computer-related equipment is assumed to be six years.

[b]Round numbers to the nearest dollar.

system, capable of supporting 96 terminals, with the A-16 and its 32 terminal system.

Fill in Table 5 with information about the facility and equipment for the requirements of the CCC-17 system, remembering that it uses three classrooms. After completing Table 5, go on to Table 6 to complete calculations for the annualized costs of the CCC-17 system. Then you will be able to determine the annual cost per daily session.

Personnel costs and the indirect costs of training were calculated in the same manner for the CCC-17 configuration as for the A-16 except that they are shown for three classrooms. These and other costs are reflected in Table 6. Curriculum rental was estimated by CCC at $20,857 and maintenance at $42,072. The miscellaneous costs are also similar to those calculated for the A-16. Use Tables 5 and 6 to find the total annualized cost of the CCC-17.

TABLE 9
ANNUAL COSTS OF PERSONNEL, TRAINING, CURRICULUM RENTAL, MAINTENANCE, AND MISCELLANEOUS COMPONENTS OF THE CCC-17

Personnel		
Administration	$ _____	
Coordinators	_____	
Fringe benefits on above at 16.7%	_____	
Teaching Aids	_____	
Substitutes	_____	
Subtotal		$ _____
Training (indirect costs)	_____	
Curriculum rental	_____	
Maintenance	_____	
Miscellaneous	_____	
Subtotal		$ _____
Total		$ _____
Total from Table 5		$ _____
GRAND TOTAL		$ _____

In order to find the average cost per session, we need only divide this annual cost from Tables 5 and 6 by the number of daily sessions provided on an annual basis. Using the information provided below, determine the annual cost per daily session.

TABLE 10 ANNUAL COST PER DAILY SESSION USING A SHARED SYSTEM

Number of Sessions per Day		Annual Cost per Daily Session
Per Terminal	For 96 Terminals	
21	_____	_____
23	_____	_____
25	_____	_____

Comparison of the Two Systems

The above data suggest that the CCC-17 has a cost that is about 5 percent lower per CAI session than the A-16. This represents a rather small difference, especially because it assumes that the CCC-17 is utilized to capacity. One of the advantages of the smaller scale of the A-16 is that it provides somewhat more flexibility. Because it can be utilized in multiples of 32 terminals, there is likely to be less of a problem in under-utilization than a system that must be implemented in multiples of 96 terminals. Because of the high fixed costs of these types of systems, under-utilization hardly reduces total costs at all. This means that one must divide relatively irreducible total costs over fewer sessions, with a marked rise in cost per session. For that reason, the 5 percent reduction in cost per session under assumptions of full utilization would deteriorate rather quickly if the CCC-17 could not be fully utilized at a scale of 96 terminals.

One other point that ought to be emphasized is that of the total annual cost of about $295,000 for the CCC-17, only about $76,000 is accounted for by the cost of the computer hardware. This means that almost three-quarters of the cost can be attributed to factors that are not ostensibly affected by improvements in computer technology, thus limiting the cost savings obtainable by technological advances in the CAI system. In fact, as a general rule, virtually

all technologically-based instructional systems will show that only about one-quarter to one-third of the costs are associated with their hardware. This means that drastic reductions in the costs of such hardware may have only nominal effects on overall costs of the instructional strategy. Further, to the degree that the decrease in even those costs is associated with a larger scale of operation, even these cost reductions may not be realized unless the system can be utilized to full capacity.

It should be noted that according to CCC, the CCC-17 is educationally superior to the A-16. Admittedly the cost per session is not as important as the cost per unit of educational effectiveness. Thus, even if the costs of the CCC-17 are comparable to those of the A-16, a superior level of effectiveness may still make it a better investment. However, without data on the relative effectiveness of the two systems, it is impossible to evaluate this claim.

Summary

The purpose of this study was to estimate both the costs and the cost feasibility of utilizing a particular CAI approach for compensatory educational purposes. Based on the results of the study, the CCC A-16 system ultimately was chosen by the Los Angeles Unified School District. By using the ingredients approach to cost analysis, it was found that up to three sessions of drill and practice of ten-minute duration could be provided for each disadvantaged child at the 1977-1978 level of Title I expenditures. This means that three different subjects could be provided, or that multiple sessions in one or two subjects could be offered, for each child. As such, it appears that the instructional strategy is cost feasible within present provisions for compensatory education. Utilizing the A-16 between two schools would increase costs rather substantially, but two sessions of CAI would still be feasible within 1977-1978 compensatory educational allocations.

Costs were also estimated for the more advanced CCC-17 computer system, and somewhat surprisingly the costs were in the same range as those of the A-16. This finding reflects the very heavy software component of CAI approaches as well as the possibility that the CCC-17 is more effective than the A-16 even though the costs are quite similar. It is clear that

a more exhaustive analysis of the merits of different CAI approaches, as well as a comparison between them and other instructional strategies, will require effectiveness data as well as cost estimates.

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Answers, Set A

1. Assumption #1: the high labor costs of education can be reduced by substituting relatively lower cost capital inputs without sacrificing educational results.

Assumption #2: approaches like CAI can be individualized to address particular strengths and deficiencies of the learner.

If these assumptions hold true, the identified problems can be addressed with CAI. CAI, according to the assumptions, is efficient and can help the needs of individual students. If either of these assumptions are not true, then (a) the cost of CAI will be too high relative to the impact, and (b) disadvantaged students may not receive the individual assistance they need; thus an approach other than CAI should be considered.

2. a. Cost feasibility
   b. Cost effectiveness

3. The LAUSD case was unique in that it was an experiment. In transfering the budget information from the LAUSD to other cases, two things must be considered:

   a. Costs that are tied uniquely to the experimental status must be omitted.

   b. Modifications will likely follow the experimental CAI. For example, costs may change if new equipment is used.

Answer, Set B

4. This cost analysis is based upon certain assumptions. For example:

   a. capabilities and applications equal to the A-16;

   b. the need for drill and practice rather than introducing new concepts; and

   c. a specific number of personnel to assist the students.

Answers, Set C

5. a. Budgets typically show estimates rather than actual costs.

   b. Budgets often indicate costs of resources that will be used over different time periods.

   c. Costs of contributed inputs are not included in the budgets.

   d. Some budgetary costs are distorted because they represent special purchases or transactions that do not reflect the true market values of the transactions.

6. Levin and Woo suggest the ingredient method. This method is based upon the principle of opportunity cost rather than budgetary expenditures. It is thus a better indicator of the actual costs to society. Additionally, the ingredient method requires that costs be annualized. Since resources are often allocated on a yearly basis it is important to know the yearly costs.

Answer, Set D

TABLE 2 ANNUALIZATION OF FACILITIES AND EQUIPMENT COSTS, 1977-1978

Cost Categories	Amortization Period (years)	Cost	Annualization Factor	Annualized Cost 10%
Facility				
Construction of a CAI room	25	$50,000	0.1102	$5510.00
Renovation	10	18,500	0.1627	3009.95
Facility subtotal				$8,519.95
Equipment[a]				
Equipment subtotal	6	121,189	0.2296	$27,824.99
Total				$36,344.94

[a]Refer to Table 1 for the details. The amortization period for all computer-related equipment is assumed to be six years.

Answer, Set E

TABLE 4 SUMMARY OF ANNUAL COSTS

Facilities and equipment	$36,345
Personnel	36,551
Training	450
Curriculum rental	6,528
Maintenance	16,080
Miscellaneous	6,000
Total	$99,985

Answer, Set F

TABLE 5 AVERAGE COST PER SESSION

Number of Sessions per Day		Annual Cost per Daily Session
Per Terminal	For 32 Terminals	
21	672	$148.80
23	736	135.90
25	800	125.00

The annual cost per daily session ($148.80) is found by dividing the total cost ($99,985) by the number of daily sessions (21) when the 32 terminals are in use (672).

Answer, Set G

TABLE 6 ADDITIONAL COSTS INCURRED FOR SHARED A-16 SYSTEM, 1977-1978

Cost Categories	Amortization Period (years)	Cost	Annualization factor	Annualized Cost 10%
Facility				
Construction of a CAI room	25	$50,000	0.1102	$5,510.00
Renovation	10	18,500	0.1627	3,009.95
Subtotal				$8,519.95
Equipment				
Two Modems	6			
Two multiplexers	6	12,500	0.2296	2,870.00
Installation	6			
Subtotal				$2,870.00
Personnel				
One coordinator				22,500.00
Fringe benefits on above at 16.7%				3,758.00
Substitutes				390.00
Subtotal				$26,648.00
Maintenance				
Printer				360.00
Miscellaneous				3,000.00
Subtotal				$3,360.00
Grand Total				$ 41,397.95

Note: It is assumed that the system is shared by two schools in the same local telephone area. If schools are at a greater distance, the miscellaneous cost category will increase according to the increase in telephone charges.

Answers, Set G, cont.

TABLE 7 ANNUAL COST PER DAILY SESSION USING A SHARED SYSTEM

Number of Sessions per Day		Annual Cost per Daily Session
Per Terminal	For 32 Terminals	
21	672	$210.39
23	736	192.10
25	800	176.73

The increase in cost with a shared system is 40 percent.

TABLE 8 ANNUALIZATION COST FOR THREE SCHOOLS SHARING THE CCC-17 SYSTEM, 1977-1978

Cost Categories	Amortization Period (years)	Cost	Annualization Factor	Annualized Cost 10%
Facility				
Construction of a CAI room	25	$150,000	0.1102	$16,530
Renovations	10	55,000	0.1627	8,948
Subtotal				$25,478
Equipment[a]				
Computer-related	6	$314,814	0.2296	$72,281
Installation	6	13,800	0.2296	3,168
Subtotal				$75,450
Total				$100,928[b]

[a]Refer to Table 1 for the details. The amortization period for all computer-related equipment is assumed to be six years.

[b]All totals are rounded to the nearest dollar.

