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Cost Analysis in Educational Decision Making: Approaches, Procedures, and Case Examples

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Cost Analysis in Educational Decision Making: Approaches, Procedures, and Case Examples

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In an era of increasing demands for education reform that is both scientifically based and cost-effective, cost analysis has become an important decision-making tool. In their review of the applications of cost analysis methods in education, Hummel-Rossi and Ashdown (2002) presented a compelling rationale for the increased use of these evaluative strategies. First, in an era of governmental downsizing and streamlining, educators' lobbying for additional funds and materials to increase student achievement needs to be supplemented with data that demonstrate the efficient utilization of these resources in achieving desired results. In addition, as education policymakers and administrators are increasingly confronted with dwindling resources, they will need more detailed information to determine which programs and policies will give them the biggest return on their investments.

School psychologists are increasingly being called upon to evaluate the effectiveness of school-based programs and services (Illback, Zins, & Maher, 1999), and cost analysis provides a powerful methodology for this task. Moreover, cost analysis methods have an important role to play in the work of the Task Force on Evidence-Based Interventions (EBIs) in School Psychology (Kratochwill & Stoiber, 2000). Increasingly, school psychology research on prevention and intervention will need to report not only *what works,* but also *what works at what cost.* Inclusion of this information is essential for consumers who want to consider the appropriateness and feasibility of an EBI for the needs, resources, and expectations of their school or other applied setting (Kratochwill & Stoiber, 2002).

Different methods of cost analysis can answer different sorts of questions. For example, if an evaluator simply wants to know how much a particular program or intervention will cost and whether it can be implemented within existing budgetary constraints, a *basic-cost* or *cost-feasibility analysis* may be appropriate. If, on the other hand, an evaluator wants to be able to reach conclusions not just about cost, but also about the relative effectiveness or utility of a range of programs or interventions, a *benefit-cost, cost-effectiveness,* or *cost-utility analysis* may be desirable.

The terminology used when discussing cost analysis can be quite confusing. For example, the terms *cost analysis, cost-effectiveness analysis, benefit-cost analysis,* and *cost-utility analysis* are frequently used interchangeably in the existing program evaluation literature. However, each term represents a different method for analyzing economic information, and each has evolved from historically distinct economic traditions. For example, whereas benefit-cost analysis grew out of welfare economics, which places a dollar amount on the value of a program or

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intervention outcome, cost-effectiveness analysis was developed to help decide among various options in the provision of limited resources.

Although the differences between the methodologies can be subtle in practice, each method of analysis makes different assumptions regarding the data (e.g., qualitative or quantitative) and provides very different outcome analyses (e.g., comparison of alternatives or the overall "value" of a program). Figure 1 provides a general outline of the major steps involved in conducting a cost analysis of an educational program. The nature of the program evaluation and the rate of progress through the successive stages may vary, but the quality of data produced depends on the successful completion of each stage of the cost analysis process.

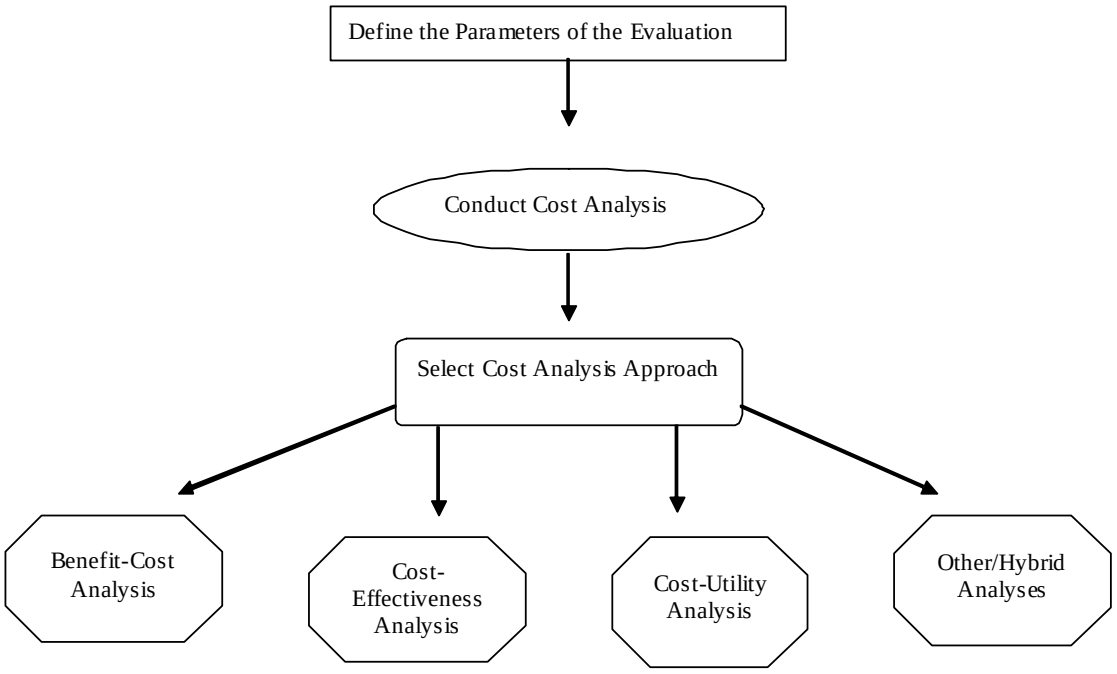

Figure 1. General steps in the cost analysis of educational programs.

Step 1: Defining the Parameters of the Evaluation

The *Program Evaluation Standards* developed by the Joint Committee on Standards for Educational Evaluation (1994) provide a comprehensive framework for determining the extent to which evaluation methodology is consistent with accepted best practices. Space prohibits a thorough discussion of the standards in this article (readers are referred to Joint Committee on Standards for Educational Evaluation, 1994). In brief, however, the standards emphasize that for cost analysis to be useful within the context of educational decision making, evaluators must (a) consider the extent to which a proposed evaluation plan is feasible and (b) ensure that evaluations will be conducted in a prudent, diplomatic, and realistic fashion.

To that end, it is necessary to define the parameters of the evaluation at the outset, giving due consideration to (a) the resources available to conduct the study, (b) the information needs of decision makers, and (c) the nature and number of program outcomes. The parameters of a given evaluation will determine in part which methods of cost analysis are most feasible. Levin and McEwan (2001) suggest that evaluators consider the guidelines set forth in Figure 2 when defining the parameters of an evaluation.

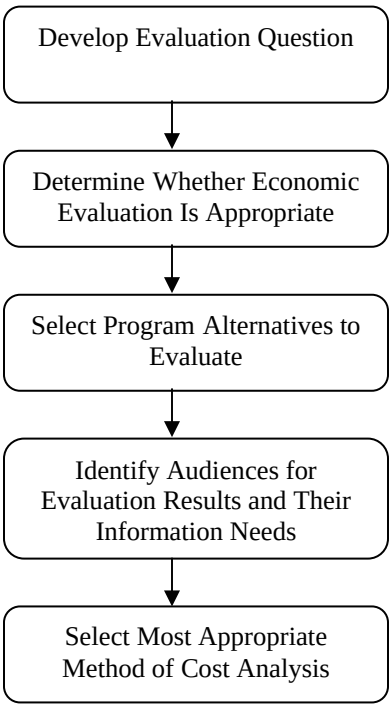

Figure 2. Steps in defining the parameters of an educational program evaluation.

