CREATING USER-FRIENDLY EDUCATIONAL INFORMATION SYSTEMS: WHAT WE CAN LEARN FROM MANAGEMENT INFORMATION SYSTEMS

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Introduction

This paper addresses an important issue in the design of educational information systems - how to create user-friendly systems that will be helpful to educators rather than ignored by them. Educational information systems are computerized data banks that allow a variety of users to ask important evaluative questions about student learning, classroom functioning, school management, and district process. We will indicate how this subject has been approached in the management information systems literature - an older "kissing cousin" to educational information systems - but before we do this, we need to sketch for you some pertinent background information.

School districts and schools vary a great deal in the uses to which computers are put. Much of the recent focus has been on instructional uses of computers, such as computer assisted learning (CAI). Some districts have developed comprehensive policies governing purchase of hardware, evaluation of software, introduction of computer literacy into the curriculum, and the setting up of labs for selected students. Other districts have chosen to ignore the problem for a while, waiting to see whether computers are here to stay on the educational scene.

But computers have other, non-classroom uses in education. Record keeping and various administrative functions are becoming computerized by district central office staffs. And computers are beginning to be put to important uses in supporting instructional decision making. Here, computers are used to collect, store, analyze, and distribute information about students' learning and their learning environments for the purpose of improving instruction, resulting in what we are calling an instructional

information system (IIS). At the Center for the Study of Evaluation we have been doing research tracking this area for the past several years.

Our present work has its antecedents in CSE's 1975 nation-wide survey of the work of district research and evaluation offices. This survey led to case studies in other districts which were, in some way, using test or survey data for internal decision making (Bank & Williams, 1980). Further intensive examination of the impact of linkage systems in districts (Williams & Bank, 1984) led to the formulation of several models of such district systems using management information systems technology (Williams & Bank, 1985).

Our recent activities related to instructional information systems include creating a network of people interested in such systems, publishing a network newsletter and directory of network members, holding small working-group meetings of network members and CSE staff, and most recently, hosting an invitational working conference, "Information Systems and School Improvement: Inventing the Future," presented at UCLA in February, 1985. We are currently editing the conference proceedings for publication. In addition, we are reviewing literature from research on management information systems (MIS) for lessons that can be learned which might benefit the educational community.

We have made some initial observations based on our work with school districts. First of all, instructional information systems are very new phenomena. They differ from district to district. Most district staff, administrators, and research directors concerned with testing and evaluation don't even describe what they do as instructional information systems, but rather see these activities as part of their routine testing

program. For example, in some districts norm-referenced test sub-scores are analyzed to identify areas of grade-level or school-level deficiency. In other districts, criterion-referenced tests geared to pre-specified learning outcomes are used to track student learning and spot students, groups or classes where learning problems appear. In still other districts, survey data, student profiles, and demographic data are analyzed either independently or in merged files to provide guidance for teachers or principals to use in planning instruction, remediation, or enrichment.

Not only do districts differ from one another in terms of the data which they enter into their systems, they also differ from one another in terms of who are the primary users: some systems are set up primarily for use by school staff, others are used by central office personnel, still others provide summary information for school boards. In some districts, sophisticated multi-user instructional information systems are being developed.

Users may be thought of as those who are recipients of the output of the information system, that is, the end users. Which people are the end users of an information system and how the system can be made user-friendly are not unique questions to school districts currently setting up IISs. Rather, they are generic to the information system field.

Research into management information systems (MIS) has been ongoing for over twenty years. The resulting literature is based on experience with conceptualizing, designing, implementing, and evaluating information systems which serve the needs of managers in the business sector.

What can we, in the educational community, learn from business sector experience with information systems? Certainly business and education

differ in a number of ways ranging from goals and clients served to sources of funding and organizational structure. But in both areas, decision making is a critical activity, and in both areas there are advocates who support using information systems to inform decision making. In the business sector, the high hopes for information systems have frequently been dashed by reluctant, indifferent, or even hostile users. Perhaps top administrators who authorize information systems for school districts and researchers and evaluators who are involved in formative stages of system development can benefit from research focusing on users' relationship to information systems in non-educational organizations. The work presented here will focus on some key issues related to information system users that might generalize to educational settings. This paper is our first attempt to analyze what some MIS researchers say about how user-friendly systems can be conceptualized and designed.

We begin with a discussion of the concept of user involvement, citing several examples of strategies for involving users in systems design. We then describe a framework that specifies characteristics of designers and organizational characteristics that foster development of user centered designs. We also describe situations in which user involvement is not considered appropriate. We have included suggestions for both designers and users and have summarized an approach to system design which places the user in charge of the design effort. The paper concludes with some suggestions for educators drawn from the MIS research.