TABLE 9
ANNUAL COSTS OF PERSONNEL, TRAINING, CURRICULUM RENTAL, MAINTENANCE, AND MISCELLANEOUS COMPONENTS OF THE CCC-17

Personnel		
Administration	$ 5,895	
Coordinators	67,500	
Fringe benefits on above at 16.7%	12,257	
Teaching Aides	15,660	
Substitutes	2,340	
Subtotal		$103,652
Training (indirect costs)		$ 1,350
Curriculum rental		20,857
Maintenance		42,072
Miscellaneous		18,000
Total		$185,931

TABLE 10 ANNUAL COST PER DAILY SESSION USING A SHARED SYSTEM

Number of Sessions per Day		Annual Cost per Daily Session
Per Terminal	For 96 Terminals	
21	2,016	$142.29
23	2,208	129.92
25	2,400	119.52

Remember to add the totals from Tables 5 and 6 to get the grand total for the shared system ($286,859).

LESSON 10
COST-EFFECTIVENESS ANALYSIS

OBJECTIVES

To understand how cost analysis can be used in evaluating proposals.

READING

All the reading for this lesson is included in the manual.

INSTRUCTIONS

In this lesson you will answer the questions as you go through the lesson. The answers can be found at the end of the lesson. If you cannot answer each question correctly, reread the section immediately preceding the question.

INTRODUCTION

As we have discovered so far, there are many occasions when cost analysis can be used in program planning. It can be used while conducting a sector assessment, while making decisions about cutting costs, while monitoring the effectiveness of a project, and when planning for follow-on projects. One of the most common uses of cost analysis is in choosing among alternative proposals. This lesson will examine such a process.

In "Economic Analysis of Radio Education," Donald Winkler outlines the alternatives of addressing the problems of low math achievement and substantial variations in math scores between schools. Given past USAID experiences, he decides to focus on radio education as the most favorable proposal.

Winkler then proposes a methodology to evaluate the radio education proposal. He considers four possible methodologies and then chooses to employ two: (1) ratios of marginal effectiveness to marginal cost for alternative means of increasing mathematics achievement (cost-effectiveness analysis) and (2) tradeoffs between improving mathematics instruction and attaining other educational objectives (production possibilities curve). The latter methodolgy will introduce new concepts and principles. Although you will not be tested on the second methodology, it should be of general interest.

In analyzing cost effectiveness, Winkler first considers the costs and then the effectiveness. Combining the cost and effectiveness information, he then compares radio education with other means of increasing mathematics achievement.

Instructions, Set A

As you read, bear in mind two issues: the uses of cost analysis and the procedures used in conducting the evaluation. How can economic evaluation assist in the selection of a proposal? How does Winkler narrow the alternative proposals? How does he select a methodology for evaluating the proposals? What sorts of factors complicate an actual evaluation? What concepts and principles does Winkler apply to his evaluation and how does he apply them?

ECONOMIC ANALYSIS OF RADIO EDUCATION: EVALUATION OF A PROPOSAL TO USE RADIO TO TEACH MATHEMATICS IN THE DOMINICAN REPUBLIC, 1984-89

Donald R. Winkler

The Problem

There are two problems with respect to mathematics achievement in the Dominican Republic. First, the level of mathematics achievement is too low. According to a recent study of eighth grade learning, mathematics achievement in even the best private schools falls below average mathematics achievement in most other countries (Luna Ramia, et. al., 1984). Second, there is substantial variation in mathematics knowledge between different types of schools. In particular, learning levels at the eighth grade vary between 42 percent in urban, private schools and 25 percent in rural, public schools. Surprisingly, differences in learning between urban and rural public schools are insignificant at the eighth grade.

What are the causes of such low levels of mathematics achievement and such high variation in learning? The typical model of educational achievement posits that the current level of learning (ACH_t) is determined by the prior level of learning (ACH_{t-1}), the socioeconomic environment of the home (HE_t), and the school environment (SE_t):

$$ACH_t = f(ACH_{t-1}, HE_t, SE_t)$$

In support of this learning model, one finds that between 50 and 60 percent of private school students are of upper or upper-middle income status, and those students have an average achievement score of 46 percent. Middle-income students in those same schools have average scores of 31 percent. One also finds that 81 percent of students in public schools are of low-income status, and the average eighth grade achievement scores in those schools is only 25 percent, compared to the average of 46 percent. Thus, differences in socioeconomic status undoubtedly explain some of the observed variation in mathematics achievement in the Dominican Republic.

Winkler, from the University of Southern California, conducted this evaluation in July 1984 for USAID/Santo Domingo.

Variables in the school environment also undoubtedly play an important role in explaining both the low average level of mathematics achievement as well as variations in that achievement at the eighth grade level. School variables that are likely to influence learning include teacher quality, curriculum design, time spent on the subject, and the socioeconomic and educational background of school peers. The study of eighth grade achievement cited above, for example, noted relatively strong student performance on numerical computations and weak performance on understanding analysis and principles of mathematics. These learning disparities as well as the low level of learning may be partly explained by a curriculum that emphasizes computational skills.

The Choices

USAID and GODR face a number of choices in improving mathematics education in the Dominican Republic. One choice is whether to improve average mathematics achievement or to improve knowledge among the lowest achievers. In theory, these need not be mutually exclusive, but they often are so in practice. Improving average mathematics achievement might be best done through a broad curriculum revision that would offer no disproportionate benefit to low achievers. On the other hand, low achievers might be best helped by improving educational quality and access in rural schools.

Once this choice is made, one must ask what is the best alternative to pursue in improving the learning of mathematics. Here the choices range from improving teacher preparation to curriculum revision, provision of basic educational materials and textbooks, and the use of radio to compensate for the lack of both educational materials and teacher preparation.

Given USAID experience in radio education, its prior investments in radio education to teach mathematics, and its prior investments in radio education in the Dominican Republic, a proposal has been made to use radio to improve mathematics achievement in grades 1-4 in the Central and Cibao regions. The question we address next is how best to evaluate this proposal.

Exercises, Set A

1. In the preceding section, Winkler makes two choic regarding the selection of a program to improve mathemati education. What was the first step Winkler used in narrowi the possible solutions?

_____

_____

2. Is this proposal intended to address the goal of (improving average mathematics achievement or (2) improvi knowledge among the lowest achievers?

_____

3. What is the second step Winkler took in narrowing h selection?

_____

_____

4. Is this a valid way to select a proposal? Explain.

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Winkler continues:

Evaluation Methodology

USAID has funded two radio education projects in the Dominican Republic. The Radio Santa Maria Project is a non-formal adult literacy program. The Radio-Assisted Community Basic Education Project (RADECO) is a non-formal primary school program designed to provide low-cost educational opportunities to children who have inadequate access to formal education. A new proposal is to use radio in still a different manner by enhancing the quality of mathematics education within the formal classroom.

Prior to funding this new proposal an assessment is required to determine if this is a wise use of AID and GODR resources. This assessment can proceed in four ways. First, the proposal can be evaluated in and of itself using cost-benefit analysis. The lack of any data on the private and social monetary returns from mathematics achievement in the Dominican Republic (or anywhere else) makes cost-benefit analysis infeasible, however.

The second method of evaluating the proposal is to compare radio education with other means of attaining the same objective of improved mathematics learning. This approach entails the calculation of the costs and the effectiveness of alternative educational policies and determining which policy is the most cost effective. Maximum mathematics learning achieved using given resources is attained when, on the margin, the ratio of effectiveness to costs is identical for all policy choices. For example, in the case of two policy choices, a and b:

$$\frac{\text{marginal effectiveness(a)}}{\text{marginal cost(a)}} = \frac{\text{marginal effectiveness(b)}}{\text{marginal cost(b)}}$$

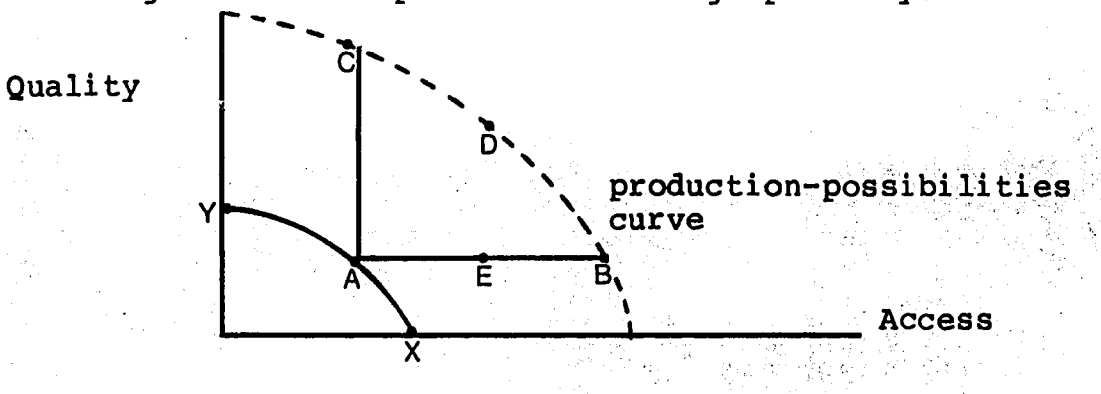
In evaluating the proposed radio-education project for the Dominican Republic, an attempt is made to compute cost effectiveness, but this can be compared with only very crude cost-effectiveness computations for alternative policy choices.

A third possible method of evaluating radio education for mathematics is to regard this as one of several proposals for improving the overall quality of education. Using this assumption, the cost effectiveness of radio education for mathematics can be compared with the cost effectiveness of other proposals in the PID (Project Identification Document) for enhancing the overall quality of elementary education. These proposals include development of educational materials and the upgrading of teachers, administrators, and technicians. The lack of common measures of effectiveness and of data on effectiveness for the other proposals makes it unfruitful to pursue this evaluation method.

The fourth evaluation method is perhaps the most appropriate one for the proposal at hand. This approach is to simply determine the tradeoff in terms of educational objectives implicit in adoption of

radio education as a component of the new PID for the Dominican Republic. The new PID has two principal components--improved access to elementary education and enhanced quality of elementary education, especially in mathematics. These two components represent two of the principal objectives in most educational systems--expanding educational opportunity and enhancing quality of the educational experience.

