Educators must achieve system development competencies so that comprehensive instructional systems can be created and tested . . .

Instructional Systems —Magic or Method?

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THE term "instructional systems" first began appearing with some noticeable regularity around 1960. During the intervening years it has come to be a part of the "new education" jargon, along with other words such as input, output, monitor, and de-bug. A growing number of instructional systems companies have been founded and many established firms have created instructional systems departments.

More and more, school districts refer to their instructional systems, and it is no longer uncommon to find the position of systems analyst listed in school district personnel classifications. Perhaps the clearest evidence that "instructional systems" refers to something real are the employment advertisements for educational systems specialists placed in many metropolitan newspapers. Several years ago such ads were unheard of.

Nevertheless, there is sufficient historical reason to justify skepticism regarding the validity and uniqueness of the instructional systems concept. Education has a history of old wine in new bottles, and many professional educators and laymen alike wonder whether instructional systems are another case, so to speak. The question is especially important, it seems to me, in light of the many claims, both stated and implied, made for the systems approach in education. These claims include: individualized instruction responsive to differences in pupil background, interests, and ability; decreased clerical tasks for teachers; better use of facilities and materials; more precise measurement of achievement; and, in many instances, increased relevancy of instruction to the real world of the learner. Let us take another look at the reality of instructional systems.

Characteristics of Instructional Systems

One should begin, I suppose, by asking, "What is an instructional system?" and "What is new or unique about its construction and operation?" Usually, such a system involves a complexity of procedures, several media, and has rela-

tively specific objectives. It seems obvious that a temporal reference point is needed, as is some statement of scope. School systems of one hundred years ago would fit the general definition just stated, but this is a different use of the term.

Instructional systems, in the current sense, are almost without exception concerned with a particular body of knowledge suggested by what has been historically labeled a course. There are certainly innovations in subject matter organization, but in some general manner an instructional system is concerned with a subject matter content which is something less than the total subject matter of a greater curriculum.

In my opinion, the traditional course consisting of a single text, supplementary reading, lectures, possibly a workbook, and several examinations is not a fair point of comparison. I can recall, however, something which at least at first look appears similar to modern instructional systems, and is illustrated by the bookkeeping practice sets which many of us did in high school, in my case during the mid 1940's. These exercises and current instructional systems have several similar aspects.

One thing which the procedures illustrated by the practice set and recent instructional systems have in common is the integration of a number of specific skills and competencies into a comprehensive and systematic package, including some representation of the real world environment. In other words, both use simulation as a teaching-learning procedure. Both also require careful planning and coordination in the development of the materials and procedures involved, and can be distinguished from many other kinds of instruction by the field test (de-bugging) which precedes large-scale use.

Another common feature is the operational concern for student motivation via active student participation in the learning process. In the practice set, as in current instructional systems, the student must do more than read. Most instructional systems are based, among other things, on the "principles" of programmed instruction, and an obvious question is: do the authors of practice sets and similar exercises, without stating so explicitly, use the same concepts? These are usually stated as: (a) organize materials in small units of instruction, (b) provide for active student participation, (c) provide constant feedback for the student, and (d) provide immediate positive reward. At least the practice sets which I completed when I was a student and similar exercises which I later used as a high school teacher seemed consistent with such principles.

I conclude that the instructional systems being developed are not entirely new. Whether they are an outgrowth or refinement of earlier materials, I cannot say. But it is clear that some teachers of at least a generation ago used instructional procedures much more complex and dynamic than textbooks and lectures.

What, then, are the distinctive characteristics of instructional systems? It seems to me that a distinction needs to be made between instructional systems in the sense of teaching-learning packages, and instructional systems as a set of procedures for developing and implementing curriculum and materials. In the first case, instructional systems

seem to be extensions of earlier learning exercises, as we have seen above. There are, however, some important differences. Instructional systems in the second sense involve what I think can justifiably be called a scientific approach to education. At least in theory, it is an attempt to design curriculum and develop instructional procedures and materials which reflect what research has revealed about the teaching-learning process. For purposes of convenience, I have considered the two kinds of instructional systems separately.

Instructional Packages

Instructional packages which I have looked at recently emphasize individualization. There is an attempt to account for differences in pupil learning rate, past achievement, interest, and aptitude. When systems developers are successful, pupils need only be concerned with what they do not know, and are given credit, and more important, respect for prior learning. In the older systems all pupils were expected to complete all of the procedures. Usually there was no choice. The instructional package could not be modified, and it was an all or nothing proposition.

Another difference is in regard to the comprehensiveness of systems. The earlier instructional exercises usually were intended to be supplementary instructional materials. It was expected that students would learn the "basics" by the textbook-lecture route, and use the exercise to practice what was "learned." While many instructional packages or systems still are intended as supplementary materials, there is a growing interest in developing comprehensive systems which encompass all of the substance and materials of a defined area of study. While such a system might be developed and conceptualized as a set of modules, it would be closely coordinated.