Designing User-Friendly Information Systems

During the last decade countless articles have appeared in the MIS literature that urge development of information systems that are user-oriented or user-friendly, that is, systems that take into account and meet the needs of users.

Lucas, in a number of books and articles, has identified what he believes is a major reason why information systems fail: the concentration by designers on technical aspects of systems and the resulting tendency to overlook organizational behavior and user needs. He proposes a model that moves away from an approach to information systems which focuses primarily on technology and emphasizes making the system accommodate the user instead.

In his frequently cited book, Why Information Systems Fail, Lucas (1975) reports research which reveals a variety of problems and complaints about information systems, most of which relate either directly or indirectly to user issues:

- users do not understand much of the output they receive;
- there is duplication of input and output;
- changes are frequently made in systems without consulting users;
- because of inaccuracies, users often discount all of the information provided by a system;
- massive amounts of data are provided which cannot be digested by the decisionmaker (information overload);
- a number of users do not actually use the information provided.

Rationale for User Involvement

One of the key recommendations Lucas makes to achieve user oriented information systems is to involve the user in the design and subsequent

implementation of the system. Lucas offers a series of propositions that link user involvement in the early stages of system development to users' later positive regard for the system and increased productivity.

> User involvement in the design and the operation of information systems results in favorable user attitudes and perceptions of information systems and the information services staff (p. 22).
>
> Favorable user attitudes and perceptions of information systems and the information services staff lead to high levels of use of an information system (p. 23).
>
> High levels of use of an information system make it more likely that a user will take action based on the information provided (p. 25).
>
> The use of problem-solving information produced by an information system leads to high levels of performance if the user takes action consistent with the information (p. 26).

Lucas' prescription to involve the user in the design and implementation of information systems appears repeatedly throughout the MIS literature as a remedy for the problems associated with use and nonuse of such systems.

How To Involve Users

A number of MIS books are targeted toward the system developer who needs concrete suggestions on how to involve users in information systems design and implementation. In a chapter titled "Effective User Relations: The Care and Feeding of Users," Synnott and Gruber (1981) describe specific "user involvement strategies" including:

- "Foot in the Door" strategy aimed at providing simple, low-cost, rapid response to users to demonstrate the costs and benefits of information systems.
- "Joint Systems Development" which involves the user in planning, development, and implementation of new systems.

- "Perception Management" which reconciles user perceptions with actual records of performance.

- "User Service Contracts" which are agreements with users on performance objectives and measures followed by reports of actual performance compared with those objectives.

- "Customer Service Center" providing two-way communications about user complaints, service status, downtime, and other problems.

Other methods for user involvement are described by Robey and Markus (1984) who note that theirs is not "an exhaustive list, but rather a sampling of methods intended to improve the utility of computer systems for those who use them" (p. 7). The strategies they describe include:

- "Steering Committees" viewed as a way to involve top management in system design. Their involvement is considered a key factor in the success of information systems since "lack of support from upper management is often cited as the reason systems projects fail." In general, the steering committee reviews proposed systems and administers information system policy.

- "Information Requirements Analysis" emphasizes a rational problem solving approach to determining what information is needed in making decisions, as opposed to merely asking managers what they want.

- "Prototyping" allows users to try out an experimental system and suggest changes. "Ideally, the user and developer are brought together and communicate more accurately by referring to the physical prototype."

- "Behavioral Approaches" differ from other, more technical approaches in their emphasis on human issues. "The main idea is to take a situation where there is potential for conflict and use it constructively." Common techniques include using third-party consultants, improving communication, increasing the influence that each party perceives, and encouraging a consensus solution. (pp. 7-8).

Requirements for User-Centered Designs

Kling (1977) recognizes the need to create systems that meet the needs of their users, but is concerned about what he terms the "common prescription" to involve users on design teams. He cautions that there is a

distinction between substantive and symbolic participation. It is his perception that pronouncements about broad participation are mostly symbolic, " . . . But even symbolic participation is still not widespread" (p.188). He thinks that computer specialists tend to over-report the level of involvement that users play in decisions about computer use (p. 189).

Kling states that " . . . 'user involvement' is merely one policy among many that may foster user-centered designs." He advocates a different approach by asking, "What kinds of personal characteristics of designers and organizational characteristics foster the development of user-centered designs?" (p. 189). This question guides Kling's framework of requirements pre-requisite for a user-centered design strategy. The main constructs of his framework include:

Personal characteristics

1. Technical competence
2. Designer values

Characteristics of the organizational setting

3. Salience of consequences
4. Salience of responsibility
5. Management support
6. Resources: time and money

(Kling, 1977, p. 198).