Any society with relatively fixed education resources faces a tradeoff between increasing enrollments and providing higher quality instruction for students already in the system. More of one objective can be had only at the expense of another. The diagram below depicts this more graphically.



Quality-Access Tradeoff

The diagram demonstrates the nature of this tradeoff; in economics such a tradeoff is labeled the <u>production-possibilities curve</u> and represents what can be produced given the educational resources available. At one extreme, point Y, these resources yield an elite, high-quality educational system. At the other extreme, point X, these resources generate universal access with low-quality. Each society's position on the tradeoff curve is politically determined, but most are located at some intermediate point between the extremes.

The tradeoff curve is constructed for a given amount of educational resources. External assistance adds more resources to the educational system and thereby permits a given country to obtain improved access and/or higher quality. These additional resources are represented by the dotted tradeoff curve in the figure.

External assistance can also alter the nature of the tradeoff curve by providing aid for improvements only in quality or only in access. External assistance earmarked in this manner influences recipient countries to provide more or less of each educational objective than probably would have occurred under conditional aid. Of course, to the extent external assistance is fungible, earmarked funds are equivalent to unconditional aid.

The new PID for the Dominican Republic can be interpreted in terms of the tradeoff diagram. The PID proposes funding activities which both improve quality and increase access in elementary education. The principal proposal for increasing access is construction or rehabilitation of some 803 classrooms. One proposal for enhancing quality is to introduce mathematics instruction via radio for grades 1-4.

In terms of the diagram, if the solid line represents GODR educational resources, the dotted line may be taken to represent educational resources inclusive of the new PID. Point A on the solid line represents the existing combination of educational opportunity and quality provided in the country. If additional resources provided under the new PID are earmarked solely for improved educational access, the new combination of opportunity and quality is point B. If, on the other hand, the additional resources are earmarked solely for improved quality, the new combination of opportunity and quality is point C.

The PID requests a total of $3.5 million for improved educational access (school construction) and $4.5 million for enhanced educational quality, including $1.9 million for radio education. The tradeoff between quality and access is now readily seen. To undertake quality improvements entails giving up educational opportunity in the amount EB. On the other hand, to put all funding into improved access requires giving up educational quality in the amount ED. Knowing the magnitude of these tradeoffs does not answer the question of how funding should be allocated, but it at least makes explicit the opportunity costs of alternative decisions.

Radio education is, of course, only one of several proposed activities that enhance quality. However, to undertake radio education entails an opportunity cost or tradeoff in terms of the increase in access that could have been provided with those same resources.

Of course, it is often the case that project requests are made for individual project components. If one component is rejected funds cannot be transferred to other components. The methodology illustrated above is still appropriate except that instead of revealing actual tradeoffs between quality and access, it reveals potential tradeoffs between those two objectives.

Exercises, Set B

5. Winkler attempted to assess whether radio education is a wise use of AID and GODR resources. In his assessment, why wasn't the cost-benefit method used?

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6. Winkler also eliminated the possibility of comparing cost effectiveness of radio education to other proposals in the PID. Why did he so quickly eliminate this assessment method?

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7. Under what conditions could a production possibilities curve be used?

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8. What can a production possibilities curve indicate? What will it not tell you?

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Winkler goes on,

Costs of Radio Education

The Project Paper requests funding in the amount of $1.9 million to adapt RADECO and Nicaragua materials, develop implementation plans, and purchase commodities required for implementation. The project anticipates expansion of classrooms and grades using radio education over time from one grade and 200 classrooms in the first year of operation (1985) to four grades and 16,400 classrooms in the fourth year of operation. Some 424,000 students are expected to participate in the project by its end.

Documentation supporting the Project Paper calculates a project cost of $1.9 million and a recurrent cost to the GODR of $0.71 per student. These cost estimates are based on a number of critical assumptions:

* The radio system is an addition to the traditional educational system; it does not replace existing teaching personnel or educational materials.

* The RADECO curriculum is similar enough to the traditional curriculum that RADECO tapes for the first three grades require only minor modifications for use in the new project.

* The project will begin with 200 classes and 5,000 students in year one and smoothly progress to 16,400 classes and 424,000 students in year four of the project.

* All classrooms affected by the project have only one shift per day.

Changes in these assumptions can significantly affect both project costs and GODR recurrent costs during the life of the project.

Because the project entails high startup costs (technical assistance, preparing teacher training materials, modifying tapes, purchasing radios, and other commodities), average costs per student of mathematics radio education will be high early in the program and diminish rapidly as thenumber of classrooms and pupils using the program increases. On the other hand, the total variable or recurrent

costs of the program to the GODR will increase as the number of classrooms and pupils increases.

Post-project recurrent costs to the GODR for radio education in the Central and Cibao regions amounts to $302,780 per year. Included in these costs are expected replacement rates for radios, tapes, and instructional materials. Assuming a total of 424,000 students in grades 1-4 by the end of the project, unit costs per student amount to $0.71 per student. Since there is a component of fixed costs (radio broadcasts, SEEBAC personnel, etc.), unit costs vary inversely with the number of students receiving radio-mathematics instruction. In addition, costs will be slightly higher if broadcasts are made twice a day to accommodate schools having double-shifts.

Another means of analyzing costs of instructing mathematics via radio education is cost function (Jamison, Klees, and Wells, 1976). The cost function includes annualized project startup and development costs and takes the form:

$$TC = F + V_n N + V_h H$$

Where: TC = total annual costs

F = annualized startup costs + project administration cost

N = number of students enrolled

H = number of hours of lessons per year

V_n = marginal costs per student (e.g., teacher guides, radios, student materials)

V_h = transmission costs plus annualized production costs per hour

In deriving the cost function for the radio-education project in its fifth year of operation, the following assumptions are made:

* All technical assistance is included in start-up costs.

* The 170 half-hour sessions are broadcast twice daily to accomodate schools with double shifts.

* The number of students enrolled in the fifth year is 424,000.

* The real rate of interest (or discount) is 7.5 percent and the project will last 25 years.

Under these assumptions, the cost function takes the form:

$$TC = 97,760 + 0.46\ N + 73.0\ H$$

and the marginal cost per student is $0.46, while the average cost per student (inclusive of annualized start-up costs) is $0.81. As expected, including annualized start-up costs results in higher average costs associated with radio education. Of course, if the program were subsequently expanded to other regions of the country, average costs would diminish and eventually approximate marginal costs in magnitude.

An assumption in this analysis is that tapes used in RADECO can be used in grades 1-3 with very minor modifications; only grade 4 tapes need to be adapted from the original Nicaraguan tapes. If this assumption proves incorrect and extensive modifications are required, the principal cost would be technical assistance. But the above estimates are not highly sensitive to changes in outlays on technical assistance. In fact, were the budget for technical assistance doubled, average costs per student would increase by only ten cents, from $0.81 to $0.91. Either figure represents an increase in total average costs per elementary student in the Dominican educational system of at most 3.0 percent (assuming a current unit cost of $30).

Another uncertainty in the proposed radio-education project is the long-term commitment of the GODR to that project. In any country political regimes and accompanying priorities and educational ideologies change. Nicaragua, site of the most significant radio-education experiment to date, is a dramatic example. If the GODR were to decide to terminate radio education two years after AID funding ended, annualized recurrent costs per student would rise from $0.81 under the assumption of a 25 year project to $1.06, a 31 percent increase.

Exercises, Set C

9. In determining the costs of a project, Winkler outlines his assumptions. In what ways will they affect decision making?

10. In the case of radio education, why is it important to discuss factors such as startup costs, average costs, recurring costs, variable costs, fixed costs, and unit costs?

11. Winkler discusses two uncertainties in the proposal. What are they? Does each merit a sensitivity analysis? In this case, do the results of the analysis make a difference to decision makers?

Effectiveness of Radio Education

As was noted earlier, traditional mathematics education in the Dominican Republic has resulted in low achievement scores relative to other countries and scores which vary widely by type of school. Also, as already discussed, there are several causes of this low achievement, including poor teacher preparation and inadequate school materials. While one prescription for improving mathematics achievement is to improve these school resources, another is to introduce new instructional technology, in this case radio education.

Since there is no current use of radio in traditional, formal Dominican education evidence on the effectiveness of radio for teaching mathematics must come from other country sources. These sources are consistent in demonstrating that radio education results in higher mathematics achievement even when teacher quality is higher in non-radio schools than in radio schools.

Supporting evidence for the effectiveness of radio comes from three different experiments conducted in Nicaragua, Thailand, and Barahona in the Dominican Republic. The principal measure of effectiveness used in all three experiments is performance on mathematics achievement tests. Nicaragua provides the most comprehensive evaluation of radio education to date. In Nicaragua radio was used for grades 1-4 within the formal classroom much as is proposed for the Dominican Republic. Given the similarities in culture, curriculum, and use of radio the Nicaraguan results have the highest external validity with respect to the Dominican Republic.

The Nicaraguan experiment yielded the following important findings (Searle and Galda, 1980):

* Experimental groups using radio did significantly better than control groups both in terms of amount of learning and average level of post-test mathematics scores.

* Urban-rural learning differences were smaller among schools in the experimental group than among schools in the control groups.

The Nicaraguan results are corroborated by the results from Thailand (Galda, 1984), which again demonstrate higher mathematics achievement test scores among experimental control groups. Thailand also confirms that radio education resulted in greater learning improvements outside than inside major urban areas.

Another experiment involving radio education is currently taking place in Barahona in the Dominican Republic. This project, labeled RADECO, uses radio for language and mathematics instruction in a non-formal setting. Post-test results for the first year of that experiment demonstrate significantly higher average achievement scores (mathematics plus language) for the experimental group (54 percent) than the control group of traditional, formal education (23 percent) in spite of the superior qualifications of instructional personnel in the formal setting.

Taken together, these experimental results provide convincing evidence that radio education in a formal setting should increase mathematics achievement among children in grades 1-4 in the traditional, formal school setting in the Dominican Republic. There are, however, some factors in the Dominican setting which are likely to affect the level of learning that would result from the introduction of radio education. These factors are:

* The area in which radio education will be introduced in the Dominican Republic is somewhat more highly urbanized than was true in Nicaragua; given that differences in urban learning (measured by post-test scores) were smaller than differences in rural learning between experimental and control groups, one might expect learning gains in the Dominican Republic to be lower than the average for Nicaragua.