Developing a Research/Evaluation Question

The nature of the evaluation question should determine which form of cost analysis, if any, is most appropriate to address that question. Carefully delineating the research question before developing an evaluation plan has the added benefit of allowing the evaluator to plan the data collection phase more carefully and focus efforts on collecting those data necessary to the subsequent cost analysis. Table 1 depicts the relationship between the nature of the evaluation question and the form of cost analysis most suited to answer that question.

Research Questions Addressed by Basic-Cost or Cost-Feasibility Analysis

As Table 1 illustrates, basic-cost and cost-feasibility analyses are best suited to answer questions about the financial viability of a given program. However, whereas basic-cost analysis is used to describe economic data, cost-feasibility analysis is used to make decisions about the economic data described. For example, cost-feasibility analysis is frequently used to determine the extent to which a program can be successfully implemented, given the existing budgetary

limitations and the stakeholder group or agency that will absorb the costs. In contrast, basic cost analyses seek only to describe the distributions of cost, both real and adjusted, that are necessary to successfully implement a given program; conclusions about the feasibility, worth, or relative benefits of the program are determined through other forms of cost analysis. In sum, basic cost analysis asks, "How much will implementing this program or intervention cost, and what is the distribution of those costs?" and cost-feasibility analysis asks, "Can we implement this program or intervention, given our budgetary constraints?"

Table 1
Relationships Between Evaluation Question and Form of Cost Analysis

Evaluation questions	Form of cost analysis
How much will implementing this program or intervention cost, and what is the distribution of those costs?	Basic-cost analysis
Can we implement this program or intervention, given our budgetary constraints?	Cost-feasibility analysis
Which program or intervention provides the most effectiveness (on a single criterion measure) at the lowest cost?	Cost-effectiveness analysis
Which among many programs or interventions provides the most benefits at the lowest monetary cost?	Benefit-cost analysis
Which program or intervention provides the most utility at the lowest cost?	Cost-utility analysis

Research Questions Addressed by Cost-Effectiveness Analysis

Questions regarding which among a number of program alternatives is most effective are typically addressed using cost-effectiveness analysis. Although cost-effectiveness, cost-utility, and benefit-cost analysis all address comparisons among programs, cost-effectiveness analysis is most appropriate when comparisons are made according to a single criterion measure, such as gains in reading achievement scores or decreases in acting-out behavior. Because programs must be compared according to this single criterion measure of effectiveness, cost-effectiveness studies require that programs being compared have similar outcome goals.

The costs of a program can be defined somewhat more liberally in a cost-effectiveness analysis. Whereas benefit-cost analysis defines cost in monetary terms, cost-effectiveness (and cost-utility) analyses allow evaluators to conceptualize nonmonetary units as costs (e.g., decreases in instructional time, increases in class size). As such, cost-effectiveness analysis in its

most basic form asks, “Which program or intervention provides the most effectiveness (on a single criterion measure) at the lowest cost?”

Research Questions Addressed by Benefit-Cost Analysis

Founded in the principles of welfare economics, benefit-cost analysis is typically used to compare programs that may (but need not necessarily) have different goals and program structures. Because a benefit-cost analysis defines cost in monetary terms, this form of cost analysis is often used by government agencies to prioritize funding for societal programs or initiatives (e.g., Reading Recovery programs vs. building repairs). Benefit-cost analysis falls short of other forms of cost analysis, however, when the costs or benefits of a given program are not easily assigned a monetary value. Therefore, benefit-cost analysis is best suited to address the question, “Which among many programs or interventions provides the most benefits at the lowest monetary cost?”

Research Questions Addressed by Cost-Utility Analysis

Cost-utility analysis uses the concept of program utility to compare programs with different outcome measures. Like cost-effectiveness analyses, cost-utility analyses do not limit the definition of costs to items that can be assigned a monetary value. However, in a cost-utility analysis, unlike a cost-effectiveness analysis, evaluators use the criterion of utility to compare programs. To define and operationalize the criterion of utility, program evaluators typically consult stakeholders to determine which outcome measures are most relevant to them. Once utility is operationalized in this fashion, program evaluators can then collect the data necessary to compare programs according to their utility ratings.

Although this method of estimating program “worth” is appealing because it defines social validity locally, it is inherently more subjective than other methods of cost analysis. As such, cost-utility analysis can only ask, “Which program or intervention provides the most utility at the lowest cost?” Thus, to the extent that definitions of utility vary across stakeholder groups, cost-utility analyses can be difficult if not impossible to replicate.

Determining the Feasibility and Utility of Evaluation

Although any program can be subjected to a cost analysis, it is not always appropriate to evaluate the economic efficacy of program outcomes. For example, Scriven (1974) has argued that when the probable gains from conducting an evaluation do not exceed the costs of the evaluation itself, it makes little sense to conduct a formal evaluation. Under these circumstances—circumstances meeting what Scriven has referred to as the *cost-free evaluation criterion*—present knowledge and intuition should suffice to meet stakeholders’ information needs. However, it is debatable whether and to what extent Scriven’s criterion can and should apply to educational programs. Still, the treatment utility of program evaluation and the mechanisms through which it affects student outcomes and/or professional practice are still largely unknown. Indeed, establishing the treatment utility of various forms of program evaluation (e.g., external vs. internal; utilization-focused vs. process-focused) or investigating

the strongest predictors of program evaluation impact would likely yield valuable data in future research.

Determining the Programs to Evaluate

Once an evaluation question has been delineated and it is decided that a formal cost analysis is appropriate, evaluators must consider to what (if anything) the evaluation results should be compared. That is, a range of comparable programs should be identified to determine what subset of these is reasonable to consider for analysis (Hopfenberg et al., 1993). Although there is no litmus test for determining whether two or more programs are comparable, the classes of alternatives identified for comparison should ideally be those most "sensitive" in treating the problem under investigation (Barnett et al., 1999). Unfortunately, there is also little consensus regarding what constitutes a responsive alternative and whether politically nonviable alternatives should ever be considered. At any rate, when no alternatives are to be considered, it makes little sense to conduct a more advanced cost analysis (e.g., a benefit-cost, cost-effectiveness, or cost-utility analysis).

Determining the Boundaries of an Evaluation

It is much harder to define the boundaries of an evaluation when a single policy or program is under evaluation and the state of the world without the policy or program must be evaluated. In such cases, the boundaries of the investigation can be identified by considering the nature of the policy or program and its sponsoring agency (e.g., federal, state, school district, classroom, etc.). For example, the purpose of the Perry Preschool Project evaluation (Barnett et al., 1999) was to inform national policy, so the scope of the project was extended to a consideration of costs and benefits at the national level. Thus, Barnett et al. (1999) decided to examine total costs and benefits to society as a whole and divide these into two groups—those affecting the Perry Preschool Project participants and those affecting the general public. Whether to include projections (e.g., the cost of future drug use or special education placements) should also be determined when identifying the boundaries of an evaluation. Indeed, time, context, and stakeholder group—not just the data collected—should be considered when defining the boundaries of program evaluations.