This framework starts by assuming the "technical competence" on the part of designers and then focuses mainly on the non-technical factors that contribute to user-centered systems. For example, designers should value the needs and opinions of the users of the systems they design. However,

Kling reports, even when they do, "articulated values, and even sincere intentions seem to be inadequate to insure appropriate designs" (p. 190).

He then identifies the organizational characteristics that will lead to designs which respond to users' needs. The first such characteristic, salience of consequences, refers to research that shows that " . . . the feedback a person receives about the consequences of his actions will promote congruence between his actions and his beliefs" (p. 190). This means that "clear feedback" from users to designers will foster user-centered designs if the designers value them . . ." and the other characteristics are also present" (p. 190).

The "salience of responsibility" characteristic refers to the designer's acceptance of responsibility for his/her designs. If everyone is clear about who has responsibility for the successful design of the system, that person is more likely to be concerned about negative responses from users. The last two requisite characteristics in Kling's framework, management support and resources, are interrelated. Management needs to invest time and interest in the support of user-oriented systems. "The major resource that user-centered designs require, aside from technical skill, is time and money and respect for the people who will use a computing application" (p. 192).

Counterindications of User Involvement

Although user involvement is strongly advocated throughout the MIS literature, there may be situations where such involvement is not productive . Markus (1981), for example, questions the automatic use of user participation and maintains that it is not appropriate in all cases. For

example, when there is great dissonance between the existing organization and the proposed system, " . . . user participation as a tactic is strongly counter-indicated, in direct contradiction to much prevailing MIS wisdom" (p. 214). Markus offers two reasons why involving users when the new system differs greatly from the existing organization may be a mistake. First, if the users are given a genuine opportunity to participate, they may try to change the system design in ways to meet their own needs without regard for others. Another possibility involves the danger of "pseudo-participation," that is, " . . . people asked to participate . . . may rightly feel that they are being manipulated into recommending a solution they would not like" (p. 215).

Markus (1981) sums up the pros and cons of user participation in situations where the new system differs greatly from the existing organization:

> True participation is a process of negotiation among users and designers. . . . The danger of opening up a design process through user participation is that some users may succeed in advancing their aims to the detriment of the goals of other groups. The corresponding benefit of true participation is that, through the process of design negotiation, parties to the process frequently resign themselves to tradeoffs in costs and benefits. When the system is finally installed, most of the potential resistance has been already worked through, and, if the design phase takes somewhat longer, ease of implementation is the reward" (p. 215).

Role of the Designer

As has been noted, systems designers can play a key role in creating systems that respond to user needs. However, it is true that even when designers are committed to creating systems that are responsive to users, there may be factors that prevent them from actually doing so. One main impediment is the designer's perceptions of the users. Kling (1977)

describes a study which showed that " . . . when designers were asked to characterize the people for whom they designed computer systems, they portrayed the computer users as limited, conservative people who work with a limited set of skills and who are extremely resistant to change" (p. 190). Such perceptions might indeed inhibit a designer's ability to estimate accurately the user's needs.

A study by Gingras and McLean (1981) discusses a different problem with designers' perceptions. This study focused on why designers who claim to have a strong user orientation still come up with designs which fall short of users' expectations. The answer in this study also deals with designers' perceptions, but identifies a problem different from the one described by Kling. As might be expected, the study found that designers' images of an actual user were significantly different from the users' self-images. What was perhaps more interesting was that the "designers' 'ideal user' differs significantly from the actual users' self-profile, but there was found to be no difference between this 'ideal user' and the designers' self-image" (Gingras & McLean, 1981). Thus, when designers think they are being user oriented, the user they have in mind is themselves.

Designers can develop a better understanding of users' needs if they stay involved in the system beyond the design stage, through the entire implementation. Ginzberg (1978) says that the designer must make a commitment to "address a problem which is real and important to the user -- and stay involved until the users <u>understand</u> and <u>accept</u> the system in their environment" (p. 300). Ginzberg (1978) makes a number of suggestions to

designers to ensure their user orientation. The following summarizes Ginzberg's advice:

- Do not undertake a project which does not address an important need of the intended users.
- Stay with the project beyond the design of the system through the entire implementation. Gain management's agreement on this at the start.
- Do not assume an "average" user. Draw each of the users into the design process.
- Decide at the outset if you are going to be a technician or a change agent. A change agent "really comes to understand the user; . . . he keeps the user involved throughout the entire project, making sure the user understands where the project is going and contributes substantially to setting this direction" (pp. 298-299).

