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ABSTRACT

Summaries are provided of the papers presented and the discussions held during the symposium "Improving Productivity of School Systems Through Educational Technology." The meeting was sponsored by the National Institute of Education's Technology and Productivity Task Force and ran August 20-22, 1973. Its purpose was to explore indepth the potentials and implications of new and advanced communications and technology-based systems for improving educational productivity. The individual presentations which are summarized focus on economic, management, and evaluation factors; on human, political, and social considerations; and on the future of technology and education in modern society. Major recommendations of the symposium relating to the documentation and demonstration of successful application of educational technology are also summarized. (PB)

# IMPROVING EDUCATIONAL PRODUCTIVITY

# THROUGH THE USE OF TECHNOLOGY

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# IMPROVING EDUCATIONAL PRODUCTIVITY THROUGH THE USE OF TECHNOLOGY

## Introduction

The utilization of technology-based instructional systems is at a crossroads. How to invest a minimum amount of money wisely and still obtain high results in both experience and actual instruction for students is a real challenge. To a great extent, the utilization of computer technology by educational institutions in the United States has been largely confined to the area of administrative data processing. Yet, it is in the instructional domain that the critical functions of schools are found. Widespread adoption of technology has not been constrained by a lack of research evidence, but rather by a variety of related factors which vary from one device to another and one instructional system to another. Areas of concern relate to cost-effectiveness, personnel resource allocation, space requirements, evaluation, teacher re-training and other human, political and social factors.

In these days of increasing demand for accountability with regard to instructional outcomes, and a simultaneous leveling of the financial resources made available, it would seem that many more institutions should be turning to the wise use of technological aids to instruction. Their failure to do so in the past most certainly supports the notion that a fundamental re-examination should be undertaken of the relationship of technology to education at all levels.

Symposium

The symposium, initiated by the Office of Education's National Center for Educational Technology (NCET), planned to investigate these issues when it initiated the symposium, "Improving Productivity of School Systems through Educational Technology" which was designed and conducted by Research for Better Schools, Inc. The project was subsequently transferred to the National Institute of Education's Technology and Productivity Task Force. Specifically, the symposium, held August 20-22, 1973, was designed to explore, in depth, the potentials and implications of using new and advanced communications and technology-based systems for improving educational productivity. Commissioned papers, discussions and the final report were to focus on the issues relating to the instruction and maintenance of alternative cost-effective methods of providing instruction. These methods were to be explored in the context of the total spectrum of human systems involved in the educational process.

The papers presented summarized the sum of the products evolving through educational technology; economic, management, and evaluation factors; human, political and social considerations; and, finally, a look at the future of education in our society and the future of technology in our educational system.

Discussants remarks were equally revealing, both in substance and in tone. The wide-spread utilization of technology-based instructional systems has its opponents, proponents, and sympathetic well-wishers. Their views, representative of the real world of administrators, teachers, state department officials, business community members and the teachers' union, are worth careful study and thoughtful consideration.

For working purposes, educational technology was defined as follows:

"Educational technology is concerned with the facilitation of human learning through the systematic identification, development, organization, and utilization of a full range of learning resources and through the management of these processes. Learning resources include the people, materials, settings, tools and equipment and activities that are specifically designed for instruction and that exist are utilized for instruction. It includes, but is not limited to, the development of instructional systems, the identification of existing resources, the delivery of resources to learners, and the management of these processes and the people who perform them. Thus, through the use of educational technology, alternative institutional patterns can be provided for the facilitation of learning."

For the three-day symposium, the basic objectives to be answered were:

1. To illustrate the availability of alternative technology-based instructional systems which show potential for improving educational productivity (case histories).

2. To examine the human, political and social factors affecting, and to be effected by, alternative technology-based instructional systems.

3. To evaluate the adequacy of planning cost models for simulating and predicting the total resource requirements for installing and maintaining technology-based alternative approaches.

4. To determine management models needed for supporting educational productivity demonstrations; i.e., how to increase educational production through management tools.

5. To examine the problems of relating input strategies to measurements of output.

6. To recommend experiments and demonstrations to be conducted.

To meet these objectives, papers were commissioned in each area to present basic data and highlight questions and concerns.

To meet the first objective, case histories were presented by Dr. Sylvia Charp, Director of Instructional Systems of the Philadelphia School District; Dr. Suilin Ling, Director and Chief Economist of Teleconsult and Dr. Robert G. Scanlon, Executive Director of Research for Better Schools, Inc.