Identifying Pertinent Audiences

Identifying key stakeholders is one of the most important (and potentially influential) steps in defining the scope of a cost analysis. If various audiences are going to use the findings of a cost analysis, an evaluator should conduct a more in-depth valuation of resources that may vary by school, district, or state.

These variable sources of funding are often referred to as *contributed resources* in the evaluation literature, and their estimation reduces the possibility that other districts will be misled concerning the real required resources. For example, when program evaluations take on national significance, it is important to evaluate financial contributions paid by federal, state, and local governments, in addition to the time and financial resources contributed by volunteers. Indeed, the broader the stakeholder base (as in the Perry Preschool Project), the more care should

be taken in the cost analysis to account for variable sources of funding so that stakeholder groups (or others who use the evaluation findings) can appropriately adjust the findings (based on local conditions) before deciding to adopt a given program (Joint Committee on Educational Program Evaluation, 1994).

Step 2: Conducting a Cost Analysis

Once the parameters of the evaluation have been established, the actual cost analysis can begin—that is, the process of gathering and organizing information about the resources required to create a program or to implement a policy (Barnett & Escobar, 1990). In this context, the term *cost* refers to the value of all the resources that a given program could use, were they all assigned to the program (Levin & McEwan, 2001). In other words, costs are those resources that could potentially be put to other uses. This definition relates to *opportunity costs*, a term commonly used by economists that implies that the use of resources for one purpose prevents their use for another, potentially more profitable, purpose. Although this definition of costs does not necessarily require that a dollar value be placed on a given product or service, it does require an in-depth understanding of the market in which a program operates and the necessary components of the program itself.

Although a cost analysis may take multiple forms, it without question involves more than simply an accounting or budget analysis. Budget analysis alone is inadequate for the purposes of cost analysis because budgets generally do not specify all of the cost information pertaining to all of the elements of a given educational program. As Levin and McEwan (2001) have pointed out, program budgets often do not include valuation of donated equipment, services, volunteer time, or payments from another agency (e.g., federal funding). In addition, such budgets often charge major costs to only the year in which the costs were incurred. In contrast, for the purposes of cost analysis, if a project makes a major purchase (e.g., testing equipment) during Year 1, that cost should be divided equally over the number of years of expected use. This type of distribution of costs over time is rarely captured by traditional budget analysis. Finally, budgets often reflect plans for the distribution of expenditures rather than an accounting of how the available funds were actually spent. For these and other reasons, a more formal, systematic approach to cost analysis is usually necessary.

Selecting an Approach to Cost Analysis

Within the context of educational program evaluation, the two most commonly used formal approaches to cost analysis are the *ingredients approach* (Levin, 1983) and the *resource cost modeling approach*. The two approaches are very similar in that they identify and assign a monetary value to the ingredients or resources required to achieve an intervention's intended outcomes.

Ingredients Approach

The most common approach to cost analysis is the ingredients approach (Levin, 1981, 1983; Levin & McEwan, 2001). This approach requires that one begin with a complete and accurate description of the program and a list of all the resources required for the program to

achieve its intended effects. This first descriptive step is essential to ensure that the interpretation of the resulting cost analysis is valid.

Once the program has been thoroughly described, the evaluator attempts to determine the cost of the program or intervention by calculating the value of the resources that were used or lost by virtue of having been applied in one way rather than another. To this end, an evaluator constructs an *ingredients model* that specifies the program ingredients required to produce the intended effect(s). Although the nature of program ingredients will vary across programs, Levin and McEwan (2001) have argued that most program costs can be divided into (a) personnel costs, (b) facility costs, (c) equipment and materials costs, (d) other program inputs, and (e) required client inputs. Once identified and valued, the ingredients can be added, and the total cost of the intervention established. Subsequent analyses can then be conducted to divide cost according to who pays for the resources, which persons or groups benefit from the reallocation of resources, and so on.

Identifying ingredients. The first steps in identifying the ingredients making up the program costs are to (a) determine what resources are required within each of the five categories listed above (Levin & McEwan, 2001) and (b) identify whether the resources are monetarily valued or unvalued (e.g., volunteer time). A correct determination of the ingredients to be included in the program evaluation relies upon a full and accurate description of the program goals or intervention during the first stage of the analysis. Only those resources (either paid or unpaid) required to sustain a program should be evaluated. Again, an intimate familiarity with the interventions or programs themselves is of the utmost importance in determining which ingredients are critical to the program outcome.

According to Levin and McEwan (2001), the standards for a complete and accurate list of program ingredients should be commensurate with the ingredients' overall contributions to the program's total costs. For example, personnel costs generally represent the most significant program costs and thus should be analyzed in significantly more detail than other program costs. Information regarding the distribution of program costs can be gained through review of program documents, direct observation of the operation of the program, or interviews with the individuals responsible for distributing program resources. In outlining program ingredients, it is particularly important to determine which ingredients were *actually*—not just intended to be—consumed by the program.

Differentiating between use and intended use can prove difficult when integrating cost information from multiple sites, because the consumption of ingredients often varies by site. It is often helpful to triangulate ingredients data when there is disagreement across sites about the utilization of ingredients.

Valuing personnel costs. Because personnel costs represent one of the largest contributions to overall program costs, special care should be taken to represent these costs accurately. All human resources required for a given program—full-time, part-time, consultant, and volunteer—should be specified. Levin and McEwan (2001) recommended beginning the valuation process by categorizing all employees by their roles, qualifications, and time commitments. Calculating the actual cost of personnel typically involves estimating the market value of salaries and fringe benefits. However, using market value as the basis for estimates

assumes that there are many employers seeking such personnel and that there are many individuals seeking to fill such positions (i.e., employment equilibrium).

In reality, the actual price of obtaining a given employee can vary significantly across schools and school districts, and costs are frequently directly connected to work conditions, constraints, and a host of undetermined factors. Thus, although there may be an average market price for a particular type of qualified personnel, it is important to adjust for local variations, which may affect the integrity of the estimate.

In addition to estimating the costs associated with paid personnel, it is important to estimate the cost contributions of volunteer time. Volunteer time is especially important in educational cost analyses because teachers and other staff may be expected to contribute preparation time beyond their paid workday. Although there is no standard or official method for estimating such costs, Levin and McEwan (2001) have suggested taking the market value of services that a volunteer would provide. Alternatively, if volunteers have the qualifications required for a paid position, evaluators can use that potential position to calculate the value of the applicable salary and fringe benefits.

