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ABSTRACT

To help administrators improve school efficiency in a time of financial constraints, this document reviews research on school productivity, points out possible improvements suggested by the research, and discusses several problems in measuring school costs and effectiveness. The author first explains the analytical concepts of school productivity, input-output analysis, and productivity functions. His review of school productivity research, covering studies of teacher, school, and program effectiveness, notes a number of variables that influence productivity, including teacher experience and verbal ability, teacher-student interaction, use of computers or other advanced technology, school climate, class size, and socioeconomic factors. Administrators wishing to apply the research findings to their schools, says the author, should also be aware of the opportunity costs--the alternatives lost--when a particular method or reform is adopted. The document also explains how difficulties in choosing among multiple educational goals and in selecting appropriate test instruments can create problems in measuring educational output. The author concludes that administrators can make a difference, however, by finding ways to make schools more productive and effective. (RW)

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SCHOOL ADMINISTRATORS CAN MAKE A DIFFERENCE

Terry G. Geske

The public has increasingly demanded greater "accountability" of the public education sector in the last decade. In the name of accountability, state legislatures across the country have been mandating minimal competency testing programs for the public schools. At the same time, a "hold the line" attitude prevails, and several states have enacted tax and expenditure limitation provisions in an effort to reduce governmental spending. In addition, rapidly rising costs and double-digit inflation are creating serious fiscal problems for local school districts everywhere. Soaring energy costs combined with reductions in state aid due to declining enrollments have already disrupted the budgetary process in many school districts.

With slower economic growth and very little "new" money available for education, budgets will continue to become tighter and more restricted. For the foreseeable future at least, administrators will be forced to seek out even more efficient and effective ways of providing educational programs. A number of studies which have investigated school productivity and resource allocation can provide some direction and insights to help school administrators identify less efficient practices and procedures as they attempt to put limited resources to better use. The findings from school productivity studies conducted to date, such as cost-effectiveness analysis and school and teacher effectiveness studies, cannot provide quick and simple solutions for improving resource allocation in schools. They do, however, offer some suggestions which can be considered by local school districts to help contain school costs.

School productivity studies are concerned with such issues as the consideration of alternatives, the importance of using time efficiently, and the concept of opportunity costs. A careful consideration of these issues can help make explicit the cost-effectiveness decisions that school administrators intuitively make on a daily basis as they administer their budgets. This paper discusses the general nature of school productivity studies, provides examples of some cost-effectiveness and school-effectiveness studies which might be useful, and addresses some of the problems inherent in measuring educational costs and assessing program effectiveness. This paper suggests that school administrators can and do make a significant difference in determining school quality by applying school productivity research.

Cost-Effectiveness Approaches

The concept of production function is crucial to understanding typical school productivity and effectiveness research. A production function expresses mathematically the relationship between school inputs (e.g., students, teachers, administrators, and curriculum materials) and school outputs (e.g., growth in cognitive skills, substantive knowledge, and affective behavior). Within this analytical framework, an attempt is made to determine the relative impact of the different input variables on the output measures. In cost-effectiveness analysis, for example, the various inputs are priced, that is, a dollar value is attached to them. The outputs in any cost-effectiveness analysis must also be quantifiable, but typically no attempt is made to equate them in terms of dollars.

In any production function computation, degree of efficiency is a term used to describe the salient difference or ratio between school inputs and outputs. Thus, efficiency and productivity in an economic sense are measured by the relationship between input and output in the school enterprise. A school can become more efficient either by obtaining a higher level of output (e.g., student achievement), while holding input constant (e.g., budget level), or by achieving the same level of output with a lower level of input. In other words, useful and meaningful comparisons can be made between the cost of different alternatives for achieving a prescribed effectiveness level or between the effectiveness of different alternatives for a fixed budget level.

A major responsibility of school administrators is to structure and organize the school resources at their disposal in an efficient manner to achieve the goals and objectives of the school district. School resource inputs consist of important human resources such as teachers, students, and staff and also the material resources such as the physical plant, classrooms, and curricular products. In addition, human and material resources have to be combined or mixed to achieve the designated objectives within certain constraints imposed by circumstantial conditions such as state law requirements and collective bargaining agreements. Despite these constraints, administrators often have more flexibility than they realize in organizing and manipulating many key resources.

In determining the most effective resource mix, the instructional content (e.g., reading, mathematics, language arts) as well as the instructional process variables (e.g., teacher characteristics, class size, length of school day) of the educational program are typically taken into account. In attempting to achieve performance objectives established for specific curriculum programs, a school staff makes several important decisions concerning resource use. How can the teachers' and students' time best be utilized? What types of student grouping patterns will best facilitate the learning process? What type of curriculum materials should be used?

