# FROM PROGRAM EVALUATION TO INSTRUCTIONAL INFORMATION SYSTEMS

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## INTRODUCTION

This article describes the emergence of a new and exciting possibility for upgrading teaching and learning in American schools. We call this new phenomenon instructional information systems (IIS). Instructional information systems are computerized data banks that allow a variety of users to ask important evaluative questions about student learning, classroom function, school management, district policies. They build on current practice in testing and program evaluation but go way beyond it.

However, we suspect if we were to send out a questionnaire to a sample of America's 15,000 or so school districts, saying, "Tell us about your district's instructional information system," they would be bewildered at the request and would not know the meaning of the term. Although some of these districts have developed regular and routine ways of doing program evaluation, of gathering test data, they do not name what they have as an information system. So, in the practical sense, instructional information systems presently exist primarily as a construct in the minds of some academics and practitioners (Coleman & Karweit, 1972; Williams & Bank, 1984)

In this paper we first define what we mean by instructional information systems, then we describe four factors which we believe are facilitating the development of IIS. We next list the elements of future instructional information systems which can be found now in some schools and districts and point out the body of knowledge in the management information system literature that educators can draw upon. We finally spell out some of the issues which will have to be faced by educators interested in IIS and speculate on a number of alternative potentialities for the future.

## WHAT IS AN INSTRUCTIONAL INFORMATION SYSTEM?

There is not yet a standard or generally accepted definition of this term. What we are calling an IIS is computerized, has a specified set of users, and data users, data inputs, data outputs, delivery modes and schedules. Its overall purpose is to provide information for educators, parents, and others who are connected with instructional decision making, management and policy formation. The instructional information systems of the future are likely to be integrated socio-technical arrangements whereby a variety of users can retrieve instructionally relevant data relating children's learning with their learning environments in order to make better instructional decisions about programming and resource allocation.

Most districts already have considerable demographic information about their students including language proficiency, health and attendance records. They also maintain cumulative files of student test scores, grades, and teacher opinions. The initial motivation for computerizing all these records may be to store and retrieve more quickly and inexpensively what was formerly done by hand in a time consuming fashion. But the coming instructional information systems, will have, in addition, the capacity to merge these data sets to answer questions about individual children or groups of children in ways that are not currently possible with isolated files. The capability to analyze and report out information at many levels of specificity, on various time-tables, and in report formats calibrated to the needs of any type of user will distinguish instructional information systems from what might be termed computerized record keeping.

An even more important distinction between computerized record keeping and an instructional information system is the impact such a system might have on school organizational patterns and the children and adults who work therein. Whereas computerized record keeping affects only those in the central office concerned with research, administration or data processing, it may be the case that an IIS will ultimately reorganize some aspects of the school's functioning as a workplace for adults or some aspects of the school's functioning as a learning environment for students. For example, longitudinal student records might enable teachers to understand the developmental patterns of individual students, or of particular groups of students and change the sequence in which subject matter is introduced. Cross school comparisons, over time, might indicate the need for restaffing or retraining. An instructional information system, if it genuinely supports and directs instructional decision making and action on the school and district levels, may transform job descriptions and organizational roles and responsibilities. It may also introduce problems of invasion of privacy and depersonalization.

In this early development phase of instructional information systems, however, the preoccupation of educators is certainly with immediate technical problems. Such problems include, among others: the selection, purchase and maintenance of both hardware and software; the determination of what information to store, to analyze and to disseminate; the hiring and training of staff to enter data and routine information. Once these immediate technical questions have been resolved, administrative and interpersonal problems, as well as more fundamental organizational and

ethical issues, will likely become the potent issues to be addressed. IIS systems will have to be flexible enough to accommodate to the unique culture of specific school or district settings. People responsible for IIS will have to be inventive enough to meet the new organizational and educational challenges they pose.

Possible Uses for IIS in Schools and in School Districts

Many of the potential uses for IIS will emerge with use. The history of technological innovations is that, at first, their use is to improve on existing methods by increasing their efficiency; only later do uses and procedures consistent with the new technology replace old assumptions and procedures. Far-off uses for IIS cannot be predicted. Near-term uses would be to do easily what can now be done only laboriously, and to make feasible what is now merely contemplated. For example, some of what an IIS could do with student test scores:

- analyze and interact on individual's test scores over time so as to target instruction precisely to the needs, readiness, and learning characteristics of that child.

- analyze group scores to discover achievement patterns which might be addressed programmatically, e.g., the discovery that, in one district Hispanic children's test scores drop appreciably from spring to fall might lead to consideration of summer sessions.

- examine connections between test scores and other factors such as attendance, mobility, home language, etc.

- search for patterns that describe and predict the pace at which subject learning occurs in relation to developmental stages (Hathaway, 1985).

- combine pretest and posttest scores into various configurations to get more sensitive program evaluations (Dussault, 1985).

Evaluative functions that an IIS might perform:

- identify school differences and their characteristics by comparing school populations with one another and with inter-district norms (Servas, 1985).

- analyze high school students attitudes towards subject matter, instructional modes, functions of schooling (Sirotnik & Burstein, 1985).

- do long-term tracing studies of the impact of single educational elements e.g., effect of a single teacher, a reading test series, bilingual programming.

- do follow-up studies of schools' or districts' alumnae performance

## FACTORS INFLUENCING THE EMERGENCE OF INSTRUCTIONAL INFORMATION SYSTEMS

"The more things change, the more they remain the same." We can recall this aphorism* in French from own our high school days. We are reminded of it because it is frequently quoted in exasperation by those mature educational writers who have lived through wave after wave of reform panaceas, each touted as the new savior of the schools. And because we ourselves have been such exasperated mature writers, we also have used the expression.

The case that we will be making in this article, however, is a different one. We believe that there are social, technical and educational factors that will make the schools of the twenty-first century different from what they are today. We believe that computerized information systems will emerge as part of this change. There are a number of reasons for this belief.

### American Society is Undergoing Major Transformations

For example, new forms of family structure are emerging. An increasing percentage of children live in single parent families, or in various types of blended families. A majority of American women with

*Alphonse Karr

school age children are now full members of the workforce. These developments change the support systems children have at home and raise issues about the role schools might play in childrens' lives (Goodlad, 1984).