Valuing the costs of facility use. Facility use is without question one of the most complex ingredients to value in applied educational settings. Indeed, it is debatable whether valuation of this ingredient is even appropriate in analyzing educational economic data. However, in order to specify the actual cost of facilities, Levin and McEwan, (2001) have suggested considering the physical space required for the program or intervention to achieve its intended outcomes. For example, storage areas, class space, building upkeep, lighting, air conditioning, heating, electricity, and the like should all be included in the valuation of facility use. Likewise, if a project is jointly sharing a particular facility (e.g., an ongoing educational project situated within an existing school), it is important to partition costs according to the amount of time the program utilizes the facility in question.

Valuing the cost of facility use is complicated by the nature of the monetary transaction employed to secure the space. If the intervention or program is implemented in rented or leased spaces, the cost of the facility is simply the actual cost of the rent or lease. However, when facilities have been purchased or constructed in the past by the entities responsible for facilitating the program or intervention, there is no tangible financial transaction. In this situation, one approach is to estimate the cost of renting or leasing a similar space. An alternative approach might be to estimate the facility's replacement cost, taking into account the depreciation of the building and interest on the remaining undepreciated original value. Depreciation of a facility refers to a decrease in the facility's value equal to the amount of the facility "consumed" in a year. Depreciation is typically estimated by determining the expected life of the facility and dividing the total replacement cost by the number of years of potential use. Therefore, to estimate depreciation correctly, the evaluator must have a general sense of (a) the replacement cost and expected life of the facility and (b) the opportunity cost that investment in the facility represents.

Levin and McEwan (2001, p. 67) recommended the following method for determining the annual cost of an owned facility:

1. Estimate the facility's replacement value.

2. Determine the facility's expected life.

3. Divide the facility's replacement value by its expected life to obtain the cost of depreciation for each year of use.

4. Multiply the value of the undepreciated portion of the facility by an appropriate interest rate to obtain the opportunity cost that investment in the facility represents.

5. Add the annual cost of the depreciated portion to the annual interest lost on the remaining investment to obtain the exact annual cost.

Unfortunately, this method for valuing facility use suffers from a number of serious conceptual and methodological problems. First, there is no real consensus about the appropriateness of valuing facility costs when estimating educational program costs. Indeed, very few educational intervention or reform initiatives require additional development or maintenance costs above and beyond those subsumed under general annual school costs. Second, this valuation method depends greatly on the age of the building in question—that is, the greater the undepreciated portion, the higher the opportunity costs. Within the context of educational program evaluation, newer schools may generate highly skewed, unrealistic value estimates. Thus, facility cost valuation presents a methodological and practical challenge to educational cost analysis. Ultimately, it is up to the evaluator to determine when it is appropriate to conduct a facility cost valuation, and by what method, and to develop cogent rationales accordingly.

Valuing the costs of equipment and materials. Valuing the costs of equipment and materials is perhaps the most straightforward part of educational program evaluation. That said, it should be noted that such costs are among those most frequently underestimated. Again, it is often difficult to differentiate equipment and materials specifically required by the program or intervention from those otherwise available from the school. However, what is most important is that evaluators include all equipment and materials necessary to the effective functioning of the intervention or program (e.g., furnishings, specialized instructional equipment, office supplies, and other miscellaneous materials), regardless of how they are supplied. In general, the value of equipment and materials can be estimated in the same manner as the value of facility use.

Valuing the costs of other program inputs. "Other program inputs" might include costs such as telephone bills, Internet access fees, and training or professional development activities (Odden, Archibald, Fermanich, & Gallagher, 2002). This category of costs—which typically represents less than 5% of program or intervention costs—does not require as detailed a valuation process as more costly portions of program or intervention investments (e.g., personnel costs). However, it is important that the valuation of other program inputs take into account both purchased goods and in-kind contributions or donations.

Valuing the costs of required client inputs. "Required client inputs" refers to the ongoing costs clients absorb to participate in the intervention or program (e.g., transportation, books, uniforms). It is important to note that client fees are not to be included in this estimate. As with the valuation of equipment, materials, and other program inputs, the degree of attention devoted to valuing required client inputs should be commensurate with the types of inputs under

consideration. If the costs absorbed by clients are of minimal significance, this point should be noted in the final evaluation. Depending on the nature of the evaluation, it might be appropriate in some cases to estimate the *relative* or *adjusted* cost to clients. For example, the overall costs of a program would likely represent a larger percentage of yearly income for low-income families than for higher income families. Thus, if the evaluation goal is to choose between two programs in a district with high income variability, such an adjustment might more accurately reflect the true costs to clients.

Limitations of the ingredients approach to cost analysis. Although Levin (1983) provided categories for evaluators to consider in estimating overall costs, no single approach to categorization will be suitable in all cases. Moreover, there is little consensus in the educational program evaluation literature concerning the most appropriate categorization of educational program costs; the ingredients model is but one of many possible taxonomies. In fact, the development and refinement of a comprehensive cost taxonomy specific to educational programs would represent a valuable methodological advancement. Indeed, the extent to which Levin's (1983) ingredients model provides a useful heuristic for organizing cost information depends a great deal on the research question, resources, and planned analyses. It is, however, one of the most commonly used taxonomies within the context of educational program evaluation, and it has facilitated data collection in a variety of cost analyses to date.

Resource Cost Modeling Approach

Resource cost modeling (RCM) is an alternative to the ingredients approach to cost analysis. RCM is a formalization of the ingredients approach and is often used to conduct cost projections and simulations as well as cost analysis. Like the ingredients approach, RCM requires a complete description of each program resource to validly complete the subsequent analysis.

RCM begins with a list of the types of classes and services provided in a school setting (e.g., regular third-grade classroom or Reading Recovery pull-out program). Each type of class or service is called a *delivery system*, and so each program is considered to comprise one or more delivery systems. Each delivery system is then described in terms of its required ingredients or resources (e.g., full-time teacher for 12 hours, supplies, aides, capital equipment).

In practice, RCM can be broken down into three essential steps:

1. Disaggregate and list all delivery systems that make up each of the educational programs under consideration.

2. Determine the resources used by each of the identified delivery systems.

3. Assign monetary values to each of these resources to determine specific program costs.

Once monetary values have been assigned, overall per-pupil costs can be derived by dividing program resources by number of students served.

Adjusting Cost Data

The adoption of a model for cost analysis provides the evaluator with a general framework for determining which ingredients or elements should be considered in the analysis itself. However, the model adopted does not necessarily dictate how actual monetary values should be assigned to those ingredients. Indeed, the assignment of actual monetary values to ingredients involves a multistage process in which costs of ingredients are estimated and then adjusted to provide the most meaningful estimate of actual program or intervention costs.

Figure 3 illustrates the general process involved in conducting ingredients and RCM approaches to cost analysis. As the diagram suggests, there is a great deal of overlap between the two approaches in terms of data collection and interpretation. Where the two methodologies diverge is in the initial stages of modeling, where RCM provides a more complex division of cost categories.

Once cost data are collected and categorized, further levels of analysis and qualification are necessary to ensure that cost data are interpreted properly. These steps include (a) valuing ingredients, (b) adjusting for inflation, (c) discounting costs, (d) calculating net present value, (e) conducting a sensitivity analysis, and (f) analyzing the distributional consequences of costs.