School productivity studies such as cost-effectiveness analysis can, therefore, provide a structure for analyzing the complex relationship among school inputs, school processes, and school outputs and for examining the different applicable mixes of school resources in a more systematic and objective manner. In conducting cost-effectiveness analysis, the objectives to be attained are identified, the various instructional or other alternatives which lead to attainment of the objectives are considered, and the cost and effectiveness of each alternative are determined.

Illustrative School Productivity Studies

Numerous studies of school productivity have been conducted over the past 50 years, and a number of models have been developed in the last decade for cost-effectiveness studies.[1] All cost-effectiveness analyses stress the need to develop and examine different alternatives in a systematic manner. Cost-effectiveness studies conducted to date suggest that teachers play an important role in influencing pupil achievement, and that the manner in which school resources are mixed does make a difference in terms of pupil achievement.[2] These studies have also pointed out that the use of time is of central importance in the educational process.

Similarly, studies of teacher effectiveness have tended to reinforce the importance of time in the learning process. In reviewing the findings of a number of these studies, Brophy notes that,

> More effective teachers allocate more of their time for teaching, and spend more of that time accordingly. Effective teachers know how to organize and maintain a classroom learning environment that maximizes the time spent engaged in productive activities and minimizes the time lost during transitions, periods of confusion, or disruptions that require disciplinary action.[3]

Several others have also discussed the positive relationship between "direct instruction" activities in the classroom and increased student learning of basic skills.[4] Key to these studies is the clarity and specificity of what is to be learned and the effective and efficient use of teacher and student time in pursuit of these specific objectives. Though studies are less clear about the relationship between time use and other, more highly held objectives, where "direct instruction" may be less pedagogically sound, for example, problem solving, discovery, synthesis, evaluation, creativity, it seems logical that a possible link exists.

In addition, several cost-effectiveness studies have consistently found teacher-related variables such as teaching experience, verbal ability, recency of the teacher's professional training, the extent to which teachers are involved in decision making, and the instructional strategies employed by teachers to be related significantly to student achievement. More recent school-effectiveness studies examining the schooling process have begun to delineate the complex teacher-student interaction effects which occur in the classroom. These studies support the notion that certain types of children learn more when matched with certain types of teachers.

Several studies have focused on the cost-effectiveness of Elementary and Secondary Education Act (ESEA) programs such as those for disadvantaged students.[5] Other studies have attempted to compare the costs associated with the more traditional instructional approaches with those involving educational technology, particularly computer-assisted and computer-managed programs.[6] By investigating the cost consequences of using different input combinations such as teachers and computers, these studies have reinforced the importance of time and its use. They have often pointed to the significant time savings obtained by students who are able to achieve similar achievement levels much more quickly through the use of computer technology. These studies also have implications for the manner in which teachers allocate their time in the future.

Along a somewhat different line, several school-effectiveness studies have consistently found a strong relationship between teacher verbal ability and student achievement.[7] In one of the more interesting cost-effectiveness studies to date, Levin applied cost-effectiveness techniques in an analysis of teacher recruitment and retention policies.[8] Using a production function approach, Levin investigated the impact of teachers' verbal ability and teaching experience on the performance of sixth grade students as measured by a standardized achievement test. After examining both the cost data and achievement results, Levin concluded that hiring teachers with higher verbal ability would be five to ten times more effective per dollar of expenditure in increasing student achievement scores than would hiring teachers with more experience.

School effectiveness studies have yielded some interesting findings as well. Summers and Wolfe studied the academic progress of approximately 2,000 students in 150 schools of the Philadelphia school system.[9] Using longitudinal data, they examined the achievement growth of individual pupils between the end of the third and the sixth grades, the sixth and the eighth grades, and the ninth and the twelfth grades. Summers and Wolfe concluded that school inputs (such as teachers and class size) and school climate variables (such as social composition, achievement mixture, and disruptive incidences) exerted an impact on student achievement. In this study, all types of students (black, white, low achievers, and high achievers) at all grade levels scored higher in achievement the more days they attended school. Elementary school students also did better in smaller classes with teachers who graduated from higher-rated colleges. Low-achieving elementary students did better with relatively less experienced teachers, in smaller classes, and in schools with more high achievers. On the other hand, high achievers did better with more experienced teachers. Apparently, specific types of students can be helped even more if particular types of resources are channeled to them.