Yet another trend is the growing diversity - in terms of language and national origin - of our student population which increases the challenge to individualize educational opportunity. In addition, students are increasingly mobile, both within and between school district boundaries, as they follow their parents' employment opportunities. Such mobility currently stresses the schools' capacity to deliver coordinated and comprehensive instruction to all students.

As a society, we are experiencing accelerating technological advances that are rapidly changing our lives. For many years now, futurists and popular social commentators such as Alvin Toffler (1980) and John Naisbett (1982) have advised that we are entering a new era, one that will significantly differentiate the daily activities of this up-coming generation from those of its parents. Often identified as the computer revolution, the development that in bringing about these enormous changes is, in reality, the micro-chip which is at the heart of the computer revolution.

Slowly and inexorably, we are becoming more aware of the value of this powerful invention - in the space program, in medical diagnosis and treatment, in entertainment, in communications. Even now our own daily lives are affected by computerized mailings, computerized analyses of our political opinions, computerized banking, computerized library services.

The computer seems to have an inordinate number of uses. But one exceedingly important computer characteristic is its ability to store massive amounts of data and to sort through these data analysing their as instructed. This powerful capacity to provide information has added the term "information society" to our image of twentieth and twenty-first century America.

At the same time as societal changes are increasing the complexity with which educators must deal, new technology is becoming available to help educators handle their need for information about these complexities.

More and More Schools and Districts Have Computer Equipment

Microcomputers are becoming a fact of life in most schools across the United States. Zakaria (1984) quotes an estimate that, as of January 1983, 53 percent of American schools have at least one microcomputer on the premises for instructional purposes. It seems that there is great variation between rich schools and poor schools, between high schools and elementary schools, and among locations (suburban districts having the highest number of computers per capita, urban districts the next highest, and finally rural districts the lowest). Nevertheless, Ataris, Apples, and IMBs, even if they lie around in unopened boxes, are becoming quite commonplace pieces of school equipment.

The classroom uses for these computers vary as much as their distribution. Students may be sent to specially set-up computer labs, or to the single computer in the back of the room. They may do remedial work, play enrichment games, learn word processing or programming. And as the students learn to use computers, so do the adults.

In many schools, individual teachers, often from the math department, have been the initial computer enthusiasts. They have taken the initiative in putting the hardware on the premises. Once the computers are on-site, however, other teachers either volunteer or are volunteered for training in how to operate them, select software for them, and integrate them into their instruction.

Some districts have evolved district-wide policies for dealing with the emerging critical issues in classroom uses of computers, e.g., determining goals and objectives for computer use, effecting curriculum integration and evaluation, selecting courseware, solving teacher-related issues, acquiring and funding hardware and software (Williams, Bank, & Thomas, 1984; Rampy, White, & Rockmann, 1984). Other districts have not yet begun to address these issues.

The use of computers at the district office level is beginning but also varies widely around the country. Some districts have computerized their administerative operations such as payroll and inventory; others have not. Some districts have acquired the technical capability to do their own scoring, analysis and reporting out of test data while others continue to pay test publishers or product contractors. Some districts are creating sophisticated distributed systems for student record keeping with input and access to computerized data at both the central office and at the school levels; and a few districts are developing the capacity to merge administrative and instructional files (Idstein, 1985; Hathaway, 1984).

Throughout the country, there is evidence that some administrators are coming to see that computers' massive information processing and analysis

capacity can provide educational decision makers - ranging from teachers to principals to district administrators in charge of curriculum, staff development, personnel, to board members - with information that will help them make more informed choices among the available options. And by organizing information in new ways, it might even help them to create new options. (Patton, 1985; Hathaway, 1985).

Recent School Reforms Have Left a Legacy

Throughout our history, the American educational system has been profoundly affected by societal expectations; schools have been regarded by the public and by parents not only as reflectors of social trends but as creators of the ideal society - aiding in social mobility, assimilating immigrants, developing civic responsibility (Cremin, 1962; Ravitch, 1983)

We have identified three developments from the recent past that seem likely to influence future developments in schools, particularly the use of instructional information systems. The three are: accountability conceptions from the business community, the federally facilitated development of a research capacity in school districts, and the academically-generated knowledge base about how educational change occurs.

Accountability refers to an approach to educational management that values and encourages the use of specified, comparable, quantifiable data in determining whether an educational program has achieved measurable objectives. This approach, epitomized in management by objective (MBO) thinking, was being tried in the Defense Department and in industry just prior to and during the early 60's period when the federal government began to fund massive programs for school improvement (McLaughlin, 1975). This

influence was evident in the Federal legislative language that conditioned the continued receipt of government funds on district-supplied evidence that funded programs were meeting predetermined, measurable objectives.

This same accountability approach began also to be directly applied to day-to-day educational management. Program Planning Budgeting Systems (PPBS) were thought to be a powerful tool for getting a handle on the relationship between educational expenditures and instructional effectiveness. California's Stull Act (1971), and similar legislation in other states, applied approaches to evaluating teachers' instructional performance. And right now, the 1984 California "Quality Indicators" (which have been encouraged and supported by groups of influential businessmen and legislators, among others) are an extensive statewide effort to apply such accountability techniques to the schools (Cuban, 1984). Instructional information systems with their potential for monitoring and feedback may be seen - by both proponents and opponents - as part of this same tradition.

The development of tests and the existence of trained educators who are familiar with administration and interpretation has, of course, been an important in support for the accountability movement. Commercially available as well as locally created tests create a means to quantify student achievement. The public now seems to view test scores as the most credible measurement of educational effectiveness, even though test developers and school administrators advise caution in making broad interpretations about educational institutions based on their students' responses to limited samples of multiple choice math and English test items.

One direct legacy of the accountability movement, then, is that schools and their attendant publics have come to rely upon quantitative data when discussing school or program effectiveness. The publication of school-by-school aggregates of students' test scores in local newspapers and the making of judgments about the educational quality of schools on the basis of these scores, however questionable the validity of these judgments might be, has become an educational commonplace.