* Radio programs were adapted to the traditional Nicaraguan curriculum via an elaborate feedback procedure; to the extent the Nicaraguan and RADECO mathematics curricula differ from the traditional Dominican and radio does not simply replace the traditional classroom instruction, learning gains may be lower.

* Preliminary results from the RADECO experiment demonstrate higher post-test achievement scores among the experimental group in spite of their

lower quality instructional personnel; the higher quality instructional personnel in the target schools should result in larger mathematics achievement gains and higher post-test scores than found among the experimental group in RADECO.

Finally, one should note that while the evidence is consistent and positive that radio education can increase mathematics achievement, the same cannot be said for other measures of effectiveness. The Nicaragua study concluded that radio education had very little, if any, impact on dropout, attendance, and failure rates (George, 1980). There is some evidence that this negligible impact is a result of teachers responding to improved achievement scores by setting higher standards for passing (Jamison, 1980). In the absence of scores on standardized achievement tests, many developing countries use dropout, attendance, and enrollment rates as measures of effectiveness. If teachers respond to higher achievement in the Dominican Republic as in Nicaragua, one should not expect changes in these commonly-used measures of effectiveness in the Dominican Republic.

Exercises, Set D

12. How does Winkler collect his data for an effectiveness analysis? Is this a valid means?

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Exercises, Set D, cont.

13. What are the specific problems in using this approach with the proposal?

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Winkler continues:

Evaluation

Earlier four alternative methodologies were presented for evaluating the desirability of undertaking an investment in radio education--(i) cost-benefit analysis, (ii) ratios of marginal effectiveness to marginal cost for alternative means of increasing mathematics achievement, (iii) ratios of marginal effectiveness to marginal cost for alternative means of increasing more comprehensive measures of achievement, and (iv) tradeoffs between improving mathematics instruction and attaining other educational objectives. It was concluded that for the purposes of this analysis, methodologies (ii) and (iv) are the only feasible ones.

COST EFFECTIVENESS

To analyze cost effectiveness of radio education requires comparison with alternative means of increasing mathematics achievement. While we now have reasonably good data on the cost and effectiveness of radio education, the same cannot be said for other alternatives such as increasing teacher quality, curriculum revision, and improving and providing educational materials.

The Nicaragua study demonstrated gains in post-test mathematics achievement ranging from 1 percent at grade four to 60 percent at grade one (Searle and Galda, p. 127), for an average gain of 25 percent over all grades and years. Earlier, the annualized increase in cost for radio education was estimated to be at most 3.0 percent. Thus, the ratio of effectiveness to cost can be expressed as follows:

$$\frac{\text{percent gain in learning}}{\text{percent increase in cost}} = \frac{25\%}{3.0\%} = 8.3\%$$

The resulting number 8.3 can be interpreted as the elasticity of mathematics achievement with respect to input costs. While it is difficult to make direct comparisons between this and other production elasticities, the absolute magnitude of this elasticity is very high relative to that found in most production studies, including studies of human capital production.

The results to date for Thailand are not quite so impressive, but they have shown an average increase of 10.3 percent in mathematics achievement among all grades and for all years. If the Dominican project were to achieve this same learning gain, the ratio of effectiveness to cost would be 3.4, smaller than 8.3 but still a high production elasticity.

Finally, preliminary results for the Dominican RADECO experiment in non-formal radio education show a 134 percent increase in combined linguistics and mathematics achievement. These data are not directly comparable nor are they as reliable as those for Nicaragua and Thailand, but they suggest that radio education in the Dominican Republic would be as cost effective as has been found in other countries.

Comparable data on effectiveness and costs for alternative means of improving mathematics achievement are hard to come by. The only reliable study is one conducted by Jamison, Searle, Galda, and Heyneman (1980) on providing mathematics textbooks in Nicaragua. That study concluded that both textbooks and radio education contribute to mathematics learning, but learning by radio education was significantly larger. In addition, the costs of radio education were lower than the costs of textbook production and distribution. As a result, one can conclude that radio education is more cost effective than textbook production and distribution.

Another alternative to radio education and textbook production and distribution is improving teacher quality. There are no data to suggest the quantitative impact of changes in teacher quality on mathematics achievement. We can, however, determine how much improvement in teacher quality could result from spending an amount equal to the annualized recurrent costs associated with radio education. The increase in spending associated with radio education

amounts to $0.81 per student or an aggregate $343,440 in recurrent expenditures for the anticipated 424,000 students.

The unit cost per graduate is currently US $815 (at market exchange rate) and approximately 660 certificated teachers are graduated each year. With an additional $343,440 per year, the supply of certificated teachers could be increased by 421 or 63 percent per year. This growth in teacher supply would, over a ten-year period (with a 10 percent attrition rate), increase certificated teachers in the country from the present 55 percent to 70 percent of all teachers.*

Tradeoff Between Quality and Access

Another means of evaluating the desirability of improving quality in mathematics education is to determine the opportunity cost or tradeoff in terms of access. At present, 143,000 students in the Cibao-Oriental subregion are enrolled in elementary education. A proposal has been made to improve access through school rehabilitation and construction. Radio education funds could in principle be used for this purpose instead.

The specific funding available for radio education from the school construction budget can be determined in two ways. First, AID's proposed budget for radio education is $1.9 million; hence, this figure can be regarded as the amount AID could allocate to school construction instead. Second, the annualized recurrent costs of radio education

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This calculation presumes (i) no growth in total stock of teachers, and (ii) present rate of production of certificated teachers only covers attrition in already existing stock of certificated teachers. These assumptions hold other things constant so the gain in proportion of certificated teachers is solely attributable to increased number of graduates.
start-up costs and GODR fundings of recurrent costs are $343,440. Assuming a 7.5 percent discount rate, the present value of these radio education outlays is $3.8 million; hence, this figure can also be regarded as the funds AID and the GODR could jointly allocate to school construction.

The PID anticipates a cost of about RD$14,000 per classroom which suggests AID funding of radio education could instead be used to construct an additional 136 classrooms. Assuming double-shifts and an average class size of 57.5 (the actual ratio of students to teachers in 1980-81), the new construction would provide schooling opportunities for an additional 15,640 students. This in turn would permit an increase in primary school enrollments in the Cibao-Oriental of approximately 11 percent. Similarly, joint AID and GODR funding of radio education could instead be used to construct 271 classrooms, assuming the GODR could in fact borrow funds for school construction at a 7.5 percent real rate of interest. Using the same assumptions given above, an additional 271 classrooms would permit an increase in primary school enrollments in the Cibao-Oriental of approximatly 21.8 percent; alternatively, national primary school enrollments could be increased about 3 percent.

These computations regarding the opportunity cost of radio education in terms of access denied primary school age children are based on strong assumptions. In particular, the official rather than market exchange rate is used in calculating USAID contributions in terms of Dominican currency. Were the market exchange rate of 1:2.70 used instead, the computed opportunity cost of radio education would be larger. Regardless of the assumptions, the numbers given here visibly demonstrate the nature and magnitude of the tradeoff involved.

And, while these figures do not imply one objective is better than another, they do give decision makers a clear indication of the magnitude of the tradeoffs involved. Whether or not radio education should be funded depends in part on the priorities of the decision makers involved.

Exercises, Set E

14. Even when cost data and the effectiveness data are collected, there are still factors that prevent a complete cost-effectiveness analysis. What prevents Winkler from having a complete analysis?

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15. Although Winkler could not arrive at a complete and accurate CE analysis, he continues his efforts. How does Winkler deal with the reality of incomplete data?

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Winkler concludes:

> This analysis of the cost effectiveness of the proposed radio-education project to teach mathematics in the Dominican Republic first through fourth grade classrooms provides no definitive answers. Evidence from other countries suggests radio education is more effective than the traditional classroom in teaching mathematics. This is also likely to be true for the Dominican Republic, but the effectiveness of radio depends on its continued use. Actual teacher use of radio will depend on the effectiveness of teacher training in radio education and, more importantly, the commitment of the Secretariat to radio education.
>
> The costs of radio education include relatively high start-up costs and relatively low recurrent costs. The start-up costs can be annualized and added to recurrent costs to yield a single measure of the costs of radio education. The resulting analysis shows that marginal costs are low, and average costs are low if the program is expanded to cover a large number of students as scheduled and if the program is not prematurely abandoned once AID funding is ended.

The elasticity of mathematics learning with respect to inputs appears to be large. Even changes in assumptions regarding the size and duration of the program do not change this conclusion. Furthermore, radio education is a more cost effective means of improving mathematics achievement than textbook production and distribution. In addition, the costs of some alternative means of improving mathematics instruction, such as increasing teacher quality, are so high that they are unlikely to prove more cost effective than radio education.

Radio education is one means of improving the quality of elementary education, a primary objective of both AID and the GODR. Another objective is to improve access to elementary education through the construction of school buildings. The tradeoff analysis provided here reveals that resources allocated to radio education could be used instead to significantly improve access. That tradeoff may be a more important factor than cost effectiveness in deciding to fund radio education.

Exercises, Set F

16. Although Winkler has some reservations about the completeness of his analysis, he is confident that he has proven that radio education is the most cost effective alternative. Upon what does he base this confidence?

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Answers, Set A

1. First, Winkler made a choice regarding the desired goal or output: improve average mathematics achievement or improve knowledge among the lowest achievers.

2. This proposal is intended to help low achievers.

3. The second step was to determine the best alternative to pursue in achieving the goal. Here he outlines the choices. Winkler selects an alternative (radio education) based on past USAID experience and investments.

4. Of course the selection of alternatives could be done somewhat more methodically, i.e., by conducting an informal CE analysis. But USAID's past experience and investments in radio educuation and in the Dominican Republic are sound bases upon which to make the decision.

Answers, Set B

5. Winkler did not use the CB method because of the lack of data on the private and social monetary returns from mathematics achievement in the Dominican Republic (or anywhere else).