Mumane analyzed the impact of school resources, especially teachers, on the cognitive achievement of approximately 900 black students in 15 schools in New Haven.[10] He gathered data over a two-year period (second and third grades) for one group of children and over a one-year period (third grade) for another group. After examining the effect of the classroom as a whole on the achievement of children, Mumane concluded that there are important differences in the amount of learning that occurs in different classrooms within the same school and among different schools, and that teachers exert a critical impact on student achievement. He also found, for example, that black teachers with less than six years of experience taught reading to black children more effectively than did white teachers with similar teaching experience.

These two studies disclosed some important findings by using longitudinal data and by also tying socioeconomic factors and specific school resources to data on individual pupils. Many school resources affect different types of students in different ways and few school resources appear to benefit all students equally. Clearly, an important aspect of the dynamic educational process is the unique interaction that takes place between certain types of school resources and certain types of students. Low-achieving students, for example, appear to learn more with relatively inexperienced teachers while high-achieving students seem to learn more with experienced teachers. Small classes apparently help low achievers but are not particularly important for average or high achievers.

To determine if a new mode of instruction would be cost-effective for slow achievers, however, the net cost of less experienced teachers in small classes would also have to be estimated. While some students may learn more in smaller classes, the size of classes is a major determinant of school districts' budgets, and even a small across-the-board reduction of two or three students per class could dramatically affect the costs involved. Nevertheless, school administrators do have several options. A recent synthesis of the research examining the effects of class size by Glass and Smith suggests that pupil achievement increases as class size decreases.[11] This research, however, indicates that there appears to be little change in pupil achievement when reducing the size of classes which are larger than about 20 pupils, whereas there is evidence of substantial change in pupil achievement when reducing the size of classes which are smaller than 20 to 15 pupils.

With most school districts maintaining an average class size of 25 to 30 pupils, it would be financially impossible to reduce all classes to a point somewhere below 15 pupils per teacher to promote significant changes in pupil achievement. At the same time, however, budgetary concerns should not necessarily mandate large classes of between 20 to 30 students. If a class size of 15 pupils represents the threshold at which achievement begins to rise rapidly, there are a number of alternatives or possibilities for containing the costs involved.

One alternative would be to vary systematically the size of classes throughout the week. Instead of having two classes of 25 pupils each, for example, a school might want one class of 40 pupils and another of 10 pupils, to provide small group instruction to specific learners at least part of the week. Similarly, it might be better to provide one 30-minute period with 10 pupils and another 90-minute period with 40 pupils than to have two 60-minute periods of 25 students each. Another alternative might be to provide a teacher's aide in each class of 30 students to produce the effect of a 15-pupil group. Yet another possibility might involve the hiring of part-time teachers for a staggered teaching-learning schedule. Regardless of the particular alternative selected or policy adopted, class size should depend on the interrelationships among specific teacher characteristics, curricular areas, and student abilities.

Considering Opportunity Costs

In conducting school productivity studies important difficulties exist in measuring school costs and school effectiveness. Those involved in development and implementation of school policies should be aware of these difficulties. Several writers have addressed the potential pitfalls in conducting cost analyses within an educational context.[12] Probably the most useful notion that can be drawn from this work for administrators involves the concept of opportunity costs. The development and application of opportunity costs have substantially advanced our understanding of the input side of the educational process, and school costs are now typically viewed in terms of "what is given up" rather than "what is put in." The concept of opportunity costs involves the problem of choice and the examination of alternative uses of resources. If resources are consumed in achieving one objective, they cannot be used to accomplish other purposes. The real cost of any alternative, therefore, is the sacrifice incurred because the decision maker chose not to pursue some other alternative.

In any cost analysis, this broad notion of costs has significant implications for school administrators and must be carefully considered along with the more obvious direct expenditure items. Thomas has argued that the time spent within school might better be governed by the principle of "foregone learning."[13] In other words, the cost of a given instructional procedure or of a given curriculum is measured in part by foregone opportunities to devote teachers' and students' time to other procedures and curricula. Thus, administrative decisions involving the scheduling of teachers and students should treat the use of time as a scarce resource and allocate it accordingly.

Administrators' actions may be significantly constrained by collective bargaining agreements and fixed salary schedules, but administrators do have discretion with regard to how teachers allocate their school time. Despite administrative ability to influence the variable of time, at least one school practitioner has asserted that.