Another, possibly indirect, legacy of the accountability movement, is that most larger school districts have developed testing and research capacities. In order to conduct the testing program and analyze the results, and to provide the required evaluation reports to external funding agencies, many districts have hired and trained a core group of researchers, testing experts and evaluators. In many places, this core group has been formed into a separate district-level unit known by a variety of names, e.g., evaluation office, research and evaluation unit, testing, research and evaluation department. Most of the large districts and many medium sized districts have such offices. Even in small districts, part of one individuals job is usually devoted to testing and evaluation. (Lyon, et al., 1978).

Even though some of the federally generated impetus and funding for research and evaluation has receded during the last three years, many school districts have retained research and evaluation leadership who value systematic and data-based approaches to school management.

The federal investment in education helped create a research capacity in school districts (Millsap, 1985). It also contributed to the academic research effort to understand the organizational change process in

education. Some educational change researchers began their work with the expectation that they could carefully track the ways in which educational innovations were introduced into schools so as to learn the relationship between the innovations themselves and the properties of schools as they related to the innovations. The hope was that, having defined these properties and relationships, effective strategies for efficiently implementing educational innovations could be devised.

As the research effort stretched out over time and as conflicting evidence accumulated, it became apparent that the topic of educational change was very complex - a combination of many factors including the nature of the innovation, the setting into which it was to be placed, the characteristics of the people who wished to implement the innovation, the culture of the school, the previous experience of the school staffs with innovations, the degree to which the proposed innovation was viewed by the intended recipients as a valid solution to a real problem.

If an instructional information system can be thought of as an innovation, then this vast body of research is an important contribution to our understanding of how best to implement such a system. Such literature is a rich resource to those who wish to understand what should be kept in mind by those interested in the emergence of instructional information systems. Some key points:

- Those who will be affected by the innovation must eventually feel ownership ofthe innovation. They should be informed about possible innovations and they should have opportunities for input into implementation process.

- Determining the what's and why's of an innovation takes time. Such time and opportunities must be made available so that all "stakeholders" can consider, study and explore implications of the

proposed innovations, both when the innovation is initiated and during the life of the innovation.

- Educators' current daily practices have been derived over extensive periods of time and they work, that is, they permit teachers and principals, for example, to get through each day with all its pressures from students, parents and the environment. In order for an innovation to have any chance to survive in schools it must realistically deal with the on-going pressures of the adults' working day. In order for an innovation to persist it must be viewed as solving an important problem.

- Since schools and school districts differ from one another on important characteristics, e.g., history, external environmental pressures, experience of staff, quality of leadership, characteristics of students and faculty, an innovation that works in one place may or may not work in another place. Therefore, one needs to match essential organizational innovation characteristics.

There is Increasing Interest In Testing and Evaluation to Provide Locally Useful, Management-oriented, Ongoing, Information

The U.S. Department of Education's 1984 "call" for a new NIE Center on Student Testing, Evaluation and Standards, to be one of the eleven federally funded centers established to conduct educational research of national importance is, we believe, indicative of a new emphasis in educational evaluation in America. That "call" states:

> Progress is being made in the area of local testing and evaluation. The amount of attention and resources placed upon it, however, has historically lagged behind that accorded to the broader issues of testing and evaluation. Advances in the broader area permit attention to be turned to the local level. . . . The primary mission of this Center should be to increase the contribution that testing and evaluation can make to local school improvement. . . . Its research, therefore, ought to directly benefit educators and parents at the local level (Planning Grants and Institutional Grants for Educational Research and Development Centers, NIE, 1985, p. 20).

This emphasis on exploring the benefits of testing and evaluation findings for local clients marks an evolution in the evaluation field. As Dan Stufflebeam (1984) notes, during the early sixties the main audiences for evaluation findings were the sponsors and the developers of the large

national curriculum projects. The sponsors wanted summative information about the effects of the new projects so as to compare them with existing curriculum, and thus make informed decisions about mandating or re-funding the new efforts; and the developers wanted formative information about the effects of the curricula they were creating so that they could revise and improve them from version to version.

After the Elementary and Secondary Educational Act of 1965 was passed, the audiences for evaluative information and the educational evaluation activities to supply that information grew more diverse. Evaluations became required adjuncts to many kinds of government funded programs. Program evaluation and how to do it became a subject of academic attention. Tests, both commercially developed norm-referenced tests and locally developed criterion-referenced tests, were taken by students. Although much test data was collected at the local level, they were usually destined for interpretation primarily by federal and state policy makers and adminstrators. These government officials tried, with varying levels of success, to use such data to monitor the extent of local compliance with program requirements as well as to certify the effectiveness of those externally funded programs by in terms of their impact on student achievement.

During the early seventies, as we have noted, many large school districts developed an organized research and evaluation unit in order to respond to these federal and state requirements. However, at that time, relatively few such R&D offices saw as their function the analysis and dissemination of district-wide test scores for internal instructional

decision-making. They rather saw their function as compliance with external demands (Lyon, et al., 1978; Bank & Williams, 1981; Kennedy, 1981). But by the late seventies, a small number of districts were beginning to use their resources and expertise to combine information from test scores with responses from parent and teacher surveys within their districts (Williams & Bank, 1984; Burstein & Sirotnik, 1984).

As early as 1963, Cronbach had emphasized the iterative nature of evaluations which provide information for course improvement. Embedded in Scriven's notion (1974) of formative evaluation was the need for ongoing evaluation activities to match program activities. Concern with in-house evaluation of programs and institutions (Wildavsky, 1972) and with evaluating program implementation (Berman & McLaughlin, 1978) escalated during the late seventies. Evaluators began to understand more fully that "strategies and personnel useful in monitoring a continuing program may be quite different from those employed in seeking information about a new program . . . It is frequently important to find out not only whether a once-effective program continues to work but also whether the delivery system keeps on 'delivering'" (Anderson & Ball, 1978).