Dr. Sylvia Charp provided an overview of computer uses and evaluation results and specific information on the CAI and CMI programs in Philadelphia. With 7,000 students involved in CAI reading or mathematics and 11,000 students in vocational and career education on-line, the PSD offers comprehensive offerings. Major concerns raised by Dr. Charp included:

-- Need to understand more about learning theory and behavior modification.

-- High cost of equipment.

-- Classroom teachers need assistance.

-- Lack of understanding by administrators on benefits.

-- Need increased interest of industry.

-- Need for definition of future role of government.

Dr. Ling presented information on the Alaskan Satellite Seminar, a case history of providing teachers in-service training in remote rural areas via new telecommunications technology. Fifty minute telecasts, once a week at 7:00 PM for sixteen weeks, linked the Alaska villages and Fairbanks with Bethesda, Maryland. This program demonstrated the feasibility of a satellite communication program and its effectiveness in delivering information and obtaining feedback and interaction.

In my paper, I described the technology activities of Research for Better Schools from Individually Prescribed Instruction (IPI) to the Advanced Instruction Delivery System (AIDS). The contributions of IPI in terms of systematic organization and delivery of instruction have been significant. The success generated has provided significant insight into the age-old problem of providing an individual plan for each youngster based on his needs and characteristics.

Applications of technology to enhance this system have been substantial. These efforts have included investigation of both the delivery of instructional materials as well as improved management capabilities. Since IPI rests heavily on data to make decisions, further efforts are needed to improve productivity. If educational systems are going to be cost-effective, technology must be aimed at the biggest item in school budgets - salaries. A device such as AIDS would at least permit research efforts in this direction. AIDS is a stand-alone computer device which has been developed by the IBM Corporation in conjunction with RBS and the Philadelphia School District. It includes a personal instructional module that is one unit including an audio-video cassette that has programming logic stored within the cassette.

An investigation of the human, political and social factors in the use of educational technology was explored by Dr. Glenn E. Snelbecker, Professor of General Educational Psychology at Temple University. The issues identified dealt with contemporary trends and issues specifically relevant to technology, such as manpower and training needs. Emphasis was placed on the need for -

-- Consumer education and information

-- A description for each project such as "Some Questions and Concerns Relevant to the People Who Use Innovations"

-- Generalization of criteria for assessing and evaluating educational technology innovations

-- Monitoring systems devised

-- Formulation and testing of instructional theories to facilitate development of educational innovations

-- Synthesis of research systematically conducted in forms for practical situations

-- Interagency panel convened on educational technology

-- Literature and personnel search to determine what changes in school staffing patterns and job responsibilities are needed when educational technology innovations are used.

The third area of concern, economic factors, was explored from two perspectives. Dr. Roger L. Sisson, Associate Director of Governmental Studies and Systems of University City Science Center in Philadelphia provided one approach and Dr. Dan Rogers of the Agency of International Development and Dr. Dean Jamison of Educational Testing Service provided a second.

In his paper, Dr. Sisson examined decision-making in relation to technology, including the three uses of technology: (1) as a small tool for aiding the teacher; (2) as requiring prior capital investment; and (3) as replacement for existing teaching process or as a new school process where none exists. Dr. Sisson also provided cost models taking into account different performance-effort-individuality variables. He concludes

with a recommendation for pilot studies to provide teachers with varying allowances for use in acquiring technology. From these studies, it would be possible to tell the extent to which teaching costs can be reduced and student time made available for other studies.

Rogers and Jamison provided some basic economic data which must be considered. For example:

-- In 1971-72, $47 billion was spent on public elementary and secondary education

-- Of this, 75% was spent on salaries, making labor the single most important input

-- 3% of the budget for 1972-73 was spent on materials

-- Federal funds account for about 10% of expenditures.

They also examined the capital intensive technologies and determined that cost and efficiency are dependent upon the scale of the operation. Television has proven to be effective, but not on the average more than traditional instruction. It is used for improving formal education in developing countries, extending the scope of formal education (e.g., British Open University) and in non-formal education. The cost is 5-10¢ an hour, but is expected to decrease to 1.5-5¢ an hour. Radio, which currently costs 1.5-2.5¢ an hour is expected to decrease to 3-4¢ an hour, or 1/5 as much as TV. CAI costs will be 85¢ an hour if the terminals can be utilized 2,000 hours per year. The authors believe it will be used effectively for compensatory education. Non-capital intensive technologies needing consideration include student-teacher ratios, year-round school, programmed instruction, correspondence education and universities without walls.

