

DOCUMENT RESUME

ED 089 672

IR 000 384

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TITLE Operations Research and Urban Education.
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PUB DATE Apr 74
NOTE 12p.; Paper presented at the American Educational Research Association Annual Meeting (Chicago, Illinois, April 15 through 19, 1974)

EDRS PRICE MF-\$0.75 HC-\$1.50 PLUS POSTAGE
DESCRIPTORS Budgeting; Cost Effectiveness; Critical Path Method; Educational Administration; Educational Planning; Educational Research; Evaluation; Instructional Design; Instructional Systems; Management; Management Games; *Management Systems; Models; *Operations Research; Organizations (Groups); *Problem Solving; Simulation; State of the Art Reviews; Systems Analysis; Training; *Urban Education

IDENTIFIERS Planning Programming Budgeting System; PPBS

ABSTRACT

The methods of operations research (OR) can make many contributions to the solution of the complex problems which beset urban education. OR techniques such as PERT are useful aids to planning school construction, budgets, and research projects. System planning models can be used to represent urban educational systems and to predict the effects of possible system changes. Gaming can be employed in administrator training, systems analysis in the design of instructional systems, and techniques such as cost benefit analysis in educational evaluation. In general, operations research teams provide an organization with scientific bases for problem-solving. OR teams should be composed of individuals who understand operations research and scientific methods, who can handle management problems, and who can work effectively with others in the organization. These teams should deal with specific problems and report both to organizational directors and to individual management teams. (1B)

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OPERATIONS RESEARCH AND URBAN EDUCATION

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Presentation made at the 40th National Meeting of Operations Research Society of America in Anaheim, California -- October, 1971

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(Abstract)

Modern urban educational systems are becoming more complex. This complex educational system, functioning in a highly integrated and interdependent manner to achieve an overall performance, is a critical problem. During recent years, the methods of operations research have been increasingly applied to urban systems in general and to urban education in particular. This paper presents the application of O.R. to urban educational systems in the categories of educational planning, educational training, design of instructional systems and others.

OPERATIONS RESEARCH AND URBAN EDUCATION

I. Apply Operations Research to Urban Education

Modern urban educational systems are becoming more complex. This complex educational system, functioning in a highly integrated and interdependent manner to achieve an overall performance, is a critical problem. During recent years, the methods of operations research have been increasingly applied to urban systems in general and to urban education in particular.

Although OR was evolved primarily for industrial and military management, urban education has been applying OR to their decision-making process. The areas in which OR has made a contribution to urban education may be classified into the following categories:

- (1) Educational Research
- (2) Educational Evaluation
- (3) Educational Planning
- (4) Educational Training
- (5) Design of Instructional System

A. Educational Research

Perhaps the earliest of OR techniques used in urban education was PERT for the planning and control of school construction. Later, this technique was extended to the planning and control of research projects particularly as they tended to become large and complex. More recently, the convergence technique developed for the planning and programming of medical research

programs is being applied to urban educational research aimed at understanding the reading process. This technique was developed largely because not all of the elements of a research effort can be specifically identified and described with the degree of precision required with PERT network.

B. Educational Planning

PPBS, a concept originating with the Department of Defense, is having its impact on urban educational planning. Beginning at the national level with the U.S. Office of Education, PPBS has since been increasingly discussed as a viable technique for education budget planning. This technique is under development at the local school district level in New York City and Philadelphia. It would seem, however, that its application is very much at an early stage, emphasizing definition of the program categories and collection of data.

It is the category of system planning models that the writer believes to be of particular significance and one which holds promise for assisting the urban educational administrator. This will be the subject of the remainder of this paper.

A model is a representation of a system. This representation is used to predict the effect of possible changes in the system on the system's effectiveness.

There are three types of simulation models which could be found

in education: an iconic model, an analogue model, and a symbolic model. An iconic model pictorially or visually represents what the system looks like, and is similar to a photograph. An analogue model employs one set of properties to represent some other set of properties which the system possesses. Graphs are very simple analogues. A symbolic model is one which uses symbols to designate properties of the system, including a mathematical equation or set of equations. Of the three types of models to be considered, the iconic, analogue, and symbolic, the latter is of particular importance. By proper mathematical or logical operations, the symbolic model can be used to formulate a solution to the problem.