Assigning a Monetary Value to Cost Ingredients

There are at least three basic methods that can be used to assign a monetary value to cost ingredients. These methods estimate costs by using market prices, shadow prices, and hybrid prices, respectively. Regardless of the valuation method chosen, what is important is to provide a cost estimate that is systematic and replicable and represents the best estimate of expected costs.

Using market prices to value ingredients. According to economic theory, when the market for a good or service is perfectly competitive, an equilibrium price is established in which the actual price of that good or service represents its true value (Dorfman, 1967). This face value price is typically referred to as its market price. The benefit in using market prices to value ingredients is that they are readily available and quite simple to estimate and understand.

Using shadow prices to value ingredients. The use of shadow prices is appropriate when the market for a good or service is not in a state of equilibrium, and few buyers or sellers of a given ingredient are available. In such cases, the market price is an inaccurate estimation of the real cost of obtaining additional units of the ingredient. For example, shadow prices may be appropriate when consultants with very specific qualifications are required to implement components of a program or intervention or when no financial transaction has occurred.

Using hybrid prices to value ingredients. Hybrid prices are often useful when programs are expected to be replicated and an evaluator would like to make adjustments for expected changes in program costs reflecting increased demand for an ingredient. For example, if a program or intervention that is likely to be implemented nationwide requires the participation of specialized personnel, the demand for such personnel will increase, resulting in a corresponding increase in the cost of obtaining the personnel. If this is a likely scenario, hybrid prices can

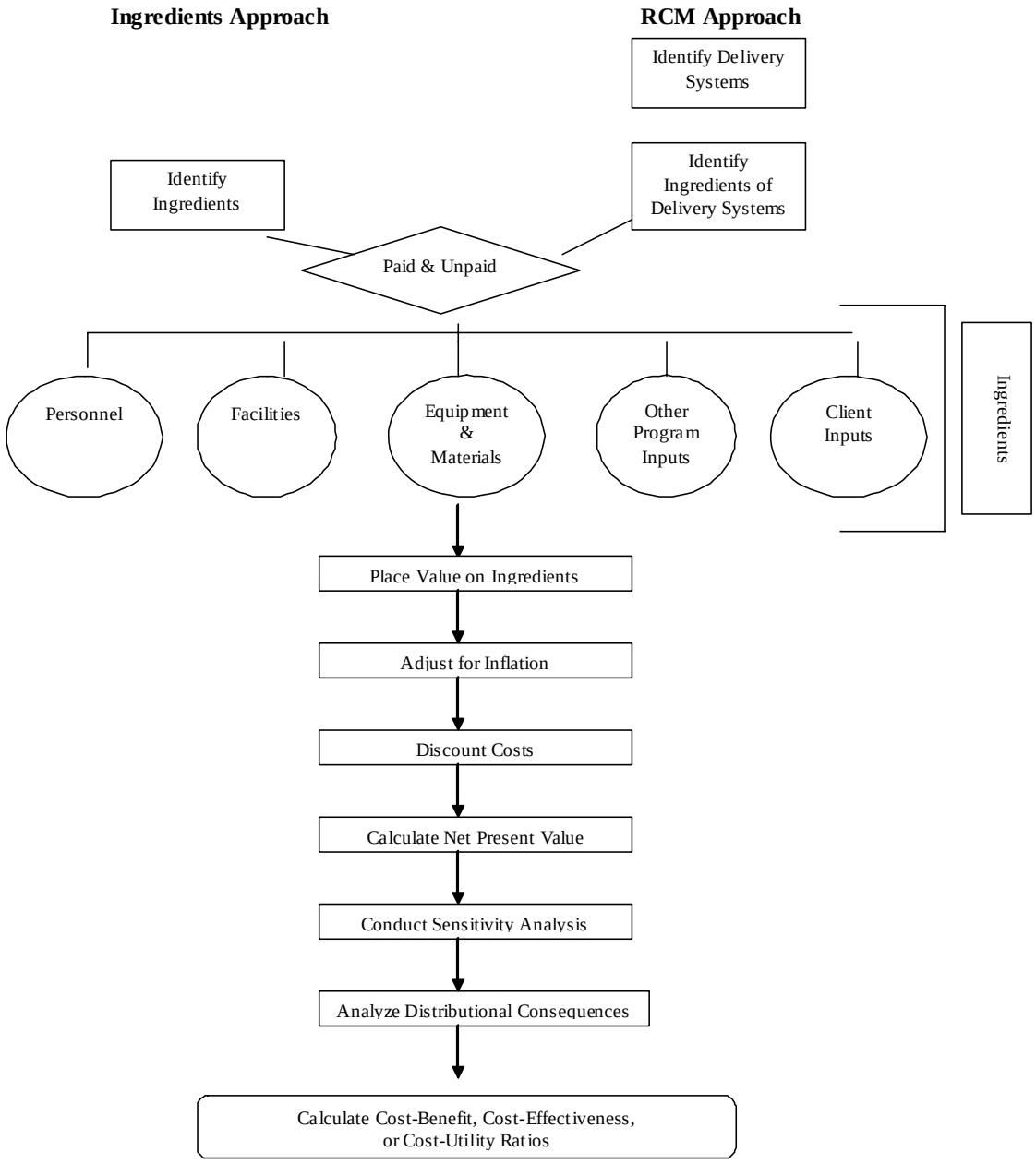

Figure 3. Ingredients and RCM approaches to cost analysis.

provide a useful means for program evaluators to represent true program costs to individuals interested in adopting the program under evaluation.

Estimating costs when cost data are unavailable. Unfortunately, in some instances cost data are simply unavailable or only a range of cost estimates is available for a particular good or ingredient. Such problems often arise when a program has not yet been implemented or when its operations are not yet clearly defined. When no cost information is available, it is often best to break ingredients down into their constituent parts and simply add the value of those parts to estimate the cost of the whole. In other instances, it may be most efficient to consult experts on the topic.

Adjusting Costs for Inflation

For any multiyear project, ingredient costs will be higher in later years due to price inflation. One way of adjusting for inflation is to convert nominal or current terms into *real terms*. There are two critical steps in this adjustment process. First, the evaluator must control for value changes that result from fluctuations in inflation. Second, the evaluator must control for the opportunity cost lost in some program designs. These adjustments are typically made by using a consumer price index (CPI) available from state and federal sources (e.g., U.S. Department of Labor, n.d.).

Since the prices for some ingredients rise at different rates of inflation, it is often considered good practice to adjust rates according to the different price indexes provided for different categories of goods or services. On the other hand, Levin and McEwan (2001) have suggested that the general CPI is a sufficiently accurate approximation of current rates. Thus, an evaluator is probably justified in using the general CPI to adjust program costs for inflation unless there is reason to believe that the rates of inflation will vary significantly across different ingredients, in which case these variations should be taken into account.