6. Winkler quickly eliminated the possibility of a CE analysis with other proposals in the PID because of the lack of a common measure of effectiveness and lack of effectiveness data.

7. The production possibilities curve is useful when there are relatively fixed resources and a choice must be made between two dissimiliar objectives and projects.

8. The curve will demonstrate the tradeoffs of choosing one alternative at the expense of the other, i.e., employing all the resources for increasing enrollments at the expense of providing higher quality instruction for students already in the system. It makes explicit the opportunity costs of alternative decisions but it does not answer the question of how funds should be allocated.

Answers, Set C

9. It is important to outline the assumptions upon which the costs are determined. Changes in the assumptions can significantly affect both the project costs and recurrent costs. Knowing the assumptions not only helps decision makers determine the soundness of the cost estimates, but also how sensitive the estimates are to changes.

10. In the case of radio education it is important to discuss not only startup costs, but also average and recurring costs. The startup costs, which are quite high, would describe a costly project--much more costly than teacher training, for example. However, radio becomes more appealing when you discuss recurring costs and unit costs because they are considerabley less with radio than with teacher training.

11. The first uncertainty is whether the tape used in RADECO can be used in grades 1-3 with only minor changes. If the tape cannot be used, one of the assumptions is invalid and the cost estimate will change. This merits a sensitivity analysis. In this case, however, the results of the senstivity analysis will make little difference to decision makers because average costs change so little.

The second uncertainty is whether the GODR will remain committed to the project for a long time. If the GODR terminates the project after only two years, for example, annualized recurrent costs would rise significantly. In this case a sensitivity analysis would be useful and the results should be of interest to the decision makers, especially if they have doubts about the GODR's commitment.

Answers, Set D

12. Since there is no current use of radio in traditional, formal Dominican education, effectiveness data must come from other country sources. This is the most valid means available.

13. There are factors present in the Dominican Republic which are not present in Nicaragua. Therefore, not all data can be completely transferred from the Nicaraguan case to the Dominican Republic case. For example, the area in which radio education will be introduced in the Dominican Republic is more highly urbanized than was true in Nicaragua. Factors such as this are likely to make a difference in the effectiveness ratings between the two countries--making it difficult to transfer the results from Nicaragua to the Dominican Republic.

The second problem with transferring results from one country to another is the differences in standards ofmeasurement. While some countries may use dropout, attendance, and enrollment rates as measures of effectiveness, others may use achievement test scores. This might mean, for example, that a high effectiveness rating in one country would indicate high test scores and a high effectiveness rating in another country would mean a low dropout rate. Effectiveness ratings would not indicate the same sort of success, therefore caution should be taken when comparing results in different countries.

Answers, Set E

14. With cost data and effectiveness data one can calculate a cost-effectiveness ratio. However, this score has little use if it cannot be compared to other ratios. In the case of the Dominican Republic, there are not sufficient cost and effectiveness data on other alternatives such as teacher training and curriculum revision. If there were more complete data, Winkler could have conducted a more thorough analysis.

15. Winkler takes data available and makes the most of it. He cannot draw infallible conclusions, but he can make a strong case based on the available data. Even though the data are not complete and are not directly comparable nor reliable, they are suggestive of the fact that radio education in the Dominican Republic may be as cost effective as it has been in other countries.

Answers, Set F

16. Winkler knows that there are uncertainties about his analysis. He also knows that changes in assumptions regarding the size and duration of the program will not change his conclusions. Additionally, costs of alternative approaches are so high that they are unlikely to prove more cost effective than radio education.

LESSON 11
COST REDUCTION

OBJECTIVES

To establish a criteria for including cost analysis as an integral part of programming.

READING

There will be no readings outside the manual for this lesson. Included in the manual is:

INSTRUCTIONS

After reading the following article by Robert G. Myers, complete the exercises at the end of the lesson.

INTRODUCTION

In the following article Robert Myers discusses ways in which information about costs can become a more integral part of programming.

Myers attempts to demystify the topic of cost analysis. He reminds us again of the limitations of cost analysis, but urges us to consider it because it can provide answers to important questions during project planning.

The first issue Myers addresses is how costs can be kept low or reduced. First he discusses some cost-cutting illusions and in response to the inadequacies of these methods, Myers offers suggestions on ways to reduce costs through changes in organization and management.

The second issue Myers deals with is whether the project is justifiable. He suggests that cost-benefit analysis can help us answer this question, in addition to other noneconomic methods.

The third basic issue addressed by Myers is who bears the cost and how equitable that is. Although it is an important issue, this has not yet been discussed in this course. Myers will introduce this concept as well.

Myers devotes the last pages to providing a framework for analyzing costs. Here Myers offers an interesting and valuable alternative to the ingredient method discussed earlier in the course.

This reading provides insights into childhood development projects, multiple intervention programs, and how cost analysis can be used in sectors other than education. The focus of your reading, however, should be on how to integrate economic analysis into program planning, especially through cost reduction strategies.

ANALYZING COST OF COMMUNITY-BASED EARLY CHILDHOOD DEVELOPMENT PROJECTS

Robert G. Myers

Introduction

An increasing interest has been shown by national governments and international organizations during the last decade in discovering and implementing low-cost effective programmes to improve the survival and development of young children. That concern is evident in the slow but persistent growth of out-of-school early education programmes, in the primary health care movement, and most recently and dramatically, in the GOBI-FF initiative launched by UNICEF.

In the search for low-cost, effective strategies, three elements appear and reappear: participation, simple technology, and integration. Community participation is sometimes encouraged for its own sake as a basis for developing solidarity. More often participation is viewed as an instrument--as a means of making programmes more effective by engaging potential recipients actively so that usage will increase. But encouraging participation is also a key strategy for reducing costs. Community-based participation programmes are widely thought to be less expensive than, for instance, services delivered through the established health or educational systems. Systematic evidence to back that intuitively appealing position is still lacking.

Another element in most low-cost alternatives is the use of simple technologies--oral rehydration, growth charts, etc. These technologies are certainly less costly to acquire than their high-tech alternatives. But cost of delivery and problems of organization and use can easily push up both totals and average costs involved in using a simple technology. Again, the systematic evidence is not in hand to allow firm conclusions about the conditions

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under which the low-tech options are really low-cost options.

A third ingredient in recent initiatives to affect child survival and development is "integration". Programmes are conceived as "multi-sectoral" or "multi-component", and integrated. A primary purpose of such integration is, as with participation, to improve programme effectiveness; interaction among the various components is thought to produce a better effect than separate delivery. But there is a cost implication as well. Integrated services can, so it is hoped, take advantage of common administrative, supervisory, and other structures. Again, however, systematic evidence is lacking to support the assumption that integration lowers costs or even that it improves effectiveness.

Despite the growing concern about costs, that element of programming and evaluation has been obvious by its absence. For instance, a recent and extensive review of 52 primary health care programmes assisted by the United States Agency for International Development, concluded that:

> "Although the stated intention of all the programmes is to provide low-cost, affordable health care, this study yielded little evidence that would indicate whether such can or cannot be delivered" (American Public Health Association, p. 77).

Moreover, the same evaluation concluded that:

> "Initial assumptions about projects are often overly optimistic and costs are underestimated" (American Public Health Association, p. 78).

Even less evidence exists for community-based programmes centered on the child.

The main purpose of this paper is to assist in the search for ways in which information about costs and analysis of costs can become a more integral part of programming. To advance the search, the topic needs to be demystified. To that end, a relatively straight-forward framework for obtaining cost information will be presented--a framework that can be used by project field staff as part of a monitoring system.

In the following pages, I will also set-forth for discussion a series of observations and questions regarding the analysis of costs for community-based, multiple-interventions designed to improve the survival and development of young children.

Why the Resistance to Analyzing Costs? Why Analyze Costs?

Costs analyses--particulary those which would relate costs to measure of benefits or effectiveness are questioned on several grounds. Sometimes questioning is ideological--to emphasize costs, it is argued, takes the accent off more important values, distorts thinking and biases actions. ("Solidarity," for instance is not something that can be assigned a monetary value and is unlikely to be "efficient.") Sometimes the questioning stems from a concern that cost analyses will lead to invidious comparisons among dissimilar options and circumstances so that those most in need will be screened out unjustly on purely economic grounds. Sometimes the questioner is skeptical because of difficulties associated with accurately estimating real costs and associated benefits.

But someone (or some people), somewhere (or at some places), sometime (or continuously at various times), makes decisions about how best to use limited resources. Cost analyses can help to inform these decisions. The words "help to inform" are used advisedly. It is <u>not</u> my purpose to enshrine results of cost analyses. Obviously, cost-benefit or cost-effectiveness analyses are not the only, or necessarily the most important basis for decisions and actions. As stated in a recent report:

> "While an awareness of cost-effectiveness considerations and techniques should certainly be useful to every project founder and leader, it will not be the main skill required to understand poor people's expressions of needs, ascertain root causes of problems, suggest creative solutions and alternatives, enlist community and staff enthusiasm, and implement plans according to schedule" (Robert Nathan Associates, Inc., p. 7).

todesired outcomes can aid planning, improve the use of resources in a project, and provide pragmatic standards for judgements about whether to begin, continue, expand, or replicate a project. The results can aid advocacy.

One reason for analyzing costs is simply to answer the question, "What does it cost to provide services to children?" Answering that question can help a government decide whether it can afford a proposed programme or not. That deceptively simple question (Gaspari, p. 2) provides a point of departure in this paper, but of greater interest are answers to three other basic questions:

1. How can costs be kept low or reduced (without a loss of effects)? Or, how can the largest effect be obtained at a given cost? Here emphasis is placed on improving the performance of a project, not on deciding whether or not it is worthwhile to continue or extend it. The main tool for analysis is a comparison of costs and effects.

2. Is the project economically justifiable (as compared with alternatives)? A benefit-cost analysis can help answer this question. Usually, benefits as well as costs are defined in monetary terms with the benefits expressed in terms of estimated additions to the productivity of individuals. The standard of justification, although set in monetary terms, can incorporate non-economic considerations as well.

