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ABSTRACT

This paper deals with two questions: (1) what are the the applications that might be made of microcomputers in evaluation? and (2) what are the kinds of problems (personnel, organizational, and technical) that must be overcome if microcomputers are to be used effectively? The applications include proposals and planning, management, data collection, data analysis and interpretation, and reporting. Several types of microcomputer software could be used in these applications: word processing, data bases, test generations, calculation or statistical analysis, graphic presentation, and telecommunications. The ways in which these types of software can be effectively used in evaluation activities are discussed in the first part of this report. The second part addresses the personnel, organizational, and technical issues surrounding microcomputer use. In addressing these issues in their own setting, and by following a systematic, problem-solving approach to their own use of microcomputers, evaluation researchers can gain knowledge and skills needed to help others as well. (BW)

No. 98 MICROCOMPUTERS AND EVALUATION RESEARCH: POTENTIAL BENEFITS AND PROBLEMS

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PREFACE

The Research on Evaluation Program is a Northwest Regional Educational Laboratory project of research, development, testing, and training designed to create new evaluation methodologies for use in education. This document is one of a series of papers and reports produced by program staff, visiting scholars, adjunct scholars, and project collaborators--all members of a cooperative network of colleagues working on the development of new methodologies.

What are the applications that might be made of microcomputers in evaluation, and what are the kinds of problems (personnel, organizational and technical) that must be overcome if microcomputers are to be used effectively? These questions are addressed in this brief introduction to the use of microcomputers in evaluation work.

Nick L. Smith, Editor
Paper and Report Series

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MICROCOMPUTERS AND EVALUATION RESEARCH: POTENTIAL BENEFITS AND PROBLEMS

Microcomputer! The very word causes both fear and longing in the heart of the most seasoned evaluator. This is a natural and appropriate response since both great potential and important problems are associated with the use of microcomputers in evaluation research.

Microcomputers are not ends in themselves, but are rather the means for performing tasks more efficiently and effectively. Microcomputer hardware components (e.g., central processing unit, key board, monitor, disk drives, printer, modem) embody raw potential. It is the programs or software that direct the operation and integration of these components for a particular purpose that allows the user to realize their potential. The potential of using microcomputer programs for accomplishing the tasks related to evaluation research is the topic of the first section of this paper. There are, however, some potential problems inherent in applying microcomputer technology to evaluation research. These problems revolve around people, organizational, and technological issues. In the second part of this paper these issues are explored.

Tasks and Programs

Evaluation research typically follows a process which begins with the clarification of a problem and the development of a plan or, more formally, a proposal for a particular way of addressing the problem. That plan usually contains designs for managing the study, for data collection, and for data analysis, synthesis, and

interpretation. Some provisions for reporting the results of the study are usually included as well. Microcomputers can be used to facilitate both planning and implementing each of these steps.

Figure 1 is a matrix showing the relationship between the steps in the evaluation research process and common types of microcomputer software. Programs may be written by the user with the aid of a programming language (e.g., BASIC, Pascal, COBOL). They may be in the form of general purpose pre-packaged programs which are designed to accomplish a class of tasks such as is subsumed by the concepts of word processing or data base management. These packages can be tailored to meet the requirements of many different tasks within a group of tasks. Programs may also be designed to accomplish a certain kind of task in a particular way with little opportunity for modification. This is the case with some statistical packages and some accounting packages, for example.

Figure 1

Matrix of Evaluation Research Tasks and Related Types of Software Programs

Activities	Word Proces.	Data Bases	Test Genera.	Calc/ Stats	Graphic Present.	Telecom/ Network.
Proposals & Planning	X	X		X	X	X
Management	X	X		X		X
Data Collection		X	X			X
Data Analysis & Interpre-tation		X		X	X	X
Reporting	X				X	X

This section is organized around the activities that are listed down the side of the matrix in Figure 1. The discussion relates the characteristics of the different types of programs

and their utility to the steps of the evaluation research process. For more extensive discussions of the various types of microcomputer programs, see Gray (1984, in press), Gray and Deck (1983), Spuck and Atkinson (1983), Talley (1983) and the various program specific reviews in computer magazines referenced in these sources.