Accompanying their concern with the needs of local administrators, teachers and parents, and their concomitant recognition that evaluation should supply a continuing stream of information, was the acknowledgement by evaluation theorists that much of the purpose of evaluation is to provide help to educational managers. As more and more school administrators have become either the clients or the commissioners of evaluation, their information needs have influenced the process and the focus of evaluations. (Patton, 1985; Cooley, 1985; Alkin, in press).

There has been, then, a gradual shift in the clientship for evaluative information from federal and state bureaucrats to local educators. And with this shift has come a renewed recognition that evaluations need no longer be considered as primarily one-shot efforts. In summary, program evaluation can now be conceived as providing sustained and continuing information for policy makers and managers to use in improving operations and outcomes (Cronbach, 1980). Noting that political and bureaucratic activities typically dictate incremental program modification, rather than program termination. Charles McClintock summarizes the new orientation by defining formative evaluation as "the systematic use of empirical procedures for appraisal and analysis of programs as a way of providing ongoing information to influence decisionmaking and action on policy, resource allocation and program operations" (McClintock, 1984).

Because American society is undergoing a major transformation, because computers are moving into the schools at a rapid rate, because the public is orientated towards quantitative measures to measure educational effectiveness, and because the testing and evaluation community is interested in locally useful data, the way seems to be paved for the emergence of information systems supporting instructional decision making and management. This view is born out by an examination of what currently exists in a number of school districts across the country.

## WHAT CURRENTLY EXISTS: TESTING/EVALUATION/INSTRUCTIONAL LINKAGES IN SCHOOL DISTRICTS

### School District Data Collection and Use

During five years of research at CSE, we identified and studied a number of "heroic" districts all of which had linked together student achievement data, other evaluative data, and instructional decision making. Field work, which included extensive interviewing and on-site observation, revealed much diversity even among a small number of districts. (See Table 1.)

The types of student test data differed substantially from district to district. For instance, one district documented student achievement by using scores from a district-wide all-grade levels, commercial norm-referenced test. In another, district-developed criterion-referenced tests were used to measure student achievement; and in a third, scores on state assessment tests were taken as the measure of student learning.

The extensiveness and substance of evaluation data also differed from district to district. One district required school by school reports on a variety of district-specified "quality indicators." In the other districts, various kinds of parent, teacher, and student satisfaction surveys were used. In one district, logitudinal data about school demographics was available for the past ten years.

Finally, who made decisions with this array of data and the type of decisions they made varied from district to district. In one district, parent-teacher school advisory teams functioned as the decision makers and examined solutions to school problems. In other districts school principals and their teacher staff were the primary decision makers; in one

TABLE 1

| District | Types of Test Data | Types of Evaluation Data | Information Recipients | Decisions/actions Based on Data Analyses |
|---|---|---|---|---|
| 1. In this medium-sized district, the student population within each school was heterogeneous and becoming more so while teaching and principal staffs were stable and likely to remain so. Upgrading of professionals' skills was regarded as essential. | State-wide proficiency tests were checked against high school course offerings to find skills not being taught. | None | - District officials<br>- Principals<br>- Teacher committees | - New in-service courses<br>- Teacher committees prepared remedial materials<br>- Teachers trained in diagnostic/prescriptive instructional strategies<br>- Principals were required to attend courses on supervision and on diagnostic/prescriptive instruction; and then mandated to spend a specified percent of their week in classrooms observing and facilitating instruction. |
| 2. In this large district, the central office staff knew that the schools, by reason of history, geography, or present ethnic populations, represented distinctive organizational entities. The principal, teachers, parents, students and surrounding community for each school were regarded as the | Printouts of norm-referenced test scores and criterion-referenced test scores | School Information Surveys including demographic data, teacher and student attendance/transiency records, disciplinary actions, etc.<br><br>Parent Surveys asking about satisfaction with | - District officials<br>- District evaluators<br>- Parent advisory groups | - Central office technical assistance to principals and advisory boards in integrating scores and surveys<br>- Central office provided assistance to underachieving schools |

TABLE 1 cont.

| District | Types of Test Data | Types of Evaluation Data | Information Recipients | Decisions/actions Based on Data Analyses |
|---|---|---|---|---|
| primary actors responsible for improving students' learning; therefore, these individuals should be supported by the district in doing what they themselves thought advisable. | | Subject-matter offerings, school safety, extra-curricular activities, etc. | | |
| 3. This small district took approximately eight years to develop a systematic, highly structured diagnostic/prescriptive teaching model supported by a scope and sequence set of objectives, compulsory staff development for principals, teachers, aides, volunteers and substitutes during school hours. Weekly district-wide principal meetings were held to discuss individual school and across-district problems. | School-level criterion referenced tests keyed to district scope and sequence | Parent Surveys<br>Teacher Surveys | - District officials<br>- Principals<br>- Teachers<br>- Parents | - Staff development activities<br>- School level planning<br>- District-level problem review<br>- Supervision<br>- Student grouping<br>- Parent conferencing |

TABLE 1 cont.

| District | Types of Test Data | Types of Evaluation Data | Information Recipients | Decisions/actions Based on Data Analyses |
|---|---|---|---|---|
| 4. In this medium-sized district, the research and evaluation office provided supportive services to local school improvement councils who allocated discretionary money to solve locally perceived problems | Norm-referenced tests | Parent satisfaction surveys with common district-wide questions supplemented by school-specific questions<br><br>Teacher satisfaction surveys<br><br>Surveys of student attitude towards school/subject matter | - District evaluators<br>- Principals<br>- School site committees of parents and teachers | - Problem identification<br>- Program allocations<br>- Program monitoring |

of these the data was used to group children into classes, and within classes, into reading groups. In another district, the central office staff were the primary users using the data to identify schools which were performing below expectations (Williams & Bank, 1984).

School District Technical and Administrative Staff Arrangements

The technical and administrative staffing arrangements for data collection and distribution also differed among districts. In one, the Research and Development Office administered the tests, developed the parent and student surveys, analyzed the data as it came in, and put together school profiles which it distributed back to the schools on an annual. In another district, the Director of Special Education devoted part of his time to meeting with teachers and principals to develop and design the system, while the data processing of criterion-referenced tests was handled by the administrator responsible for payroll and inventory. In yet another district, school information was routinely solicited from the principal at the beginning of the semester by the research and development office. Anyone could request reports based on these longitudinal data cross-referenced with test scores. The research office processed these requests and returned reports to those requesting them.