Discounting Costs

In addition to adjusting for inflation, evaluators must adjust costs for value associated with the passage of time, a process refereed to as *discounting costs*. Discounting is based on the premise that costs occurring in the future are less of a burden than costs occurring in the present. Resources invested in a program or intervention, be they monetary or nonmonetary, could theoretically be invested elsewhere and earn interest on that investment. Therefore, using resources now implies a loss of that potential interest. As such, discounting costs is distinct from accounting for inflation because even in the absence of inflation, evaluators need to discount costs for changes in their distribution over time. For example, a project that incurs a cost of $500 during Year 1 is considered less cost-efficient than a project that incurs a cost of $500 in Year 2 because the money retained by the second project in Year 1 could be allocated to other, perhaps more profitable, investments.

Although there is agreement on the need to discount future costs, there is far less agreement on the specific discount rates to be used. This lack of agreement is partially due to the fact that there are many ways to conceptualize and calculate discount rates, in part because different government agencies set different standards. For example, the U.S. Office of

Management and Budget, the Congressional Budget Office, and the Government Accountability Office all have set different standards (see Table 2) for discounting rates within the context of program evaluation (Boardman, Greenberg, Vining, & Weimer, 1996).

Table 2
Federal Regulatory Agencies and Their Guidelines on Cost Analyses

Agency	Circular #	Details	Location
Office of Management and Budget	A-21	Determining costs applicable to grants, contracts, and other agreements with educational institutions	http://www.whitehouse.gov/omb/circulars/a021/a021.html
	A-94/64	Discount rates and guidance on benefit-cost analyses	http://www.whitehouse.gov/omb/circulars/a094/a094.html
	A-94 App. C	Discount rates for cost effectiveness	http://www.whitehouse.gov/omb/circulars/a94c-fy00.html
Congressional Budget Office	—	General recommendations	http://www.cbo.gov/Pubs.cfm
Government Accountability Office	—	Lots of information on "best practice" standards for design and interpretation of evaluation	http://www.gao.gov/special.pubs/erm.html

One approach to discounting costs is to have the discount rate reflect returns on consumer saving options (e.g., the interest rate on treasury bills), while another approach uses average returns on investments made by entrepreneurs in the private sector. Still another approach uses the weighted average of the two preceding options. In practice, most evaluation analysts use a range of approximately 0–11% as a discount rate (Barnett, 1996). Often, stakeholders pressing for the implementation of a program will argue for lower rates, and those not in favor of implementation will argue for higher rates. Thus, the choice of discount rates has both professional and ethical implications. Currently, the Office of Management and Budget suggests using a 7% discount rate.

Calculating Net Present Value

The concept of *present value* refers to the value of a dollar from any year expressed in terms of the value of the dollar to the beginning of the program or policy. If multiple policies or programs are being evaluated, present value is calculated by discounting for all projects to the

beginning of the policy or program that was first implemented. Far too often, a cost analysis is conducted without adjusting for inflation or discounting the costs and benefits. This practice often makes programs or policies look more economically sound then they really are.

The calculation of the net present value uses an interest rate or discount rate to discount future costs relative to current ones. The formula for calculating net present value is $PV = Ct / (1 + r)\ t - 1$, where *PV* refers to the present value, *C* refers to present cost, *r* refers to the discount rate, and *t* refers to the year in which the project incurred its cost (see Levin, 1983, or Levin & McEwan, 2001, for a more detailed explanation).

In this context, the discount rate is considered the interest rate that indicates the tradeoff rate between dollars in one year and dollars in the next year. As the formula suggests, the calculation of present value tends to reduce the value of later costs and benefits relative to earlier costs and benefits. For example, if the discount rate is 3%, the present value of benefits would be calculated by multiplying 1.03 for Year 2, 1.03^2 for Year 3, and 1.03^3 for Year 4.

Conducting a Sensitivity Analysis

Almost every cost analysis makes some assumptions to produce estimates of costs and benefits. However, different assumptions can give rise to substantial variation in the interpretation of results. Sensitivity analysis refers to the procedure used by evaluators to identify critical assumptions and explore their effects on the results. One important consideration in a sensitivity analysis is the discount rate. When conducting a cost analysis, it is important to undertake sensitivity analyses with several probable discount rates to provide a range of net present values. This procedure identifies the conditions that must hold in the future for the evaluation results to be considered valid. If a positive present value is found for a number of potential discount ranges, the analyst can conclude that the variability in discount rates does not factor heavily into the analysis.

Sensitivity analysis can be conducted using a variable-by-variable analysis or a scenario analysis. The two techniques are quite similar and offer several advantages over other methods of examining the effects of uncertainty.

1. *Variable-by-variable analysis.* Variable-by-variable analysis is intended to understand how change in a single variable will affect the subsequent cost analysis (e.g., benefit-cost ratio). To conduct a variable-by-variable analysis, the evaluator must first list all of the important factors considered in the cost analysis. Second, for each factor, the evaluator must determine a range of possible values (generally three to five). These values can be based on "optimistic," "most likely," or "pessimistic" outcome values. Other options include establishing a range of values on the basis of one or two standard deviations from an expected value. In practice, these values are often determined by past experience or expert

[2] *Note:* This analysis is a simplified version of events. Sensitivity analyses, distribution of costs, discounted estimates, and expected changes over time must be taken into consideration to ensure the validity of interpretations.
[3] *Note:* This analysis is a simplified version of events. Sensitivity analyses of weights and costs, as well as other financial factors must be taken into consideration to ensure the validity of interpretations. Likewise, if costs or benefits were expected to change from year to year, it would be important to calculate multiple cost-effectiveness ratios to reflect those differences.

opinion. Finally, the evaluator will calculate the outcome variable of the cost analysis (e.g., benefit-cost ratio) and net present value for each value of a factor while holding all other factors at their expected value. For example, if there are three factors that are uncertain and three estimates are developed for each of those three factors, nine different net present values should be calculated. The resulting net present values can then be examined to determine the degree of overall variation and the extent to which one or more of the uncertain variables under consideration are responsible for the variation in outcome estimates.

2. *Scenario analysis.* In contrast to the variable-by-variable approach, scenario analysis assumes that uncertain factors do not operate independently from one another. As such, scenario analysis allows evaluators to group levels of various factors in sensible, consistent combinations. For example, if one is examining the cost associated with implementing a new reading curriculum at a school, it is unlikely that the costs of textbooks and their respective workbooks are independent. Thus, to conduct a scenario analysis, the evaluator would follow the basic steps necessary to conduct a variable-by-variable analysis, but would combine costs that are expected to covary (e.g., text books and workbooks).

Sensitivity analysis has several advantages. First, it is relatively straightforward to conduct, and the information necessary to develop several ranges of cost is usually not difficult to develop (although developing such ranges of cost is somewhat more complex for scenario analysis than for variable-by-variable analysis). Second, a sensitivity analysis that uses scenario analysis can provide more realistic information about the potential interaction of cost factors. Third, a sensitivity analysis provides more information, which may be important to various stakeholder groups. Specifically, it provides a general sense of (a) just how uncertain economic impact estimates are and (b) how much variability one can expect from economic projections in applied settings.