Role of the User

Although the designer is certainly an important factor in achieving a user oriented design, the user is not merely a passive participant waiting hopefully for the designer to present her/him with a design that will meet her/his needs. Ginzberg (1978) emphasizes the responsibility of the user to specify goals and objectives and to evaluate the progress made by the designer. A summary of Ginzberg's advice to users includes:

- Think through the demand for change (implied by the system) and the organization's capacity to change.
- Carefully articulate goals and objectives for the project.
- User must recognize his/her tremendous responsibility for the progress of an implementation effort. Time and commitment are required.
- User has a responsibility to manage his/her relationship with the designer:
    a) demand that the designer have the necessary skills for the project being considered;

b) demand that the designer behave as a change agent; that he not view his role as one of simply injecting technical expertise;

c) periodically test your perceptions with those of the designer (p. 299).

The Nature of the Design Strategy

An even greater emphasis on the user's role in information systems design is found in Lucas' (1978) suggestions of alternative design approaches. Lucas criticizes the conventional design approach with its division of responsibilities between users and designers: "The major problem is that the classic method of design gives too much responsibility to the professional systems designer. While user reviews are included in the process, they often tend to be superficial" (p. 242).

Lucas (1978) suggests two alternatives to the conventional design approach: creative systems design and evolutionary design. The creative systems design involves three components. The first is that the end-user is in charge of the design effort. Lucas maintains that user control will create commitment to the system and will " . . . force the user to understand the system during the design stage, so that changes are made when they are easiest and least expensive" (p. 243). The second component is what the technical user sees and does with the system. Lucas considers that the input/output design is critical to the success of the overall system and thinks the person who will actually use the computers should design the format for the input and output. Finally, the overall system should be evaluated by user criteria. Lucas maintains, "Evaluation, according to the criteria of usefulness and user appeal should improve the chances of successful implementation" (p. 244).

Lucas' (1978) "evolutionary design" approach is an expansion of his "creative design" approach. In evolutionary design there is no finished product. Users are encouraged to suggest new applications and entitled to receive immediate response from designers. Such response should be specific and serve as a focal point for further discussion and feedback. A continuous cycle of user input and designer response becomes a part of creative design.

McLean (1979) also describes an active, assertive role for users. He proposes having end users function as their own developers to create and modify their own applications as needed. Under the conventional approach, users have to communicate their requirements to designers. Even if their communication skills are quite good, it is likely that the users' information requirements are not totally clear to themselves and are likely to change during the lifetime of the application. Thus, McLean recommends getting rid of the middle man and having users develop and modify information systems to meet their own changing needs.

McLean (1979) acknowledges an important technical consideration: "Easy-to-use interactive systems are essential if users are to become developers." He says that it is a mistake to think that end users are going to become markedly more sophisticated: "For the vast majority of users, the system will have to be adapted to them rather than vice versa" (p. 7).

Conclusion

The message of the MIS literature is clear: the design of information systems must be responsive to users' needs; technical quality alone will

not ensure effective systems use. Although MIS authorities agree on the need for user-friendly instructional systems, they disagree on the best method for developing it. Suggested approaches range from relatively simple user involvement techniques (e.g., steering committees and communication improvement exercises) to systems design strategies in which the users assume all design responsibilities.

What lessons can educators draw from the MIS research dealing with the development of user-friendly systems? Such systems appear to be difficult to create. But the research aimed at increasing the utilization and effectiveness of information systems are good indicators that experts in the MIS field continue to value the functions MIS perform: providing information to inform decision making.

One lesson school administrators and research and evaluation specialists might infer from the MIS research is the need for significant involvement at the design stage of those who will use the system -- both end-users and others involved in making the system go. This involvement must move beyond token or symbolic participation of one or two user representatives at occasional planning meetings and into substantive discussions.

A second lesson suggested by the MIS research is that both designers and users may need training for their interaction during the design stage. Designers must learn how to understand the users and to become aware of their own perceptions of and biases toward users. Users must come to understand the importance of their involvement in the design process and must become adept at stating what they want from the system.

A third lesson suggested by the MIS research is that the extent of user involvement in the design stage may be dependent on the degree of the change being introduced into the organization by the system, and in the organizational climate. Large organizational changes likely to disrupt many people's daily activities may require one kind of user-involvement whereas smaller changes likely to simplify or speed up particular tasks may require another kind of involvement. An organizational climate characterized by high degree of trust and communication may predispose designers to a strategy different from one for organizations where there is lack of trust.

Instructional information systems may be likely additions to school district operations in the not-too-distant future. As educators explore this new territory they should take advantage of the road maps to be found in the management information literature.

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