In one last district, very little independent data was collected or tabulated. Rather, information coming from the state was handed back to principals who were then responsible for discussing the implications of the scores.

But documenting the diversity among school districts and their use of information was not our study's only outcome. We noticed, also, similarities among districts. These similarities seemed to corroborate the emerging research on evaluation use and innovation implementation.

School District Motivations and Incentives

We found four factors in our field sites that seemed to contribute to the systems' success: First, in all the districts we studied, there was an "idea champion" - someone who cared about initiating and maintaining such a system with the clout to do it (Daft & Becker, 1978). This person may have been the R&D director, the superintendent, an influencial high school principal, a curriculum director. But this person took a lead role, mobilized others, and found the technical and financial resources to operationalize the system.

Secondly, there was a neutral or favorably disposed community and parent body. In three cases, the parents and the community were outspoken in their desire for the district to change instruction in some fashion; in three other cases, the community and parent body was supportive of changes that the district itself wished to make. All our field sites were also responding to state and federal efforts to create and support district-wide testing and evaluation programs.

A third factor common to all our districts was a stable central office staff which had learned how to work together and was energetic about moving forward on new projects. Such a stable core of people was needed to ride out the shifts in district priorities that sometimes resulted from school board elections or sharp policy changes, such as court ordered bussing.

Fourth was the availability of resources. In most cases, federal grants and program funds provided some of the financial means to buy time and equipment and the outside expertise needed to initiate the system. In many of the districts, access to academic consultant knowledgeable about the issues of data-based instructional decision making was perceived as a valuable resource.

Interestingly, we found no one development sequence which led to the creation of the system nor was there a single prototypical model. Creating linkages between testing, evaluation and instruction appeared to be idiosyncratic to the district's situation, and to follow an evolutionary sequence consistent with the usual way in which the district carried out its other functions (Bank & Williams, 1981).

WHAT CURRENTLY EXISTS: MANAGEMENT INFORMATION SYSTEMS LITERATURE

As can be seen from the foregoing discussion, there is great variety in districts' arrangements to link testing, evaluation and instruction. Although these linkage arrangements are not yet information systems, they may be precursors of information systems. Such site-specific variety also seems to be a characteristic of the more mature management information systems in the business sector.

The growing literature in the field of management information systems (MIS) documents two decades of the private sector experience and may have some transfer benefit for educators. When educators review this literature however, it is important that we keep in mind the differences between business operations and schools' operations. For example, businesses generally have much clearer dependent variables than do schools for measuring success and the means of achieving goals are often more clear-cut. Nonetheless,

there are some interesting lessons that educators can learn from the experiences non-educators have had in developing, operating and assessing information systems. Perhaps we will learn as much about what not to do as what to do, becoming aware of potential stumbling blocks and of alternative techniques.

Before indicating what we believe educators can learn from the MIS literature, we will compare the MIS literature with the evaluation literature, and describe a dominent conceptual framework used to define the field.*

Similarities between management information systems thinking and evaluative thinking. Viewed over the past 15 years the MIS literature and evaluation literature exhibit startling similarities. One similarity is the matter of definition. In the evaluation literature, there is no single accepted definition of evaluation; rather there are alternative definitions which are connected to either evaluation models or to evaluation experts. Within the management information field, there also appears to be little consensus on the definition of management information systems. Definitions come at the phenomenon from many perspectives. Sometimes authors discuss management information systems as if they were information systems for managers, at other times as if the field were concerned with the management

*Journals that interested educators might peruse for current articles include the MIS Quarterly, the Harvard Business Review, Management Science, and the Sloan Business Review.

of information systems.†

A second similarity between the evaluation literature and the MIS literature is the way in which each reflects the fields' changing concerns over time. Much writing in the early days of educational evaluation dealt with the technical aspects of how to do evaluation - how to develop the appropriate tests or measures with which to collect data and how to best analyze the data. High hopes were expressed that with the solution of important technical problems, evaluation would provide a way to compare programs, to monitor programs and to manage programs thus leading to greatly improved educational practice. Recent evaluation literature now more often reflects overall concerns with evaluation utilization, that is, with matching alternative evaluation models appropriately to the situation, and with integrating evaluation into organizational life.

Similarly, the 1960's MIS literature wrestles with technical problems, particularly data processing; it also expresses the fears, hopes and expectations that MIS might produce changes in managerial decision making. For example, there were speculations that the manager's workload would become heavier due to the increase in quantity of detailed data (Diebold, 1979), that his work environment would be substantially altered and therefore that his behavior would have to be modified (Daniel, 1961), that MIS would have a devastating effect on managerial attributes such as

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†Fredericks (1971) describes MIS as "an interlocking coordinated set of management information systems designed to optimize the planning, control and administration of specific processes operationally, tactically and strategically." Burdeau (1974) identified the major attributes of a MIS as the operating systems, the measuring system, the reporting system and the management system. Holland, Kretlow and Ligon (1974) describe MIS as "a communication process in which data are accumulated, processed, stored and transmitted to appropriate organizational personnel for the purpose of providing information on which to base management decisions."

challenge, responsibility, opportunity and regard, and thereby change the characteristics of people who want to become managers (Anshen, 1960).

By the late seventies and early eighties, there was a more realistic and limited view of the amount of organizational and personal change that MIS would introduce. In an article titled "Management in the 80's Revisited," Hunt and Newall (1971) review several of these early predictions. They contrast the prediction that computers would result in centralized information processing and decision making -- because time sharing and fast transmission systems would make it more convenient and inexpensive to maintain a large centralized computer operation rather than a number of small operations -- with the opposite prediction that computerization of information would lead to decentralization because of the availability of personal computers. They conclude, based on reviews of the actual experience of businesses, that the centralization of decision making "is frequently determined not by the computer but by the personal preferences or philosophies of the chief executive."