Analyzing Distributional Consequences

Policies and programs differ in their distributional consequences—that is, who gains and who loses—as well as in their economic efficiency. For example, the net present value of a particular program can be equal for projects that benefit only the poor, only the rich, or only the rich at the expense of the poor. For cost analyses to be useful and informative, evaluators need to consider the analyses' distributional consequences. All that is required for such a procedure is extensive disaggregation of net present value estimates according to a predefined set of stakeholder groups.

The first step in analyzing distributional costs is to divide the ingredients into sections describing who will pay for what. Various constituencies may provide cash contributions and payments that subsidize the purchase of ingredients provided by other constituencies. Although this type of analysis does not reduce overall cost, it does frequently alter the distribution. It is also important that a net cost be calculated for every relevant constituency. This way, the data collected from a cost analysis can be reported in such a fashion that each constituency or stakeholder group is able to easily understand what effects, if any, the program or intervention will have on their particular group interests (Joint Committee on Standards for Educational Program Evaluation, 1994).

Step 3: Comparing Program or Intervention Costs and Outcomes

After the findings have been reviewed, net present values determined, distributional costs and benefits considered, and sensitivity assumptions taken into account, evaluators can then turn their attention to ranking the desirability of the net present values of various projects. The next section of this paper provides case examples of how to use the most popular methodologies for calculating and adjusting net present values and ranking program alternatives: basic-cost analysis, cost-feasibility analysis, cost-effectiveness analysis, and benefit-cost analysis.

Basic-Cost Analysis: What Is the "Bottom Line"?

Basic-cost analysis is the most limited form of cost analysis. This form of analysis answers questions regarding the overall cost (or distribution of costs) of implementing a given intervention program. Program or intervention benefits are not considered. Although this form of analysis can be very helpful for projects during the planning phase of a given project, it is not appropriate for making within- or cross-site comparisons.

Example of Basic-Cost Analysis in Action

A principal wanted to implement a new school-wide social skills program that had proven successful in other districts. However, before she purchased the curriculum, she wanted to project how much this program would *really* cost to *implement*. She needed a systematic way to think about costs, and so she conducted a basic-cost analysis using the ingredients method.

Step 1: Identify Cost Areas

The principal began to collect data on how much how much the program would cost in terms of the following factors:

1. *Personnel costs.* The principal decided that three categories of personnel were relevant to consider:

    a. *Instructional staff.* Since teachers would be required to attend after-school meetings and additional parent conferences, it would be important to take into account how much overtime pay for instructional staff would cost.

    b. *Administrative/support staff.* Since a program coordinator would also need to be hired, it would be important to take into account how much this position would cost. However, since this was to be a new position, it would be important to take into consideration not only salary, but also any additional fringe benefits and contributions to Social Security tax.

    c. *Consultants.* The principal decided it would be best to hire a consultant to help organize and implement the program during the first year. So she included an estimate of consultant costs in her initial cost analysis. However, since this would be a contractual

position, she did not have to take into account any fringe benefits or Social Security tax contributions in her estimates.

2. *Facilities*. Since the program was held at the school (and the school was usually open until at least 7:00), the principal decided there were unlikely to be any facilities costs up-front. But if they rented the local community center, as one teacher had suggested, she would have to include this rental cost in her estimate of facilities costs.

3. *Equipment and materials.* In addition to estimating the cost of purchasing the curriculum, the principal chose a "best guess" estimate of the copying and other miscellaneous costs that would be associated with implementing the program. Since she did not expect miscellaneous costs (e.g., pencils and supplies) to be very high, she did not need to spend much time on this step.

4. *Other program inputs.* To get the project up and running, all participating teachers would need to attend a 2-day workshop. The principal also wanted to collect data on how much student behavior improved each year. The principal included the workshop and data collection costs under *other program inputs*.

5. *Client inputs.* Since no fees were charged to parents and all supplies were given for free, client inputs were negligible. Although the principal could have included transportation costs or parent time in her estimate, she concluded that this step was unnecessary since the program was voluntary and most students lived within walking distance of school.

Step 2: Generate Cost Ranges

Before presenting her results, the principal generated ranges of estimates wherever possible (e.g., how much the program would cost with and without consultants, a program coordinator, etc.).

Step 3: Interpret Results

The principal was now in a position to present her results and have a framework for discussing what were, and were not, essential ingredient costs. She could then go through each of the above steps for each curriculum she was considering for each year of implementation.

Cost-Feasibility Analysis: Can We Do This Given Our Current Budget?

Cost-feasibility analysis is a situation-specific form of analysis that addresses whether a given program can be successfully implemented within predefined budgetary constraints. Program or intervention benefits are not considered. Although this form of analysis can be very helpful during the planning phase of a project, it is not appropriate for making cross-site comparisons.

Example of Cost-Feasibility Analysis in Action

Now that the principal knew how much implementing each of the social skills programs was likely to cost, she wanted to compare these costs to other alternatives to determine how feasible each alternative would be, given her current and projected school budget. She considered three programs: Social Skills Program A (a four-star program), Social Skills Program B (a three-star program), and Social Skills Program C (a two-star program). This year, she had $50,000 available for social programming (with 400 students), or $125 per pupil. Since her current social programming cost $100 per pupil, she deduced that her per-pupil costs could increase by no more than $25 unless she was willing to cut her current programs.

However, the principal expected that in the following year she would be awarded a grant for $20,000 (for a total of $70,000), which would mean she could spend up to $175 per pupil for social programming, allowing her per-pupil expenditures to increase by $75, without cutting other program costs. She would have to wait until the next year, however, to implement a more expensive program.

Step 1: Consider the Feasibility

Social Skills Program A. From her cost analysis, the principal learned that Social Skills Program A would cost $90,000 to implement in Year 1 and $80,000 in Year 2. Thus, the per-pupil expenditures would increase by $225 in Year 1 and $200 in Year 2. She concluded that she could not afford Program A even *if* she cut all other social programming.

Social Skills Program B. From her cost analysis, the principal learned that Social Skills Program B would cost $30,000 per year to implement. This would increase per-pupil expenditures by $75. She concluded that although she could afford to implement this program next year, it was not feasible to implement this year *unless* she was willing to cut all other social programming.

Social Skills Program C. From her cost analyses, the principal learned that the Social Skills Program C would cost $10,000 per year to implement. This would increase per-pupil expenditures by $25 each year. She concluded that she could afford Program C *and* still keep her current social programming.

Step 2: Interpret Results

Given her current and projected budget, the principal concluded that of the three possible social skills programs, only Programs B and C were feasible.

Step 3: Make Decisions

At this stage the principal could decide which program to implement:

Option 1. She could implement Social Skills Program B in Year 1 *if* she cut her current social programming.

Option 2. She could wait until Year 2 to implement Social Skills Program B *and* keep her current social programming.

Option 3. She could implement Social Skills Program C in Year 1 *and* keep her current social programming.

Alternatively, the principal could decide to conduct further analyses (benefit-cost, cost-effectiveness, or cost utility) to help her determine whether to implement Social Skills Program B or C.[4]

Cost-Effectiveness Analysis: Which Program Will Increase Test Scores the Most at the Lowest Cost?