Another difference which would appear to be important is the multi-media characteristic of new instructional systems. The concept goes beyond using several media in a given unit of instruction. Some instructional systems attempt to provide the pupil with a choice of media for each "lesson" in a unit. To the extent that people differ in the capacity to learn from different media, and to the extent that media differ in effectiveness with certain kinds of learning tasks, the multi-media aspect of instructional systems can be a major innovation.

Two additional characteristics of recent instructional systems are especially important. First, some systems are developed to minimize the dependence on the teacher for their operation. While not totally teacher-independent, they are to varying degrees capable of being operated by the pupil himself. The significance is in the changed role of the teacher, whose function as a presenter of information is lessened considerably. Ideally, he is then free to give greater emphasis to instructional planning, troubleshooting, and enrichment for individual pupils.

Second, it is clear that in one way or another the instructional systems characteristics noted so far all aim at increasing individualization of instruction. Individualized instruction results in the need for current and responsive instructional management systems. Two important functions that such a system must perform are monitoring pupil

learning behavior and coordinating instructional personnel facilities and materials. Historical reporting of pupil achievement and once-a-term scheduling of facilities, personnel, and materials are totally inadequate for an individualized instruction system. Sometimes daily flexibility of scheduling and real time information about pupil behavior are essential for comprehensive individualized instruction systems. It is becoming apparent that at least with large groups, nothing short of a computer-assisted management system can meet these requirements. Several such systems are under development, including one at the U.S. Naval Academy in Annapolis; another being developed by the American Institutes for Research; and a joint Duluth, Minnesota Schools-URS Corporation project, to name only three. When operating, the management system would provide for on-line instructional management as well as being a research and evaluation vehicle.

The instructional packages or systems, it seems to me, do represent something new in education. In theory their attention to individualization, perception, and specificity of learning goes beyond anything in the past.

Educational Research and Development

The second meaning of instructional systems refers to the use of systems concepts and procedures as both tools and as a model for developing instructional programs. The general steps involved are: (a) defining learning objectives; (b) determining specifications for a system which would meet the objectives; (c) designing a system based on the specifications; (d) developing the system (for example, instructional materials and routines, physical plant, training of personnel); (e) system debugging (i.e., a trial run and necessary corrections); and (f) system implementation and evaluation.

How much of this is educational nonsense and how much a useful approach? This probably depends on whether two major conditions are met. First and most essential is the careful defining of learner objectives in behavioral or performance terms, and the second is the careful and imaginative work which must go into system design.

The difficulty in preparing performance objectives differs immensely, of course, with both the nature of the subject and the kind of learning involved, e.g., facts versus learning to apply a concept. Nevertheless, those who have attempted writing performance objectives in the humanities for example, find they can increase the specificity of objectives. Without carefully defined objectives, the use of a systems approach is likely to be educational nonsense, and one had better limit instruction to textbooks and lectures.

But given adequate performance objectives, there is still no guarantee that an effective instructional system will emerge. A superficial and unimaginative approach to systems development results in a mechanical-like system with which learners usually become bored quickly, or in a set of procedures which have questionable relevancy to the objectives.

There is nothing magical about the instructional systems concept. A systems approach to education, whether it be used to design instructional packages, or as a basis for operating instructional

programs, is neither easy nor does it guarantee effective learning. Not infrequently, both the ardent supporters and severe critics ignore the latter point.

There are too many instances of individualized instruction which differ from traditional instruction only in regard to more machines and brightly colored boxes of what are essentially cut-up textbooks. A disappointing proportion of what are labeled behavioral objectives fail to qualify, and much of what is claimed to be flexible in the new education actually appears to increase the rigidity of schools.

Excluding (but not discounting) the important early work in programmed instruction, a systems approach to education was first used by researchers, who began to borrow this tool developed by industry and the military. In brief, the systems approach was first used in education as a research procedure, and it is probably still used with greater skill and understanding primarily by researchers. There are, of course, exceptions.

I would suggest, then, that the eventual contribution of instructional systems depends on how well educators learn to use a systems approach. The essential difference between using this particular tool and others in education is the multi-functional nature of systems analysis, and the difference is one which should not be overlooked. A screwdriver, for example, can be used in a clumsy manner and still be of some value. In contrast, the minimum level of efficiency needed to render a wood lathe useful is considerably greater. Analogously, multiple choice exams, for example, are useful to most teachers, even when they possess only the crudest of test construction skills. In contrast, the point where a systems approach will be useful entails both a more complex set of skills and a higher level of proficiency in their use.

In conclusion, my chief concern at this point is not whether educational systems represent a new and useful development. I think they do, at least potentially, and the experiences to date justify a major effort to find out. What is most important is for educators, especially those in teacher education, to achieve the necessary system development competencies so that comprehensive and precise instructional systems can be developed and tested in a number of areas.