In terms of the effects on personnel of computerized information systems, they find that the earlier predictions of changes in job descriptions have indeed occurred. "With the advent of computers, middle managers spend more time on such functions as communication, interpretation and council . . . Repetitious, routine aspects of their jobs decreased or disappeared". However, the predicted takeover of the organization by the computer specialist apparently has not happened. "Evidence indicates that companies tend to put operating people in charge of the computer function rather than vice versa because it is easier to educate them in computers than to teach computer specialists about business."

Whatever the experience in companies using computerized management information systems, there appear to be many cases where the anticipated utilization of MIS has not occurred. Several major review articles are introduced in ways similar to this: "Recently, researchers have suggested . . . that many operations research models are never used. The problems of implementing information systems and operations research models must be solved if benefits from management science are to be realized" (Lucas, 1978). From the number of articles dealing with implementation, it is clear that information systems - like evaluation systems - are somewhat more likely to be themselves changed, subverted or ignored by the host organization than to effect drastic changes in the organization's structure, routines, and relationships.

Our review of the MIS literature, then, documents the struggle to define what such a system is and does, the attempt to anticipate both negative and positive consequences of installing such systems, and dismay at the implementation difficulties of introducing new systems into old organizations.

The MIS life cycle. A number of authors have attempted to categorize the most frequently discussed issues related to management information systems. They have used the rubric of the MIS life cycle to provide an outline. It seems apparent that the life cycle framework, while convenient as a roughly chronological delineation of phases or steps, does not necessarily describe the many stops and starts in the decision making sequence

that an organization goes through when it begins consideration of a management information system.

The stages in the MIS life cycle - as well as the topics discussed within each stage - have been named differently by a number of authors. Leavitt and Whisler (1958) label the stages as planning, purchasing, implementing and utilizing, whereas Lucas (1978) lists them as inception, feasibility, analysis and design, programming.

Kroeber (1982) describes the cycle in terms of steps, and succinctly indicates the content of each step. Paraphrases of his steps are listed in Table 2. We will discuss each in terms of what they might mean in the business community and what they might mean in the education community.

In business settings, organizational needs which can be met by a management information system might arise due to the complexity and the volume of transactions, the interdependence of operations, the desirability of reducing error and speeding up the handling of transactions. Alternatively, or in addition, such needs might include those of strategic planning or information support for complex decision making. In educational settings, an information system might be needed because of the increasing mobility of children and the diversity of their backgrounds, because of the large numbers of children coming into or going out of a school district, because of the transiency or high absentee rate of the teaching or clerical staff - making continuity of record keeping a difficult task to maintain by hand - or because of the demands by state or federal agencies for various kinds of surveys or lists. An information system might meet these transaction needs; but more importantly, it might also provide information to

support instructional planning in terms of reallocation of staff, retraining of staff, grouping of students, remediation of students, etc.

Prior to installing a MIS or an IIS technical feasibility studies in either the business or the educational setting should be undertaken. These would include investigating the appropriateness of state-of-the-art hardware and software and defining the limits imposed by storage space, access time, etc. Economic studies might include cost-benefit analysis with costs and benefits analyzed in terms of time and dollars, benefits also to include savings resulting making better decisions. Behavioral feasibility studies might answer the question "Is this worth all of the trouble it is going to cause?" Areas for attention include the nature of the organization's resistance to management information systems and likely options for dealing with it, staff training and re-training needs, and the possibilities of having to restructure the organization.

Creating the master plan which defines the objectives of a MIS or an IIS, the resources which can be made available for development and maintenance, and the development strategy over time is a critical step. Input should be obtained from a variety of stakeholders about each factor. The techniques to do this in business are currently better developed than those in education. Businesses have an array of outside consultants and inside managers and technicians familiar with systems thinking. Educators do not yet have such a support group.

Strategies for developing MIS or IIS may be top-down, bottom-up, total systems, modular, or eclectic. Each of these design approaches has advantages and disadvantages. Within a business setting, the top-down approach

TABLE 2

MIS LIFE CYCLE

Step 1: determine those organizational needs which can be satisfied by a management information system.

Step 2: perform technical, economic and behavioral feasibility studies to determine whether an information system can be established.

Step 3: create a master plan which includes objectives of the MIS, resources available for development and maintenance, and development strategy and time line.

Step 4: develop the MIS using either a top-down, bottom-up, total systems, modular, or eclectic strategy.

Step 5: design the components of the system attending to the decision points in the organization, and to the defined relationships among users, operators, equipment, input, output and processing.

Step 6: implement the system by preparing the site, installing and debugging the hardware and software, developing procedure manuals, training personnel.

Step 7: start up MIS operations by ensuring the system's physical security, the integrity of the information, e.g., confidentiality, access, and the system's accuracy.

Step 8: create control and assessment mechanisms at each stage of the life cycle including progress reviews during the development and start-up stages and periodic financial, operational and management audits after the system is up and running.

- also referred to as an objectives-oriented approach - explicitly supports the organization's goals and objectives as articulated by top management. This ensures their support of the system. On the other hand, the bottom-up strategy is intended to satisfy lower-level transaction processing requirements by summarizing data for first line managers, reanalyzing that data for middle managers, and so on up the line. While top-down strategies attend to the needs of high level decision makers, bottom-up strategies attend primarily to the needs of middle managers. If the middle managers are satisfied in handling the operations of the organization, so the argument goes, the satisfaction of overall organizational goals and objectives will follow.

The total systems approach, on the other hand, is a view that treats the entire organization as a single integrated operating system to be served by a similarly integrated information system, whereas a modular approach divides the organization into subsystems and addresses the information needs of each subsystem of the organization separately. Each subsystem would follow organizational chart divisions, often along such functional lines as finance, accounting, production, marketing. The entire information system would only be integrated at the end of the process if at all. It is argued that the resulting MIS is likely to be less disruptive to the organization than one designed in relation to the total system since it follows the existing structures within which work is organized. The eclectic design strategy says that MIS designers should adapt features from each or all of the foregoing and combine them into what is appropriate for a given organization.