Cost-effectiveness analysis is able to determine which program or intervention provides the most effectiveness at the lowest cost. *Effectiveness* is defined as performance on a single criterion variable (e.g., reading test scores). Costs are monetary (e.g., cost of materials), but benefits can be monetary (e.g., supplies) or nonmonetary (e.g., time) in nature. Although this form of analysis can be helpful in deciding which of two programs with similar objectives (e.g., reading improvement) is most effective at the least cost, it generally is not used to compare programs with multiple program objectives.

Example of Cost-Effectiveness Analysis in Action

Now that the principal had a good "annualized" estimate of costs for Social Skills Programs B and C, she wanted to compare the two to see which program would improve students' social problem-solving scores the most for the least cost.

Step 1: Estimate Effectiveness

The first step in a cost-effectiveness analysis is to estimate the effectiveness of each intervention. The measure of effectiveness that the principal chose was improvement on the Social Skills Rating System (SSRS). To estimate effectiveness, the principal could use either non-experimental or experimental methods. Regardless of which method she selected, she would want to compare the relative achievement of students using greater and lesser quantities of each intervention (Social Skills Program B and C), while holding constant other important factors such as socioeconomic status (SES).

Because the principal did not have the time or resources to conduct an experimental study, she chose to estimate the effectiveness of each program by piloting each in two different classrooms and using multiple regression to study differences in students' SSRS scores. She was interested in whether the cost associated with implementing a school-family component of Program B was really worth it for children from low socioeconomic backgrounds, as the program developers had claimed.

[4] *Note:* This analysis is a simplified version of events. Sensitivity analyses, distribution of costs, discounted estimates, and expected changes over time must be taken into consideration to ensure the validity of interpretations.

This pilot study showed that implementation of Social Skills Program B caused students' SSRS scores to rise by 4.7 points for high SES students, 5.3 for medium SES students, and 12.6 for low SES students. Implementation of Social Skills Program C caused students' SSRS scores to rise by 1.7 points for high SES students, 3.2 for medium SES students, and 3.9 for low SES students.

Step 2: Calculate Cost-Effectiveness Ratio

With these data in hand, the principal then had to combine the data on costs and effectiveness by calculating a cost-effectiveness ratio. This ratio would indicate how much it would cost to achieve a 1-point increase on SSRS scores.

Table 3
Cost-Effectiveness Calculations

Cost-Effectiveness Ratio $= \frac{\text{Cost}}{\text{Effectiveness}}$	
Program B	Program C
High SES $\frac{\$75}{4.7}$ = \$15.95 per pupil to raise SSRS score by 1 point	High SES $\frac{\$25}{1.7}$ = \$14.70 per pupil to raise SSRS score by 1 point
Medium SES $\frac{\$75}{5.3}$ = \$14.15 per pupil to raise SSRS score by 1 point	Medium SES $\frac{\$25}{3.2}$ = \$7.81 per pupil to raise SSRS score by 1 point
Low SES $\frac{\$75}{12.6}$ = \$5.95 per pupil to raise SSRS score by 1 point	Low SES $\frac{\$25}{3.9}$ = \$6.41 per pupil to raise SSRS score by 1 point

Step 3: Interpret Results

From these data, the principal could conclude that Program C seemed to be the most cost-effective option for children from high and medium SES backgrounds. However, when targeting children from low SES backgrounds, Program B seemed a much more cost-effective alternative.[5]

[5] *Note:* This analysis is a simplified version of events. Sensitivity analyses of weights and costs, as well as other financial factors, must be taken into consideration to ensure the validity of interpretations. Likewise, if costs or

Benefit-Cost Analysis: By How Much Do the Benefits of This Program Outweigh Its Costs?

Benefit-cost analysis is commonly used by governmental agencies to determine which program or intervention provides the greatest benefits at the lowest cost. Program or intervention benefits are measured according to a single criterion variable (e.g., reading scores). All costs must be translated into monetary terms (e.g., a dollar amount must be placed on the cost of time). Although this form of analysis can be very helpful for making decisions regarding the distribution of resources between two categorically different projects (e.g., road construction vs. educational investment), it requires that all benefits and costs be converted to a monetary units.

Example of Benefit-Cost Analysis in Action

If the principal was interested in gaining public support for her project—demonstrating how it would save taxpayers money, showing how risk reduction would save money, or comparing it to other non-educational programs (e.g., road construction)—she might be interested in doing a benefit-cost analysis.

Step 1: Estimate Monetary Costs

The first step in conducting a benefit-cost analysis is to calculate the monetary costs associated with implementing—or not implementing—the program.

Table 4
Monetary Cost Calculations

Monetary costs			
Variable (per year)	Cost without program	Cost with Program B	Cost with Program C
Program costs	0	30,000	10,000
Teacher time	0	31,000	25,000
Parent time	0	10,000	0
Total costs	$28,159	$71,000	$35,000

benefits were expected to change from year to year, it would be important to calculate multiple cost-effectiveness ratios to reflect those differences.

Step 2: Estimate Monetary Benefits

Next, the principal calculated the per-unit monetary benefit associated with each program. This step can be difficult (e.g., placing a monetary value on a reduction in teacher stress). To deal with this uncertainty, the calculation of multiple cost projections is encouraged.

Table 5
Monetary Benefit Calculations

Monetary benefits			
Variable (per year)	Estimated $ benefit per unit	Benefits with Program B	Benefits with Program C
Reduced number of office referrals	$5	100 × 5 = 500	150 × 5 = 750
Reduced number of drug offenses	$250	25 × 250 = 6250	38 × 250 = 9,500
Reduced teacher stress	$175	2 × 175 = 350	3 × 175 = 525
Reduced expulsions	$550	15 × 550 = 8250	19 × 550 = 10,410
Reduced suspensions	$200	2 × 200 = 400	3 × 200 = 600
Total benefits		$45,750	$31,785

Step 3: Calculate Net Benefits (Discount and Sensitivity Analyses)

Next, the principal calculated the net benefits for each program.

Table 6
Net Benefits Calculation

Net benefits	
Program B	$71,000 - $45,750 = $25,250
Program C	$35,000 - $31,785 = $3,215

Step 4: Calculate Benefit-Cost Ratio

The principal then calculated a benefit-cost ratio. In this case, any benefit-cost ratio above 1 would suggest that the benefits outweighed the costs.

Table 7
Benefit-Cost Ratio Calculation

Benefit-cost ratios	
Program B	$71,000/$45,750 = 1.55
Program C	$35,000/$31,785 = 1.10

Step 5: Interpret Results

From the available data, the principal could tell that the benefits outweighed the costs for both Program B and Program C. However, of the two, Program B provided the most monetary benefit for the least monetary cost.[6]

[6] *Note:* This analysis is a simplified version of events. Sensitivity analyses of weights and costs, as well as other financial factors, must be taken into consideration to ensure the validity of interpretations. Likewise, if costs or benefits are expected to change from year to year, it would be important to calculate multiple benefit-cost ratios to reflect those differences.

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