> Classrooms squander teacher talent. By assigning teachers and students to boxes, we have made our schools grossly inefficient. Fully

two-thirds of a teacher's work in a classroom consists of maintenance items that could be performed equally well by nonprofessionals.[14] Although this may be an overstatement, a number of studies suggests that teachers could be used much more effectively

A study by Rossmiller and Geske, for example, focused on the use of time by instructional personnel and involved a sample of 30 elementary schools from nine states.[15] Teachers in the schools sampled were asked to estimate the total amount of time, both in school and out of school, that they devoted to their professional responsibilities and to indicate how much of that time went to instructional activities and how much went to noninstructional activities An analysis of the data obtained for 96 teachers disclosed that approximately 40 percent of their time was devoted to noninstructional activities These noninstructional activities included supervision, planning, testing, record keeping, and clerical and administrative tasks

In another study, Hiatt focused on the use of time by 25 primary teachers in urban and suburban Los Angeles who were representative of the general teaching population[16] She found that these teachers devoted a whopping 80 percent of the morning class time to noninstructional activities Teachers, for example, spent time evaluating student progress (22 percent), handling discipline problems (18 percent), and giving directions (10 percent). The remainder of the morning was taken up with yard duty, recess break, preparing materials and equipment, and administrative and clerical duties.

Since salaries for teachers typically constitute approximately 70 percent of a school district's operating budget, many regard the classroom teacher as the most important single school resource over which administrators can exercise some degree of control. Given a consideration of the opportunity costs involved, administrators will have to devise more efficient staffing arrangements that utilize human resources, for example, teachers and paraprofessionals, in such a way as to maximize the use of their particular qualifications, talents, and skills.

In this regard, computer technology can also be used effectively to reduce substantially the amount of time that teachers have to devote to noninstructional activities A number of school districts are exploring the uses of microcomputers which are compact in size, relatively inexpensive, and easy to use. These microcomputers are ideally suited for use in individual school buildings and can accommodate records for approximately 1,000 students in 40 different curricular areas Microcomputers, for example, can be used for storing information about individual student achievement on specific learning needs to form different instructional clusters This technology can also be used for providing reports for diagnosing and prescribing learning activities, for producing group performance information, and for generating student progress reports for parents Microcomputer technology can also be used to provide data and reduce the time required to complete reports of mandated Individualized Education Plans (IEPs) for special education programs

Developing Effectiveness Measures

Traditionally, the focus in school financing has been on the input side, despite the fact that the concept of efficiency also requires a careful examination of the output side as well. The recent emphasis on efficiency and accountability in education, however, is prompting a much closer look at measuring educational outputs. In addition, some recent state supreme court cases have begun to consider the equity implications of state support programs in terms of educational outputs.[17] In the coming years, it seems likely that educational organizations increasingly will be required to consider the quality of their outputs and also to consider the relationship between their outputs and the costs involved.

As is true of the analysis of school costs, the measurement of educational outputs involves several difficult problems. To begin with there often is disagreement with regard to the specific outcomes desired from an educational system and the relative importance of various outcomes. Some people believe every high school graduate should possess a salable skill, others are primarily concerned that graduates be qualified to enter the college of their choice, still others are concerned that the school inculcate students with certain values and behavioral patterns.

Educational systems are expected to serve multiple and often competing goals and objectives. Schools, for example, are urged to provide students with equal educational opportunities and, at the same time, to provide these opportunities and learning experiences in the most efficient manner possible. The dual objectives of equality and efficiency often conflict with each other and usually involve some type of trade-off. Educational organizations often are confronted, for example, with choices that involve greater equality at the expense of efficiency, or greater efficiency at the expense of equality.

While the efficiency criterion is typically stressed in a cost-effectiveness analysis, the equity aspect of a program must also be considered Since a particular school program will rarely affect all student populations, for example, low achievers and high achievers, in an identical manner, an attempt should be made to examine changes in the distribution of gains as well as overall gains in test scores Techniques have been developed for treating multiple outcomes in cost-effectiveness studies, and generally a single criterion of effectiveness cannot adequately detect and estimate all possible effects of a program In fact, even the measurement of progress toward attainment of a single objective often will require the use of multiple indicators.