In an educational setting, making the correct match between the existing organizational structure and its decision making style on the one side, and the proper IIS development strategy on the other, is as important as it is in business. Because of the reluctance and skepticism surrounding information systems in education, and because of the profound differences in perspective among policy makers, educational administrators and teachers, it would seem very important to involve both the anticipated technical users and the anticipated end users of the system in its planning.

In some school districts the technical users of the system will be the staff of the research and development office, or the data processing staff in the administrative offices; or they may even be the office staff within the individual school, that is, the clerks who handle the school's record keeping functions. The end users of the system may be either the teachers, the principals, the curriculum and staff development specialists, the board and the superintendents, or a combination. Because both technical and end users may differ from district to district, it is essential for proper system development to identify who they are before the IIS is developed. Lucas (1975) 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).

After system design comes component design. Component design must attend to the places in the organization where decisions are made and to the defined relationships among users, operators, equipment, input, output and processing. Four components must be designed. Output design requires attending to the timing, formatting and content of reports. Input design looks at the data needed to arrive at such reports, some of which may be already collected routinely, others of which may have to be collected for a specific report. Process design indicates how input is converted to output; the physical systems design consists of the needed personnel, facilities, hardware and software. These components seem the same for educational settings as for business settings.

The implementation step also seems to be similiar in business and eduational settings. Implementation means preparing the site, installing and debugging the hardware and software, developing procedure manuals, and training personnel. This is a time consuming, make-or-break time for either a MIS or an IIS. All ongoing information systems must also ensure the system's physical security, the integrity of the information, e.g., confidentiality, access, and the system's accuracy. There must be control and assessment mechanisms at each stage of the life cycle including progress reviews during the development and start-up stages and periodic financial, operational and management audits after the system is up and running.

Lessons from MIS. In addition to perusing the MIS literature for specific tools and techniques relating to each step in the MIS life cycle, educators might do well to extract general lessons from that body of experience, such as the following:

1. We must recognize the importance of initially and continually specifying system goals and objectives, system users and uses. We must ask ourselves what data are worth having? what questions of worth can IIS help us address?

2. We need to understand the complexities of information systems as socio-technical innovations that have the potential for meeting organizational needs. In education, we should neither immediately foreclose their utility, nor assume that they are a panacea for improving instructional management and student learning.

3. We should become knowledgeable about business-sector alternatives which have succeeded, and about those which have failed, so that we can avoid expensive and costly mistakes.

4. We must anticipate spending considerable time at the "front end" for context analysis and information system design.

5. We must understand that there are costs not only of initial system development but also of maintaining equipment and ensuring the quality of data.

6. We should acknowledge the importance of dealing with "people issues" such as the need for and the limits to accountability; building of commitment and trust; training; need for job security; sources of resistance, responsiveness.

## OUTSTANDING ISSUES SURROUNDING INFORMATION SYSTEMS IN EDUCATION

Instructional information systems, as we have indicated, are a new enterprise which expand testing and evaluation data bases and seek to involve policy makers, administrators and teachers as end users of instructionally relevant information. Although we believe that there are forces moving educators towards an interest in IIS, there are many issues surrounding the introduction and implementation of these complex socio-technical systems which are just beginning to be understood. We will indicate some of these below but the list is in no sense exhaustive.

Design Decisions

Legitimate questions can be raised about the purposes of IIS. What organizational needs will such systems meet? Just how different will school level or district level instructional decision making be when IIS are in place? What is the range of uses to which IIS can be put? Are there high priority uses? And even so are IIS worth the costs and the hassles?

After such first-order questions have been resolved, second-order questions follow. Who will be the primary users of the system? Can the system serve simultaneously and cost effectively the information needs of board members, district administrators, principals, teachers, counselors, researchers, parents, students? If it cannot do so, who should it serve first, and how will these decisions be made?

Related to the questions of specified use and specified users are questions of development. Should the system be centralized, decentralized or distributive? Should the system be user-friendly or technologically sophisticated? Should the system start small and build as commitment and experience build, or should it be conceptualized and implemented all at once?

What data should be entered into the system? By whom? With what quality checks? What information should be routinely requested for the system? By whom? With what privacy or "need to know" checks? How responsive should the system be to special requests?

How should the system be monitored and debugged? How should its staff be trained? How should it be financed? How should it be evaluated?

Organizational Characteristics

There are important differences among organizations with regard to the internal and the external context in which they operate. These contextual factors have a significant influence on the ways in which organizations react to innovation and the extent to which technical innovations, in particular, will be accepted into the organizational culture.

School districts are typically characterized as having loose coordination among their various units, both horizontally and vertically. For example, many analysts have commented on the isolation teachers experience from each other in their classrooms (Goodlad, 1984; Sarason, 1982). Their autonomy behind the classroom doors also means that new policies and programs initiated or mandated by the principal or by the school board or central administration may only intermittently be adopted and implemented in individual classrooms. Organizations with such limited articulation and coordination are sometimes referred to as being "loosely coupled" (Weick, 1976). Such organizations may not embrace an information system that requires close coordination among individuals or units as a precondition of its success.

Also, public schooling is an institution with external boundaries that are easily breached. Periodically elected school board members, state legislatures, single purpose citizen groups can, and do, have a profound influence on setting local goals and priorities. It is difficult, sometimes, for a school district to commit itself to any set of long-range plans or policies because the priorities and goals may be changed or altered by pressure from external groups or agents. Control over budgets

has shifted from the local school board to the legislature. School districts, faced with both diminished control over and a decreased level of resources have reduced whatever central administrative planning and policy capacity they may have had. This means limited "slack" is available for the activities which instructional information systems are meant to support, as well as for the development of the IIS itself. Finally, school districts, until recently, have not been under strong pressure by parents to change their ways of delivering instruction. Since they are valued as public service organizations, carefully documented analysis about the success or failure of their programs may be seen by the local community as interesting but certainly not essential for continued operation.

It may be the case, then, that public school districts are loosely coupled systems, with weak boundaries and with a limited span of control over their own planning and development activities. This combination of characteristics argues that, in any given district, designing, developing and implementing an instructional information system will not be a naturally occurring phenomenon. Strong leadership will be required to tighten the couplings, free a small amount of resources for planning and development, and create internal pressures for using data to support the management of instruction.