Planning and Proposal Development

It is in situations where repetitive activity occurs that microcomputer programs are of the greatest potential benefit. These situations include producing multiple drafts of documents, making repeated calculations, and reporting similar information in slightly different formats. Planning and proposal development usually include all of these.

The initial conceptualization of a study typically relies on the use of words. A statement of the problem as the researcher sees it, a review of the relevant literature, the description of the proposed solution are all standard parts of research plans or proposals. And, they usually have to be presented in a pre-specified format. These often go through many drafts in the planning process. Programs that help one manipulate words, that is, word processing programs, make microcomputers useful in planning and proposal development. They have features that make the typing of text and its editing, formatting and printing very convenient.

Developing a proposed budget is also an important part of the planning process. All-purpose or generic electronic spreadsheet programs provide a ledger format for use in laying out the line items of a budget. As the details of a plan are finalized, its budget changes, too. The ability to automatically recalculate budget figures based on pre-defined relationships between the cells in a spreadsheet means that it is a simple matter to make budget projections under changing conditions with spreadsheet programs.

Large data banks and data base programs can be useful for doing the literature review at the initial stages of a study. Data banks such as that represented by ERIC can be very helpful in finding research related to a particular study. Through the use of telecommunications, various data banks can be searched. The information from these sources and from more conventional manual searches can be entered into a data base of references organized by author, subject, and so on. From these records, specific information and references can be extracted for inclusion in a proposal, for example, as direct quotations or as general references. Data base programs provide the flexibility to take one standard set of information and organize it in many different ways.

Setting up the schedule of activities for a study can be accomplished using a general program, such as one for word processing, or a specific project management program. What is needed is some way to organize the events of the study along a time line. This can be done under column headings such as event, date, cost, and responsibility using a word processing program. It can also be done in the form of a PERT or other such chart. Using the microcomputer to set up and revise the study schedule provides an advantage, in that as conditions change, new versions of the schedule can be generated and printed. This alleviates the necessity of having to manually reproduce those parts of the schedule that stay the same from one draft to the next.

Study Management

The ongoing management of a study encompasses many different tasks. These include developing and monitoring data collection techniques, accounting for program expenditures, maintaining study timelines, and reporting program progress.

The development of data collection procedures can in many cases be aided by microcomputers. In Data for Decisions, Hoaglin, Light, McPeek, Mosteller, and Soto (1982) list three types of studies: cause and effect, status quo, and prediction.

Each type has several designs related to it. For example, cause and effect studies include experiments as well as comparative observational studies. Status quo studies include sample surveys, longitudinal studies, and case studies. Prediction studies include simulations, mathematical modeling, and studies of introspection and advice.

The test and observation protocols used in experimental studies and the survey instruments used in status quo studies can be generated, formatted, and printed using generic word processing programs. In some cases a data base management program may be used to maintain, sort, and select among a large pool of potential items for a particular purpose. Special canned instrument development programs which are a form of data base programs are also available, or one can be created for a specific bank of items.

One of the most valuable uses of microcomputers in educational settings is to engage learners in simulations. Such programs can be used in prediction studies, for example, to evaluate likely future administrative behavior through "in-basket" simulations. As the power and speed of microcomputers continue to grow, they become even more attractive tools for use in the development of mathematical modeling procedures, another form of prediction study. Increased power and speed also will make them useful in regard to complex procedures which involve the repeated manipulation of information such as introspection and advice studies.