3. Who bears the costs and how equitable is that? The distributive dimension of costs as well as of benefits is often disregarded in cost analysis. The analysis requires disaggregation by classes of participants and/or by sources of support for projects.

How Can Costs Be Kept Low or Reduced ?

Reducing costs, or becoming a more efficient project manager is not itself a goal. It is, rather, a means to increasing coverage and/or improving upon desired effects. A project could become more efficient but less effective in terms of its stated goals.

Two kinds of strategies are used to try and reduce costs. The first and often illusory set of strategies involves shifting burdens and/or redefining

the problem. The second set of strategies involves changes in management and organizations which can reduce real costs in relation to effects.

1. Some cost-cutting illusions

a. Concentrating resources. Re-orienting a project or programme by concentrating resources is a favorite formula for cutting costs while presumably improving effects. During the last decade, for instance, resources have been concentrated on "the poorest of the poor" and families "at risk". While helping organizations live within their budget, this strategy may or may not reduce costs of services supported. The same amount of resources may be spread over fewer people. To the extent that "at risk" groups are homogeneous or concentrated geographically, average costs might be reduced. But because the people most in need or at risk are seldom all alike, and because they can be the most difficult people to reach, average costs are likely to increase. Moreover, effects may be hardest to achieve with those most in need so that when expenditures are related to effects, the unintended result could be negative. Concentrating resources does not necessarily, therefore, reduce costs or improve effects.

b. Shifting the burden. To reduce its costs, an organization may seek to shift the burden of costs to sources other than its own budget. If successful, the result is obviously a reduction in costs to the organization, but the shift may or may not lead to reduction in the total costs of a programme. The reader will instantly recognize this strategy as social myopia or sleight of hand.

From one viewpoint, the increasingly popular and seemingly successful strategy of fostering community participation falls in this category. In the name of "participation," a programme may insist on community donation of time and labor--to build facilities, to manage projects locally, and to volunteer time for work as para-professionals. As a result, governments or others may be able to reduce budget allocations. And, because no value or a low value is placed on volunteer time, real costs seem to be reduced as well.

> "Efforts to keep costs of PEC programmes low by transferring responsibility for certain recurrent costs to the community have been particularly successful" (American Public Health Association, p. 77).

But community resources are generally undervalued, even though local labor usually costs less than "imported" labor and para-professionals get paid less for their time than professionals. And, personnel turnover, additional supervision costs, etc. could make community-based projects as costly as others, even while reducing programme effectiveness. We will discuss this further when dealing later on with distributive issues.

c. Cost recovery. Asking recipients of a service to pay for the service so that costs are "recovered" may make a programme viable but not any more or less cost-effective. This strategy seldom takes into account that individuals are already incurring costs in order to take advantage of (participate in) services--time and transportation costs, for instance.

> "A number of projects have been successful in getting communities to finance drugs, but of the 28 projects that use community financing to compensate community health workers, none has a satisfactory method for obtaining local support" (American Public Health Association, p. 77).

Indeed, attempting to recover costs by asking clients to pay more can negatively affect demand. If the demand decreases, total costs may decline because less materials and supplies will be needed, but the average cost may increase.

The three strategies sketched above can provide the illusion of reducing costs but not result in real reductions.

2. Reducing cost through changes in organization and management. There are at least three main ways in which cost reductions are sought through changes in organization and management.

a. By identifying and correcting wasteful use of resources (without expanding a project and without changing the form of service delivery and technology). A cost analysis will not show that particular individuals on a payroll fail to contribute to the success of a project or that donated food supplies have disappeared from a warehouse and have been sold privately. What analyses can do is suggest ways to cut costs. For instance, by comparing costs of various pre-schools or health posts it may be possible

to show that, beyond a certain point, adding resources does not increase the quality of an intervention or raise the desired effects. Or, it might show that some projects are better able than others to husband and utilize their resources. The finding could lead to suggestions for improving local management that are applicable to all units in a programme. Or, an analysis could show the effect of, for instance, using locally-produced toys rather than imported toys, and of employing local rather than foreign advisers. Such variations do not involve major changes of programme form or content, simply the substitution of better management techniques or use of less expensive resources.

b. Changing the project design, organization, and/or technology is a second means of cutting costs. There are, of course, many different ways of delivering similar services. At a relatively mundane level, for instance, and with important implications for costs, an organization can alter the ratio of supervisors to para-professionals and/or the ratio of para-professionals to the number of families or children being served. Or, a project using professional teachers might decide to experiment with a different "technology" by employing volunteer para-professionals and providing training within the project. A cost analysis could show which of the options was less costly as related to the effects each produced (including effects on the lives of the para-professionals). Or, a home-based alternative, with visitors might be compared with a center-based alternative. An "integrated" approach involving health, nutrition and stimulation might be compared with an approach in which each component is provided separately. The costs of providing information through television spots might be compared with face-to-face methods. And so forth.

Caution must be exercised when making the kind of cost-effectiveness comparisons just described. The comparison could easily be a comparison of apples and oranges. In most cases variations in organization and technique will be required that depend on the context. To take an extreme case, assisting poor children in a remote area where supporting services are not available and the population is dispersed, will require different methods (and much higher per capita costs) than assisting children in a concentrated urban area. Using a comparison of per capita costs to help decide whether to invest in the urban or the rural alternative would be inappropriate and probably unjust. Thus, comparisons may be built upon the

unrealistic assumption that identical benefits reach equally needy people in similar circumstances when they do not. At least one author would argue that that is always the case (Richards).

c. Realizing "economies of scale." A third route to reducing costs is through realizing economies of scale. Cost reductions can occur as a local project expands to cover more individuals or as local utilization increases. The increased coverage allows fixed costs to be spread over a larger group, reducing the average cost. However, economies may not appear as a programme moves from a pilot project to a regional or national level.

> "While many planners 'intuitively feel' that economies of scale exist with respect to their particular projects, there is no conclusive evidence on this topic" (Gaspari, p. 12).

As most programmes expand, they begin to reach into more remote areas, increasing rather than decreasing costs. Bureaucracies grow and the associated costs eat away at what has been gained through increased coverage. Training and re-training costs can increase with expansion, associated with increased turnovers as less dedicated individuals are employed. In brief, expanding a project may or may not reduce the average cost.

Is the Project Justifiable?

Answering this second key question requires a somewhat different approach than the first. There are, of course, criteria other than economic criteria for judging the worth of a project. Here, our concern will be with the worth as indexed by a relationship between costs incurred and results produced. To judge the economic worth of a project or programme, it must be related to an agreed-upon standard for judging investments or to other uses of resources that seem to be logical alternatives. Assigning worth to a programme goes beyond simply calculating the per-child cost of delivering services. It requires a measure of the social impact of a project expressed in monetary terms.

In a project dealing with the health, welfare, and productivity of people, rather than with machines or agricultural seeds, measuring effects in monetary terms is not an easy task. Such analyses are rarely done for child-oriented projects.

One example of a benefit-cost study producing extraordinarily positive results is that done by the High/Scope Foundation based on longitudinal data from a pre-school intervention in the United States. In the High/ Scope study, benefits included: estimated addition to the productivity of children (over their lifetimes) and mothers (mainly as a result of having additional time available to earn and learn), and cost savings (e.g., less need for remedial services in schools, and less social costs incurred in combating juvenile delinquency). The study concludes, even on the basis of conservative estimates, that the original investment has brought a high return. Interestingly, however, that return was not evident in a short period. Had the return been assessed after five years, the project would have been deemed a failure in strictly monetary terms.

There is considerable art involved in benefit-cost analysis. And the assumptions are very demanding. Therefore results, even when as overwhelming as those presented in the case of the High/Scope analysis, must be treated with some caution. If, however, the empirical results are supported by reasonably consistent testimony in the same vein, they can provide useful estimates of general orders of magnitude.

In this paper no attempt will be made to deal with the relative virtues of the main indicators used in benefit-cost analyses: rates of return, net present value comparisons, and benefit-cost ratios. Nor will I enter into such matters as the arbitrariness of comparing returns against a specific standard--(say a return of 15 percent) or the weak treatment of "qualitative" factors in such analyses, or the difficulty of assigning shadow prices to costs and monetary values to benefits. For a discussion of these and other issues, the reader is referred to: John D. Donohue, "Cost-Benefit Analysis and Project Design".

Who Bears the Cost ?

Sorting out who bears costs is important for at least two reasons:

1. The analysis can point to inequities. For instance, "In many countries, persons in rural areas are being asked to pay for public health care, while those in urban areas have access to 'free' care" (American Public Health Association, p. 77).

Moreover, unless proper allowance is made for contributions in kind and in time when calculating costs, the burden placed on poor community members is certain to be undervalued and a subsidy by the poor to the rich who draw on the public purse for more expensive, high-technology health care will remain hidden.

If users are asked to bear the cost of a service, demand and use may decline, more so for the poor than the rich, exacerbating an inequitable distribution of the services. That seems to be the case whether the user cost is payment of cash for services rendered or a contribution in terms of volunteer time. A change in demand may have, in turn, a bearing on whether or not resources can be used efficiently because the scale of operations may be associated with economies of scale, particularly at the project level.

2. Knowing who bears the cost provides clues about what will be necessary to sustain interventions. If, for instance, international organizations are responsible for covering an important portion of recurrent costs, consideration must be given to how (if?) the costs can be covered locally when international assistance is retired. Expansion may not be possible without international aid. The aforementioned review of primary health projects concluded that:

> "It appears that many countries will not be able to afford to continue programmes once external support ends" (American Public Association, p. 78).

If community members are already bearing a high proportion of costs through the contributions of materials or time, or by paying directly for services, the chance of transferring even more of the costs to the community is slight. In general, the extent to which the community is already covering costs is not appreciated. Two recent studies suggest the community typically provides at least one-fourth of the resources employed (Cornia, Carbonetto).