Changing Technology

Because technological breakthroughs in both hardware and software are occurring at such a rapid pace, it is difficult for schools and school districts to know when is the "best" time for them to purchase their systems. Today's "good deal" is tomorrow's anachronism. What seems now to

be an advantageous management software program may be replaced within a few months by something far more sophisticated and less expensive.

In addition to being confused about when to buy, schools and school districts have difficulty knowing what to buy. Advertising is often misleading. Consultants, when available and affordable, may come up with radically different solutions to a district or school need. There are, as yet, few published guidelines that are applicable to all situations, few people within school systems who are technically literate consumers.

Compounding the decision over how to purchase compatible terminals, software, printers, card readers, is the need to consider the stability and service capacities of the companies supplying the equipment. The computer industry is in such flux that obtaining replacement parts or finding repair personnel is not a certainty. And, there is nothing more frustrating than dependence on a system that is "down" much of the time or which requires constant debugging.

People Differences

As we all know, people differ in many ways, e.g., physically, in personality, abilities, tastes. Specific human differences may complicate the development and implementation of a truly effective instructional information system. For example, individuals differ in the kind of information they respond to. Some easily use and are influenced by numbers and tables while others are more interested in descriptions and ancedotes. Individuals differ in their rigidity or openess as regards different ways of doing things.

Finally, and importantly, individuals in different roles have different kinds of information needs. The summary data school boards would

welcome to support their annual policy decisions differs considerably from the more specific weekly diagnostic pupil data needed by classroom teachers. School board members have different responsibilities and usually have different occupational skills than do teachers. Teachers may have learned their craft on the job and from experience; habits so acquired are often difficult to change. If teachers have been teaching successfully without the outputs of an instructional information system, they may see no compelling reason why computerized reports would improve their teaching. The challenge will be to design an information system that can input a minimum set of common data but perform analyses and deliver reports in formats and under timelines appropriate to the styles of different individuals and to the needs of different role groups.

Ethical and Legal Problems

A whole set of potential problems begins to emerge when one contemplates the actual operation of information systems in the schools. The ethics of information use is an obvious one. How do we assure that data collected for one purpose is not misused for other purposes? Pupils' classroom test scores, for example, can be collected to help the teacher determine pupil progress. These same data could be used by someone else to make judgments about the teacher's instructional effectiveness. Is it ethical to do this? If not, how does one protect in advance against such unauthorized analyses and uses?

And how does one assure the privacy of "sensitive" data that might appear in an information system? Although it may be instructionally important to know the financial or educational status of a child's family

members, what rights do parents have to refuse to answer such questions on the grounds that their privacy is being invaded?

Finally, what are the legal ramifications of information use and misuse? What steps must be taken to assure a school district that it will be free from legal challenge if unauthorized use is made of the information system's output? From the opposite perspective, what rights do parents have to challenge what is compiled about their children? What rights to other organizations, perhaps concerned about equity or perhaps interested in research, have, under a freedom of information principle, to see reports?

## POTENTIALS FOR THE FUTURE

As has been previously indicated, if instructional information systems are to be successfully implemented certain preconditions must be established, and some predictable organizational and management problems must be resolved. Once information systems become commonplace, as we think they will, what then? Here we want to speculate a bit on what might happen after an instructional information system is installed. We will consider three possible scenarios.

### Potentiality #1 - Negative Impact

There is the possibility that an instructional information system can become a negative force in a school district. For example, such a system could become a very expensive source of excessive and irrelevant information. Administrators and teachers might suffer from "information overload" and sink into despair when faced with mountains of unintelligible information, especially if they are expected to change their behavior on

the basis of such data and are given no guidance or resources for doing so.

Another negative possibility is that educators at some level might ascribe to computer-generated reports an unwarranted degree of credibility and make faulty decisions or take unwise actions on the basis of information that is inaccurate or misanalyzed. The possibility that locally-generated information will be misinterpreted by the public and by legislators or used to draw conclusions about overall educational effectiveness also exists.

Potentiality #2 - Minimal Impact

American educational history is full of examples of much heralded innovations that had a record of changing practice in fields such as business being tried out in education with limited or no success. A classic example is the use of Program Planning Budgeting Systems (PPBS) (Trist, 1978). While computers seem presently to be pervasive in many aspects of our lives, will they significantly change the traditional and embedded instructional methods that have endured for so many decades? It is conceivable that a fully operational instructional information system might not have much of an impact at all on instruction; it might only be an expensive way of making some administrative operations more efficient. For example, such a system might be used to better perform the test storage and retrieval functions that have heretofore been performed manually or mechanically. Reports might be generated in somewhat different ways than in the past, (reflecting the merging of student academic, attendance and aptitude test files). A limited set of individuals would be pleased but instructional management and teaching would remain largely unaltered.

Potentiality #3 - OPTIMAL IMPACT

The full benefits of an instructional information system might indeed be realized in some places. For reasons previously noted, the computer is a fundamentally different kind of invention, one that has already changed our lives and gives every indication of continuing to do so. The growing mass of computer literate teachers and administrators in school districts, may come to perceive the value and use of an instructional information system. Teachers could seek teaching strategies that have high probability pay off for given individuals or groups. Principals could do better scheduling, grouping, developing and deploying of staff; central offices would be able to pinpoint emerging problems requiring immediate attention. New orgnizational structures and committees could emerge as trusted computer-generated information stimulates the desire to take action.

Which of the above scenarios will prevail? We expect that, within ten years, we will see all three. The development and implementation of instructional information systems is now moving forward with sites "doing their own thing." Some "heroic" districts have already made considerable progress while others are starting out without much awareness of what has been learned by those who have already been through the struggle. Networks among interested individuals, the growth of a how-to-do-it literature, the development of integrated software systems may bring increasing standardization, but for the present, districts and students are on their own.

We believe that instructional information systems have great potential for improving instruction and learning. In this paper we have tried to

initiate the conversation about how this potential can be activated. We have defined an instructional information system, described some of the developments that have brought us to this point, alluded to the state of the art in management information systems and sketched out a number of issues for those wishing to move in this direction.

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