Clearly, word processing, data base management, and various special programs can make microcomputers valuable tools in the refinement of data collection procedures. Similarly, electronic spreadsheet programs and accounting programs are convenient and effective tools for monitoring program costs and projecting expenditures. The programs that were used to set up the study budget and the study timeline in the first place can facilitate updating costs and target dates. These provide efficient vehicles for monitoring data collection and for managing the

study as a whole. Of course, word processing programs are useful in the ongoing reporting of study progress.

Data Collection and Data Analysis

In addition to being useful in the development of data collection procedures, some software can also facilitate the collection and analysis of data. There are programs which can be used by interviewers to conduct telephone surveys. And there are programs that collect data directly from subjects in a more or less obvious fashion depending on their purpose. Many of these programs have routines built into them to analyze the data collected.

A growing body of statistical software for data analysis is accumulating. These range from simple inexpensive programs to those which emulate the complexity of mainframe programs. Almost every type of statistical analysis can be found, including exploratory data analysis techniques (see, especially, Carpenter, J., Deloria, D., and Morganstein, D., 1984).

Many statistical programs can provide numerical syntheses of data, and also graphic presentations. In addition, there are graphics programs which can take a data file and create line, bar, pie, and three- dimensional graphs. Some spreadsheet programs are integrated with very sophisticated graphics programs. Using graphics can be a great assistance in the interpretation of a study's results by the researcher, as well as others.

For data that include information other than numbers, data base or file management programs can be very useful in collection, analysis, and interpretation. Such programs facilitate the sorting and selection of data with particular characteristics, for example, subjects from certain areas or with particular interests. If, after analysis, other characteristics appear to be important, a data base program can be used to reorganize the records in a file and present the results from a different perspective.

If data have been collected at remote sites, it is often advantageous to be able to telecommunicate them to a central location. They can then be acted upon by the appropriate program. This may mean a mainframe program if the data set and/or analysis is too complex for a microcomputer. In such a case, a microcomputer can act as a dumb terminal to just transmit and receive information, or as a smart terminal in order to interact with the larger, more powerful computer.

Reporting

Reporting, like planning, is an activity which relies mainly on words. However, in addition to word processing programs, graphics programs can greatly enhance the effectiveness of a written or oral report. There are some integrated software programs that combine word processing, data base management or spreadsheets, and graphics programs. Such programs can provide an efficient way to pull together the results of a study. But even the separate output from a word processing program, and a data base, spreadsheet, or graphics program can be easily combined to produce effective reports. Reports thus generated can be transmitted via telecommunication networks to sponsoring agencies or other interested audiences.

In summary, custom designed, generic, or special purpose programs make it possible to use microcomputers at every step of the research process. However, the availability of such programs does not mean that the adoption and implementation of microcomputer use will be easy. In the next section, the problems surrounding the use of microcomputers for evaluation research are discussed.

People, Organizational, and Technical Issues

The versatility and relatively low cost of microcomputers has given rise to a new phenomena, the personal computer. Individuals can, on their own, purchase a very powerful computer

for personal/professional use. In many organizations, the price of a microcomputer is within the discretionary budget of many departments. In such a situation, it is hard enough to keep an inventory of hardware and software, and almost impossible to control their purchase, maintenance, and use. Clearly, the radical technology represented by microcomputers creates some important people, organizational, and technological issues. This is no different for evaluation researchers than for any other professionals.

Technology with a capital "T" is so evident in regard to microcomputers that concern over "getting machines" often overshadows legitimate people issues and organizational issues. In addressing these issues in their own setting, evaluation researchers can gain knowledge and skills needed to help others as well.

People Issues

The people issues surrounding microcomputer use include both personal concerns and informal social group concerns. Individuals seem to be either fascinated by microcomputers or hostile to them. This may be a case of the "techno-twit" versus the "techno-phobe." That is, as with any area, there are those who find microcomputers natural and exciting tools, and others who approach them with fear and trepidation.