The Costs and Effects of Community-Based, Multiple-Intervention Programmes: Some Issues

1. <u>Multiple Goals</u>

Many programmes to improve the survival and

development of young children are simultaneously concerned with improving health, nutritional status, and the mental and social development of a child. Each of these goals requires separate indicators to assess the progress of a child. However, the total effect may be greater than all of the individual effects taken together. For instance, some of what is spent for early stimulation will increase the effect of nutritional interventions and vice versa. The interaction makes assigning costs to any of these goals difficult even though, for instance, early stimulation may be the responsibility of a Ministry of Education and nutrition the responsibility of Agriculture or Health. At the same time, capturing the multitude of expected benefits in any one meaningful index is extremely difficult. We have, then, a problem of describing costs in such a way that they can be related to effects. When other goals are added, the picture becomes even more complicated. How, for instance, can a goal of improving solidarity and community organization be measured and costed so as to be included in an analysis of the desired effects on children? The question leads to a second set of analytical problems related to the fact that most programmes have:

2. Multiple Beneficiaries

In many projects, a focus on the child is a convenient way of promoting general practices of sanitation and hygiene or of fostering organization benefitting many people. Even those programme components that are specifically "targeted" on the young child will often benefit others. For example, supplementary feeding of pregnant mothers may raise the birth weight of a child, hence reduce the chance of death, but it benefits the mother as well. If a parent learns to stimulate a younger child, that learning can have an effect on older children as well. A center-based pre-school programme for children 3-5 can have secondary effects on younger siblings. Because programmes have multiple beneficiaries, determining programme coverage is not straightforward. If costs are to be calculated on a per beneficiary basis, getting the beneficiaries right is an important task.

3. Multiple Funders

Typically, the costs of an integrated, participatory project are spread out among many organizations

and people. Several parts of government may be involved. Several parts of several international organizations may be involved. The community itself makes a large contribution both to establishing a service and in bearing the costs of its use.

Multiple sources of funding bring along practical problems for cost analysts. Obtaining data on the expenditures may be difficult and the categories used to describe costs may be very different. More important, however, multiple sources can also bring problems such as the use of several exchange rates or the need to estimate the differential costs incurred by each organization in obtaining the funds used to purchase services and supplies. Moreover, each organization has a set of hidden or indirect costs--of administration, for instance--that should be assigned to a project. Some duplication of effort can occur, but because different organizations are involved, it may be hard to locate.

4. Costing the Time of Volunteers

Community-based projects which take as one goal increasing solidarity of organization take the participation of community members on a volunteer basis as an indicator of an effect. Economists look upon the time of volunteers as a resource that should be valued. Both are right, within their respective frameworks. A challenge is to fit together these not entirely compatible notions. By costing volunteer time one raises the cost of a project in a way that may give incorrect signals to policy makers, particularly if they are not inclined to view solidarity or the personal development of the volunteer as an effect. At the same time, posting community contributions gives proper credit to a contribution that is being made and that should be recognized as a valid "counterpart" contribution.

5. Delivery versus Use

The fact that immunizations are delivered to a health post does not mean the immunizations will be used. The fact that fifty children ages 3-5 live in a community does not mean that fifty children will attend a pre-school programme.

When calculating per capita costs, the figures used are sometimes those of the potential population to be served, drawn from demographic surveys. These calculations can be very misleading, making per capita

costs appear much lower than they actually are--in relation to usage. A more accurate indicator of coverage comes from statistics of the number of people who are treated in a primary health care center or the number of children enrolled in a pre-school programme. However, even these statistics may also underestimate per capita costs either because numbers are inflated to make a project look good or obtain more supplies, or because, in the pre-school instance, many of those who enroll do not attend or do so very sporadically. Estimating this "leakage" (Cornia, pp. 13-14) to arrive at actual use is challenging and potentially rewarding not only because per capita costs will be more accurate but also because the difference between potential and actual use can be calculated.

The challenges that have been sketched above require a cost analyst to clarify definitions, to make some simplifying assumptions, and to rely on non-economic information from a variety of sources including ethnographic case studies. Making such decisions does not, however, put the analyst in as delicate or uncertain a position as some critics contend. Indeed, calculations can and should be made using variations in assumptions in order to see how sensitive the results are to the assumptions.

Against this background we can now set out a rough framework for collecting information needed for simple but useful analyses of costs.

A Framework for Analyzing Costs

A. Costs

To carry out an analysis of costs it is essential first to establish whether the costs and effects to be measured are to be valued from a broad social viewpoint or as seen only from the perspective of a project or a local community. Here, the assumption is made that a social valuation is desired of the total and per unit costs incurred by projects. Also necessary, is a decision about the unit of analysis to be used. Is the analysis to be at a project level or at a higher level of aggregation? Is the unit to be determined by the form in which a service is delivered (e.g., health posts or pre-schools), by political or geographic divisions (e.g., a district or state), or by executing responsibility? We will emphasize project-level analysis and favor calculations at the level of the

local executing agency. Analysis at that level of disaggregation should facilitate use of the information to make local improvements, particularly if local personnel are involved in the analysis and have some flexibility to introduce changes.

To facilitate analysis, cost information can be organized in many ways. The four ways to be discussed in this framework are: activity, type of cost, the timing of the cost, and who bears the cost.

1. By Activity: A cost analysis should be carried out with respect to a goal or set of goals. The goals define activities, each with a set of desired outcomes, each with a set of costs. Unless expenditures can be organized by activity, it is impossible to relate costs to the effects expected from the activity.

Ideally, separation into activities should correspond to a set of decisions about, for instance:

- different ways of delivering the same service (e.g. in home visits, through health centers, by radio,...). The analysis might look at different approaches taken within the same programme;

- content to be emphasized (What combination of health, nutrition, education, and other contents brings the best results at least cost, and in what circumstances?);

- programme actions (e.g., training, promotion, construction, evaluation, attention to clients,...).

How to group costs by activity will depend on the outcomes to which the cost figures will be related. A burning question may be to sort out costs related to training options, requiring a division into training and a finer examination of costs related to various forms of training. What, for instance, is the cost per person per day of different training programmes? Or, the desire may be to relate health costs to health outcomes.

Often, accounting information is not grouped according to any set of activities and does not, therefore, serve programme planning well. Rather, costs are organized for bookkeeping purposes, simply

to keep track of the type of resources or services purchased.

2. By Type of Cost. Typically, costs are separated into personnel costs, capital and equipment costs, consumable materials and supplies, and, perhaps general administration overhead cost. Such a separation comes closer to standard bookkeeping than separation by activity. Examining these categories of cost will show where most of the resources are being used and may suggest where there are significant possibilities for cutting costs.

Another classification of costs by type involves separating those costs into capital costs and recurrent costs. When the former are stretched out over the life of the capital, their weight in any one year is reduced. Recurrent costs represent what, as a minimum, is necessary to sustain a project. Although recurrent costs may appear small, they may loom larger when capital costs are spread out.

A third classification by type is that of variable and fixed costs. Variable costs will fluctuate with the demand for a service (e.g., the cost of immunization varies directly with the number of people treated), whereas fixed costs can be spread over larger or smaller numbers of users providing the potential for economies (e.g., one scale may serve to weigh two or 200 children).

Yet another division by type of cost is into direct and indirect costs. Direct costs are those which can be related directly to particular outputs--e.g., immunization to health indicators. Indirect costs must be allocated among several objectives because they do not pertain directly to any one.

3. By Time. Determining costs on a year-by-year basis allows adjustments to be made for inflation. It allows one to distinguish costs in an initial "set-up" year (or years) from other years. In cost-benefit analysis, both costs and benefits are adjusted to take account of the fact that both occur over time (and in the case of the benefits, over a lifetime) and for the fact that a dollar spent (or a benefit received) in year one of a project is worth more than a dollar spent (or received) in subsequent years.

A year-by-year analysis can reveal patterns of changing costs as related to changes in coverage of a project, helping adjust future projections and providing information about the existence of economies (or diseconomies) of scale.

4. By Sources of Funding. In most cases it is necessary to divide costs by the source of funding for purely practical purposes--records are kept that way, and often kept in the offices of each organization. Beyond that, however, a careful consideration of who is providing resources will assure an approximation of total costs and will allow analysis of the distribution among organizations.

Perhaps the most important and difficult category of costs are those covered by the community. Assuming a decision to include costs of volunteer time, the question arises of how to "shadow price" the contribution. Conventions include using the standard minimum wage, or choosing the salary of the lowest-paid professional in the category (e.g., the wage of a third category primary school teacher for a pre-school volunteer). Calculations can be made with community-participation included and without it.

Attached as an appendix is a sample worksheet organized to take into account the categories described above.

B. Coverage

As indicated above, determining the coverage of a project or programme is not as it seems. In his excellent paper, Cornia not only notes the problem of differential coverage as related to particular components, but he also suggests a way of "standardizing" unit costs by component in terms of the 0-5 child population. For instance, he takes as the specific coverage for the immunization component, the number of 3-14 month-old children covered by the programme. To standardize the figure for children ages 0-5, he multiplies by four (the ratio in Indonesia of children 0-5 to those 0-1) (Cornia, p. 11).

Several definitions are offered for coverage by Cornia (p.12):

that included in the villages covered (even if only partially) by the programme.

b) that for which the end supplies have been released.

c) that to whom the services have been made available.

d) that actually using the services regularly.

e) that actually using the services and showing as a result of it, the desired effects.

To move from the concept of "intended coverage" to that of actual coverage, one must either have comprehensive and reliable measures of actual use or, separate studies of some cases are required to discover what Cornia calls "leakage" (p. 13). Leakage includes: physical wastage of supplies, diversion, non-use of the target population, and use by those who are not in the target groups.

The difference between potential or intended use and actual use can be dramatic, as shown in a 1983 evaluation of the Cono Sur programme in Lima, Peru: For some components of the programme, actual use was only one-sixth of the potential (Carbonetto).

Most programmes leave some people out who should be included and also include people who are not in need--who are not part of the so-called "target population." It is possible, therefore, for a programme to show a low unit cost, in purely economic terms, but to carry a high human cost because resources are being diverted away from those most in need (Pollitt). On the other hand (See Diagram 1) it may be necessary to include individuals who are not in need because identifying them and excluding them may be costly.