While educational planning models may differ in their characteristics, they tend to have one or more common structural elements: (a) demand populations, that is, students; (b) service units, that is, teachers and classrooms and other resources; (c) rules for the allocation and assignment of the various service units to the student population; and, (d) mechanisms for measuring and evaluating system performance.

C. Educational Training

The value of gaming in the military context for designing strategies as well as for training has long been well established. It also may be a viable technique for training of urban educational administrators; witness the growing number of games

developed for this purpose. Various game simulations for student instruction have been developed including some that employ computers and terminals in which the student plays against nature and in the process learns economic concepts. Their value has been demonstrated but because of the cost factor their development has been slow.

D. Design of Instructional System

The literature is full of discussions and illustrations of the "systems approach" to urban educational problems, unmistakable evidence of the impact of operations research. The notion of alternatives, measures of effectiveness, and the use of models to evaluate alternatives is becoming more widely accepted among urban educators.

E. Educational Evaluation

The OR concepts that have had perhaps the greatest impact on educational evaluation (they certainly have created much controversy) are cost-benefit and cost effectiveness which are being applied to evaluate many educational programs such as the job training programs, drop-out and compensatory education programs. More than ever, the question of the cost of an urban educational program and the possibility of alternatives in achieving a given effect are recognized as having significance: these aspects were not given much thought earlier.

This simulation has been used in the design and evaluation of a diversity of systems including computer systems. Its application to evaluating a computer system which is shared by several school systems is relatively new. The concept of shared computer systems for small school systems is growing in importance. Such systems would permit school systems to share the expense of a large computer and permit a variety of administrative and instructional applications including the use of terminals located in both the schools and the district offices.

II. Organize an Operations Research Team for Educational R & D

A. Selection of Personnel

The members of the OR teams generally should have the following characteristics:

- (1) Understands and can apply scientific methods.
- (2) Is intensely interested in management-type problems.
- (3) Can communicate with and gain the confidence of organizational personnel.
- (4) Has had experience with OR and knows the latest developments in OR.

In addition, the operations researchers in educational R & D must be capable of making effective lay presentation of technical matters with non-professionals. He must have a respect for the skills that make a good manager and staff member, and

he must not be inclined to look down on those who are not technically trained. The team should contain a person who is thoroughly familiar with the R & D organization's overall operations and one who is well trained in operations research. A single person may combine these two, and in many cases OR has begun successfully with such a one-man operation. However, there are considerable advantages to having at least two persons start off, for they cannot only think together but think "against each other" fruitfully. The persons involved in this task should be inclined toward qualitative thinking, but need not be highly trained in mathematics or its application. Most important, he should not be afraid of numbers and symbols and should be willing to extend his knowledge in this area. Therefore, the effective teams have included accountants, people from data processing.

B. Organization Structure Within the Educational R & D

The following questions are the most common ones regarding the organizational structure of OR teams in the educational R & D organization.

- (1) Where should the team be located in the organization? How should it be administered?
- (2) What type of problems should it begin with and proceed to?

Let me consider each of these questions:

- (1) To whom should the OR group report? In practice,

successful OR groups have been assigned to Presidents, Executive Vice Presidents, Directors, and Department Heads. I would recommend OR teams report to Directors directly and management groups individually; these groups should attend the management group meetings once per month and frequently contact the staff concerned. Ideally, only one report should be prepared per project. To the extent that all reporting can be done orally to the people involved on a periodic basis. Results will be absorbed in small doses and implementation can be made gradually as results become available. Such meetings make participants out of those who must eventually take the recommended actions, and resistance to change is minimized.

- (2) What type of problem should it begin with and proceed to? In general, initial problems should be those that will not be very difficult or require too much time, and should be such that the results are demonstrable. The specific assignment should result from the meetings of management groups and OR teams.

III. Conclusion

The objective of OR teams in educational R & D is to provide managers of the organization with a scientific basis for solving the problems involving the interaction of components of the organization in

the best interest of the organization as a whole. This approach is an example of a "system approach" to education R & D. It is hoped that this approach will make a contribution to the educational development.

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