Many microcomputers seem designed for the "techno-twits." There is an emphasis on programming, on cryptic commands, and on the "gee-whiz" factor associated with the technological bells and whistles of hardware and software. As a result, a new role has emerged, that of the computer-buff--the one person who early on established himself or herself as the local expert.

The emergence of a computer-buff can cause tension in a group, because such a role is often viewed as attractive and because in some cases the person can dominate the use of the computer(s). However, it can also be a benefit to a group if the person is willing to share information and to act as a leader in building the group's computer-related capabilities.

What to computerize? One way to think about capacity-building is to begin with the tasks that individuals do every day. A three-step screening process can help to identify which ones are amenable to computerization, and who might be involved. The first step is to eliminate, for the time being, those tasks that are being performed in a relatively efficient and effective manner. (If it isn't broken, don't fix it.)

This should leave those tasks about which people have some dissatisfaction. From this group, eliminate those where the time and expense of computerization is not feasible at present. Other solutions to these problems should be explored before that of using microcomputers (e.g., hiring someone to do it, contracting it out, changing the task). A good example here is an out-of-control filing system. A filing system will not automatically become efficient by putting it on a computer. In fact, you may end up with a sloppy computerized filing system that is worse than before. Perhaps the appropriate solution is to have someone to get the filing system in order first and then think about the use of computers.

After eliminating those tasks that do not need fixing and those that might better be fixed some other way, the final group will include tasks that are likely to benefit from computerization. These are tasks about which there is a felt need for improvement and which are doable within a short period (1-2 years). These tasks may well cluster around particular roles in an evaluation research office such as office/clerical (repeated typing of report drafts), statistician (flexible and varied manipulation of data), consultant (development of transparencies and handouts summarizing results), research specialist (instrument design and data collection), research associate (proposal and report development), and administrator (budget tracking and project management).

The planning process. The literature on change suggests three steps leading to the implementation of an innovation:

1. Clarification
2. Adoption of Alternatives
3. Planning for Implementation

By going through the screening process just described, the various people in a group can become clearer about the meaning of computer use for their own tasks. They also come to see the alternatives to computer use and the alternative ways computers can be used.

Involvement in planning for the utilization of microcomputers for tasks that are considered important, and in need of improvement, will continue to enrich people's understanding of computer use. In effect, this will facilitate the development of many local experts regarding the various tasks for which the implementation of microcomputers is warranted.

Involving people in each stage of the above process will help them find personal meaning in such a change as computer use. It can also help to build good interpersonal relationships as people see each other becoming expert in a particular computer use.

Organizational Issues

The process of planning for microcomputer use can be carried out in an informal way, but in most evaluation research settings it will be part of an organizational effort to manage the introduction and widespread use of microcomputers. Two related issues typically emerge when microcomputer use is considered in an organizational context. One is centralized versus decentralized control, and the second is equitable access to and use of microcomputers.

With large mainframe systems, and with most mini-computer systems, control is centralized, for example, in the data processing department, and both access and uses are strictly limited. Microcomputers bring some of the power of these larger computers to individuals. In addition, the great variety of generic and specialized programs, as well as the potential for individuals to write their own programs for microcomputers, means that pressure for multiple uses by many different individuals is likely.

Managing this pressure is not an easy task. Setting priorities for access and use, balancing control and flexibility, and maintaining use schedules are often complicated by the fact that, at least at first, only a few machines are available, and their current users may feel very possessive of them. Both short-range and long-range plans are needed to work out these complications.

Short-range plans (1-2 years) should focus on clarification, adoption of alternatives, and the development of long-range implementation plans. Short-range plans should include provisions for training and other experiences designed to spread expertise throughout the organization.

Training can be linked to the purchase of a few new systems to broaden access beyond the initial users. These systems should be designed to facilitate the accomplishment of the highest priority tasks identified by the screening process described earlier. Having potential users involved in both short-term and long-term planning for implementation will help to spread the understanding of meaningful computer use throughout an organization.