Rogers and Jamison recommended that future research and experiments should deal with:

-- Incentives to students via reduced time or increased convenience

-- Incentives to teacher to lessen the burden through technology

-- Incentives to administrators by demonstrating significant impact in terms of tangible improvements.

"Management Models and Instructional Productivity" by Dr. Robert Heinich provided a comprehensive overview of the factors involved in the implementation of educational technologies. Dr. Heinich is Professor of Education at Indiana University. The specific facilitating changes recommended by Dr. Heinich for incorporation in a management model were:

-- Do not challenge the authority of the teacher in his/her own territory

-- Use interface forms that students, not teachers, use

-- Use differentiated staffing

-- Evaluation of students as a "public" process

-- Accountability of teachers for only that role spelled out in the planning process

-- Include logistical management factors such as the need for faculty awareness and acceptance, and the need for decision to accept and continue (or discontinue) the system based on student performance data

-- Involve administrators and teachers in role restructuring

-- Certification and accreditation, including potential problems

-- Confront teacher associations with technology. The best demonstration spots might be medium-sized districts operating under flexible state laws with no history of labor problems

-- Provide a range of choices and systematizing of student options.

The evaluation of educational technology received a thorough analysis by Dr. Marvin Alkin, Director of the Center for the Study of Evaluation at UCLA. Stages of pre-formative, formative and summative evaluation were detailed. Specific issues raised related to the evaluation of educational technology were the need for:

-- Norm-referenced or criteria-referenced tests

-- Measures in the affective area

-- Timing of observations

-- User oriented product evaluation reports.

Delving into the future were two experts: Dr. Harold Shane, Professor of Education at Indiana University provided an analysis of society of the future and Dr. Robert Morgan, Director of the Center for Development Technology provided an informative futures look at technology. Dr. Shane's conjectives regarding societal futures and their educational implications included the following specific recommendations:

-- Educational experiences beginning at birth with methodical education starting at age three

-- Development of future-focused role image (FFRI)

-- Utilization of community as adjunct to schooling

-- Flow of education involving the paracurriculum concept and communiversity.

Dr. Robert Morgan, in his paper on the technology in the future of education, included the following hardware: television, radio, cable communications (TICCET), videocassette recorder and portapaks and computers. He also reported on a delphi forecast for 1980-1990 which shows that television instruction will be used in specialized learning situations given the needed software is developed. Information services, used as reference aids will be used. However, teachers will continue as the most important components of instruction.

In the discussions during the symposium, two major issues emerged. The first was the definition of "productivity" and second was the availability of education technology. The group generally accepted the following definition of productivity. "Productivity is defined as the amount of output or results obtained from a given amount of input." To this definition, efficiency was added as the "attainment of the maximum possible output with a given amount of inputs, or the attainment of a given output with the possible amount of inputs." (Rogers and Jamison)

Availability is an issue because little has been done to document available technology for potential consumers and users. Much has been developed but the question of how to best use these advances remains unsolved. It was repeatedly pointed out that supposedly "well-documented" technological innovations actually had a very limited data base, and furthermore, that these data were not readily accessible. Without such documentation, investigators in the field are unable to track the paths which have been explored.

## Recommendations

A major recommendation of the symposium was that documentation was an early and urgent need if research in the field was to progress. Before such documentation can be collected, however, standardized guidelines must be defined and adopted. This will allow the same questions to be posed across technologies and programs. In this manner, the data collected will permit meaningful comparisons and contrasts, and support decisions based on facts, not assumptions.

The result of the documentation process would be case studies of two important technological innovations which would contain relevant information on cost, effectiveness, historical development, management factors, and human, political and social factors.

The second recommendation is to conduct major demonstrations. Based upon the symposium discussions, it was apparent that some participants wanted to start with a new institution or setting, while others strongly favored working within the existing structure. Thus, two differing environments are recommended for full-scale experimentation:

-- Environment A would utilize an existing school district in which technologies were used to increase productivity. Multiple configurations of educational technology would be used by synthesizing parts of existing hardware and software capabilities.

-- Environment B would be the construction of a "Life Process Center for Education" which could be used by all levels of population from pre-schoolers to senior citizens. This center would utilize the bast of existing educational technologies in a design to cut across existing institutions and enable the extension of "schooling" to broad education.

The Final Report of the Symposium entitled, "Improving Productivity of School Systems Through Educational Technology" is available through Research for Better Schools, Inc., 1700 Market Street, Philadelphia, Pennsylvania 19103 at a cost of $7.50. Also available is a "Compiled Bibliography on Improving Productivity of School Systems Through Educational Technology." There is no charge for this document.