DIAGRAM 1: ANALYZING PROGRAMME COVERAGE AND NEED

AT RISK (+)	NOT AT RISK (-)
a	b
c	d

C. Effects

Costs should be defined in relation to programme activities. Analysis of costs should include relating costs to expected outcomes of programme activities--i.e., to effects. Given the limits on space, no attempt will be made in this paper to deal with the many ways in which effects might be measured in a cost-effectiveness study. These range from elaborate indicators of the quality of life, adjusted to the local context to one-indicator inappropriate measures such as imported IQ tests to assess mental development. The measurement of effects is complicated by the need for a broad view when community-based early childhood development projects are assessed. Simply focusing on the child is not sufficient. In addition, effects on families, on programme staff (particularly the para-professionals), and on communities should be considered.

D. Matching costs with effects

If effects are defined in terms of coverage achieved, the matching is relatively easily captured in a per unit cost. The relationship is relatively simple because time is not a major factor, i.e., one can realistically expect effects in a relatively short time. Costs can also be related to some immediate measurable outcomes such as weight gain, or reductions in morbidity. Problems arise when attempting to match immediate costs with effects that occur over a lifetime. An investment in nutrition and/or pre-school education may, for instance have very long-term consequences, as shown in the High/Scope study and others in the United States.

Concluding Comments

Even within the limits described there is room for insightful and useful analysis of costs. As is evident from the previous pages, it would be possible to spend an endless amount of time pointing to, anticipating, and discussing the problems of analysis. It is my hope that the Workshop* will instead work toward specification of a concrete and acceptable method of analyzing costs and related effects. A most desirable effect of this Workshop would be to arrive at a methodology that is manageable at the project level and by communities.

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*See footnote on page 167.

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Figure 1. Example Summary Sheet for Cost Analysis of Multi-Sectorial Project

Project Location/Name: _____ Funding Source: _____

Components/Activities	Recurrent Costs[3]					Amortized Capital Costs[4]				
	Salaries[5]	Equipment Supplies[6]	Services[7]	Other[8]	Total	Buildings	Land	Equip.	Total	Total Costs
A. Education 1. Diagnosis[9] 2. Design[9] 3. Implementation a. Construction b. Materials Dept. c. Training[10] d. Service Delivery e. Supervision f. Administration g. Promotion h. Monitoring 4. Evaluation Sub-Total Education:										
B. Health 1. Diagnosis 9/ 2. Design 9/ 3. Implementation . . . Etc. Sub-Total Health:										
C. Nutrition 1. . . . Etc.										
Totals										

Specific Notes:

1. The project is assumed to be at the "local" level, i.e., cost-figures pertain to an executing unit.
2. Source =, for instance, Public Sector (Ministry of Health, Education, Labor, etc.), International Agency, Community.
3. Recurrent Costs
4. Amortized Costs are calculated by dividing the cost of the investment by its estimated lifetime, or by using the equivalent rental value.
5. Salaries include several levels and include benefits related to salaries (e.g., years of service, vacations, social security, bonuses, etc.)
6. Equipment/Supplies are those that are for immediate use and/or have a lifetime of less than one year.
7. Services = non-personal services such as: transportation (gasoline, maintenance), light, telephone, etc.
8. Other could include such items as per diems (associated with travel for training or supervision, or another activity).
9. If the project is truly integrated, then the diagnosis and design activities will not pertain to any one component.
10. Initial costs associated with training can be treated as capital costs with a lifetime of between two and five years.

General notes

1. The components and activities are examples. A particular project may have different activities than those listed, or, may wish to organize activities according to different categories. The principle would be the same and the goal would be to compare costs of different activities.
2. It will be necessary to adjust to inflation. If inflation is high that may mean monthly adjustments are needed.

Exercises

Based on the Myers' reading, address the following:

1. We have been cautioned several times during the course to not overestimate the value of cost analyses. Myers gives us four reasons why cost analysis is often questioned. List two of those reasons.

   a. _____

   b. _____

2. What then are the reasons to use cost analyses?

_____

_____

_____

3. Myers gives us three basic questions that can be answered through cost analysis. These answers may provide useful information in planning. List the three questions.

   a. _____

   b. _____

   c. _____

4. In order to improve the effectiveness of a project, efficiency is often considered fundamental. Efficiency may be improved either by increasing the quality or quantity of the outcomes or reducing the inputs. Address the following questions regarding cost reduction as a means of increasing efficiency.

   a. Reorienting a project by oncentrating resources is a good way to cut costs and improve effects. True or false? _____

   b. A cost analysis can show that particular individuals on a payroll fail to contribute to the project and thus should be cut. True or false? _____

c. A cost analysis can indicate that adding certain resources to a project does not increase the quality of an intervention or raise the desired effects. True or false? _____

d. Asking recipients of a service to pay for the service will make a program more cost-effective. True or false? _____

5. Suppose you are to reduce the proposed budget for the Management Training Center. Someone suggests that you shift some of the burden of cost to another donor (by requesting matching funds) and to the participants (through charging fees). Is that a useful solution? Why? What will a worksheet (as used in Lesson 5 of this course) reveal about this method of cost reduction?

_____

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_____

6. A project cannot realize economies of scale (select one):
   a. as a local project expands to cover more individuals;
   b. as local utilization increases;
   c. as it moves from a pilot project to a regional or national level.

7. Myers touches on the idea of cost analysis with a project that has multiple goals, multiple benficiaries, and multiple funders. How do these factors complicate a cost analysis?

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8. Myers outlines a framework for analyzing costs. What are the four ways in which cost information can be organized and what are the advantages of each?

a. _____

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b. _____

_____

c. _____

_____

d. _____

9. Two options have been proposed to improve bilingual education in Country X. One option calls for radio education and the other for new curriculum development and textbook production. In choosing an option you will want to consider the cost effectiveness of each. How will you request that the cost analysis be presented, by Levin's worksheet for estimating cost (see page 81) or by Myers' approach to analyzing cost by variable and fixed cost? Justify your choice; why did you choose that method? Why did you reject the other method? Will each method give you different information?

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Answers

1. Myers gives four reasons that cost analyses are often questioned: (1) to emphasize costs may ignore more important values, distort thinking, and bias actions; (b) cost analysis may lead to comparisons among dissimilar options; (3) decisions may be based only on economic grounds; and (4) there are difficulties associated with accurately estimating real costs and benefits. Manual, p. 169

2. Cost analyses should be considered because cost is an important factor in making decisions about how best to use limited resources. Analyzing costs in relation to desired outcomes can aid planning, improve the use of resources in a project, and provide a pragmatic standard for judgements about whether to begin, continue, expand, or replicate a project. Manual, pp. 169-70

3. To aid in planning, there are three basic questions that can be answered through cost analysis: (1) how can costs be kept low or reduced? (2) is the project economically justifiable? and (3) who bears the cost and how equitable is that? Manual, p. 170

4. a. False. To the extent that people who receive aid are homogeneous or concentrated geographically, average costs might be reduced. But because the people most in need are seldom all alike, average costs are likely to increase. Concentrating resources does not necessarily reduce costs or improve effects. Manual, p. 171

b. False. A cost analysis cannot indicate the resources within a project that are being employed inefficiently. However, when you analyze a project in relation to a similar project, you can see that, for example, some projects are better able to utilize their resources because of good organization and management skills. Manual, p. 172

c. True. For example, by comparing costs of various pre-schools or health posts it may be possible to show that, beyond a certain point, adding resources does not increase the quality of an intervention or raise the desired effects. Manual, p. 174

d. False. This strategy seldom takes into account that individuals are already incurring costs in order to take advantage of the project. Increasing the fees imposed on participants may decrease the number of participants interested in the project, thus increasing average costs. Manual, p. 176

5. According to Myers, shifting the burden of cost and cost recovery are not useful means of **reducing** the costs. When you place all the information on the worksheet you will notice that although "costs to sponsor" and "contributed private inputs" as well as "imposed student and family costs" will all change, yet the "total cost" column will remain the same. Ma

6. C. A project cannot realize economics of scale when it moves from a pilot project to a regional or national level because as most projects expand they begin to reach into more remote areas, increasing rather than decreasing average costs. Manual, p. 174

7. A program that has multiple goals would require separate indicators to assess each goal. According to Levin's requirements for cost-benefit and cost-effectiveness analysis, no comparison can be made unless there are common goals and indicators. Manual, p. 176

With multiple beneficiares it is difficult to measure the benefits and effects of a project because it is not clear who is supposed to benefit. It is impossible to measure benefits when you do not know who you will survey.

When there are multiple sources of funding obtaining data on the expenditures may be difficult and the categories used to describe costs may be different.

Additionally, exchange rates, differential costs incurred by each organization in obrtaining funds, and indirect costs must be considered in dealing with multiple funders.

8. a. By activity--it allows one to relate costs to the effects expected from the activity. Manual, p. 180-82

b. By type of cost--it will show where most of the resources are being used and may suggest where there are significant possibilities for cutting costs.

c. By time--a year-by-year analysis can reveal patterns of changing costs as related to changes in coverage of a project, helping adjust future projections and providing information about the existence of economies (or diseconomies) of scale.

d. By sources of funding--it will assure an approximation of total costs and will allow analysis of the distribution among organizations.

9. The two methods will give you quite different information. The author's preference is Myers' variable and fixed cost method. When I use Levin's method, the cost of radio education appears significantly higher than the cost of curriculum expansion. Indeed, radio education is more costly than curriculum development, but as it expands its coverage, the average cost decreases. This is due to the high fixed cost of radio education. As curriculum production expands, the costs increase because most are recurrent and variable costs. Subjective

To help convince the decision makers that radio education has a lower average cost (assuming that is true), you might consider mixing several of Myers' suggestions. For example, present the analysis by variable and fixed cost for each year of the project. This will demonstrate that while the costs of the project are high in the first year, as the project increases its coverage to all levels and to more areas, the costs will be minimal--resulting in low average costs. It would then be helpful to do the same with the curriculum production option. Show what the costs are in the first year, then show what the costs will be as it expands to different levels and to more areas.