Long-range plans (3-5 years) should address the following areas:

1. management and coordination responsibilities
2. timelines for gradual expansion of users and uses
3. guidelines for systematic, ongoing staff development
4. rules about compatability among systems within the organization, and between internal and external computer systems
5. procedures for the incorporation of new technology

In other words, organizational issues concern the integration of microcomputer use into the policies and procedural structure of the organization in both short-term and long-term contexts (see Gray, 1984 May). In developing long-range plans, it is critical to take into account the special technological issues related to widespread microcomputer use.

Technological Issues

A change in what people do and how they do it is the essence of technological change. Microcomputer use is bound to have a great impact on both of these manifestations of change. A whole new way of thinking about things is embodied in the use of microcomputers for common, everyday tasks such as writing a letter, filing information, or creating a graph. New concepts have to be learned (e.g., document, merge, record) and, although they often are related to known concepts, they can throw anyone off balance when they are presented in the context of a brief menu of options or a set of cryptic key commands.

The two sides of the technological coin are represented by what has been called "computer literacy" for users and "user friendly" in regard to software and hardware. Computer literacy, defined here as competent computer use, will develop as people are involved in (1) clarifying the meaning of computer use in terms of the tasks they perform, (2) shaping adoption alternatives, (3) making plans for implementing the use of microcomputers, and (4) being involved in the implementation of computer use for tasks which are meaningful to them. This is an ongoing staff development process that should begin long before microcomputers are introduced en masse into an organization.

The "friendliness" of ease-of-use of software/hardware systems can best be determined through a systematic evaluation process. Such a process would consider two elements. The first is the characteristics of software packages, including (a) written and on-screen documentation, (b) input options and limitations, (c) operational speed and flexibility, (d) output options and limitations, and (e) general traits such as compatibility with other programs, reliability, and support by the manufacturer. These should be related to the second element, the physical attributes of the hardware, such as (a) number of keys, their layout of the keyboard and their function(s), (b) monitor screen color and resolution, (c) disk drive capacity, (d) internal memory and speed, (e) printer width and the quality of the printed image.

A thorough evaluation of software and hardware should be part of the process of planning for implementation (the author is currently developing an Evaluator's Guide for Microcomputer-Based Administrative Packages). In this process, tasks to be performed are matched to software with relevant characteristics after which appropriate hardware is specified. The coordination of purchases based on this evaluation can help to insure compatibility and reduce unnecessary duplication.

There are several other technological issues. For example, the provision of service, maintenance, and support of hardware and software is an issue in the sense that special expertise is needed in each area. Facilities and equipment may need to be specially designed for microcomputer use. A major facilities issue is the space allocated for microcomputers. Security versus availability is of concern here. Because microcomputers are essentially stand-alone units, they are vulnerable to abuse, vandalism, and theft. However, overly tight security such as sticking them in locked, windowless rooms may discourage their use.

Facilities issues also include electrical requirements, that is, the power to run one or more systems with central processing units and peripherals, and precautions against power surges and power losses. Furniture is needed which makes the use of machines convenient and which provides an efficient arrangement of hardware. Noise reduction in areas where many keyboards or printers are being used must be considered.

The security of information stored on a microcomputer (e.g., flexible diskettes or hard disk) is also a technological concern. Access to personnel records, student records, and district financial records must be protected.

In Gray (1983) a thorough description is presented of these and other technological factors related to organizing for microcomputer use in school districts. These factors are relevant to evaluation research uses as well and must be considered in making long-range plans.

In summary, the use of microcomputers for evaluation research has many exciting potential benefits. However, some complex issues regarding people, organizational, and technological concerns have to be addressed to insure relatively smooth implementation. Evaluation research units can set a good example and can learn how to help others plan for the use of microcomputers by following a systematic, problem-solving approach to microcomputer use. In this way the potential benefits can be maximized, and the disruptive nature of potential problems can be kept to a minimum.

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