The selection of valid and reliable instruments is also an important consideration in measuring pupil performance.[18] Almost all standardized tests involve the conversion of raw scores into normative scores to indicate a student's relative position in a distribution of scores Grade-equivalent scores, for example, indicate the grade level at which students are performing Although grade-equivalent scores have some utility, Coleman and Karweit clearly point out that these scores cannot be used for making inferences about the effect of a school program on the rates of growth of pupils who start at different grade levels.[19] These researchers argue that a more accurate estimate of the amount of change can be made by using standardized scores

While standardized tests describe a student's position relative to other students, they do not diagnose the specific skills that have been mastered by the student For this reason criterion-referenced tests (as opposed to norm-referenced tests) appear to be better suited for use in cost-effectiveness studies The distinguishing feature of a criterion-referenced test is its relationship to the specific goals and subject matter of a program of instruction Criterion-referenced tests, however, are not without problems.[20] These tests are developed to evaluate progress toward specific program objectives, but as mentioned earlier, widespread agreement on specific objectives is often difficult to achieve In addition, objectives are usually difficult to operationalize in measurable terms

Conclusions

Most educational researchers and school administrators would readily agree that the processes which characteristically occur in educational organizations and in human learning are extraordinarily complex' As yet there are no definitive and unequivocal answers to the difficult questions about how to improve resource allocations in education The work on school productivity and cost-effectiveness analysis conducted over the past decade does, however, provide direction for using school resources more effectively. The reviewed cost-effectiveness and school effects studies suggest some important variables within the control of school administrators Among these are the use of teachers' time, teacher verbal ability, and certain combinations of teachers and students These variables seem to have an impact on student achievement. All are susceptible to manipulation by administrators and by the establishment of educational policy as part of the instructional process Despite some obvious constraints such as collective bargaining agreements, school administrators do have options that may be exercised in an attempt to improve resource allocation in education.

Given the tremendous pressures for fiscal restraint, school administrators will need to consider even more carefully the manner in which teachers are selected and used in school districts Clearly, school administrators will have to analyze and reassess the opportunity costs associated with the use of teacher time Teacher time that is spent in supervising playgrounds or study halls is time that cannot be used in math classes or language arts classes. School administrators need to free teachers from numerous noninstructional activities which can be performed by community volunteers or paraprofessionals.

In view of the considerable differences and variation among school districts across the country, school administrators are in key positions to offer insights and make judgments about what types of school resources and efficiency practices will work best in their particular districts Depending on any number of district factors, for example, fiscal capacity, type of students, composition of teaching staff, range of educational offerings, an efficiency improvement that may be quite suitable in one district may be entirely inappropriate in another organization. Administrators who are familiar with the needs of their districts need to generate and examine various mixes of school resources Can administrators make an important difference in improving school productivity? The answer is *yes*, and one way to be more effective is by applying school productivity research.

Footnotes

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[3]Jere E Brophy, "Teacher Behavior and Student Learning," *Educational Leadership* (October 1979) 33-34

[4]See, for example, Charles Fisher, Richard Marliave, and Nikola N Filby, "Improving Teaching by Increasing 'Academic Learning Time'," *Educational Leadership* (October 1979) 52-54, Jane Stallings, "Allocated Academic Learning Time Revisited, or Beyond Time on Task," *Educational Researcher* (December 1980) 11-16

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[10]Richard J Murnane, *The Impact of School Resources on the Learning of Inner City Children* (Cambridge, Mass Ballinger Publishing Company, 1975)

[11]Gene V Glass and Mary L Smith, "Meta-Analysis of Research on Class Size and Achievement," *Educational Evaluation and Policy Analysis*, V 1 (1979) 2-16

[12]See, for example, Emil J Haller, "Cost Analysis for Educational Program Evaluation," in *Evaluation in Education*, ed W James Popham (Berkeley, Calif McCutchan Publishing Corporation, 1974), pp. 401-50, Henry M. Levin, "Cost-Effectiveness Analysis in Evaluation Research," in *Handbook of Evaluation Research*, ed. Elmer L Struening and Marcia Guttentag (Beverly Hills, Calif Sage Publications, Inc , 1975), pp 89-122

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[16]Diana B Hiatt, "Time Allocation in the Classroom Is Instruction Being Shortchanged?" *Phi Delta Kappan* (December 1979) 289-90

[17]See, for example, *Robinson v Cahill*, 62 N J 473, 303 A 2d273 (1973) The Supreme Court of New Jersey focused on educational outcomes when it stated that a, "thorough and efficient system of public schooling must be understood to embrace that educational opportunity which is needed in the contemporary setting to equip a child for his role as a citizen and as a competitor in the labor market "

[18]For a useful discussion on the validity and reliability of achievement tests, see William E Coffman, "Those Achievement Tests—How Useful?" *Executive Review* 1 (1980)

[19]James S Coleman and Nancy L Karweit, *Measures of School Performance*, Report No 488-RC (Santa Monica, Calif , Rand Corporation, 1970)

[20]See Coffman, op cit , for a discussion of the problems inherent in criterion-referenced tests

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