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ABSTRACT

A further development in the systematic development of individualized instructional materials coupled with the availability of interactive terminals linked to time-sharing computer systems (computer-managed instruction) is the implementation of a computer-assisted instructional design system. With existing computer technology, the common elements of any instructional design model could be processed more effectively: analysis of tasks, derivation of behavioral objectives, composition of instructional materials, development of test items, evaluation of instruction, and revision of instructional materials on the basis of evaluation. Thus, three major capabilities are evident--information retrieval, composition and editing, and computation and analysis. (SH)

Interactive Educational Design[1]

David B. Thomas[2]

Much has been said over the past few years about the technological advances in the design and use of computers. Computer equipment such as portable terminals has been developed which places the computer's computational capabilities in the hands of practically anyone.

Another topic that has been much discussed over recent years is the development of instructional materials. A large number of models for the design of instruction have been proposed to facilitate the development of instructional resources that effectively teach identifiable skills. Any of the half dozen or so models, if systematically followed, should lead to good instructional materials.

An interest in the systematic development of individualized instructional materials coupled with the availability of interactive terminals linked to time-sharing computer systems naturally led to expreimentation with computer-assisted instruction. A more general application referred to as computer-managed instruction followed.

I would like to suggest that a further development take place involving both the computer and instructional materials and that is the implementation of a computer-assisted instructional design system. Such a system could be implemented with current computer technology applied to the elements of an appropriate instructional development model. This ideal system would not be a CAI system in any sense as instruction would not be administered by computer, but rather a computer-based materials authoring and production system.

A number of procedures for the development of instructional materials have been published and most of the procedures would lead to effective instructional materials if the procedures were followed. The elements of the instructional development models vary greatly in terms of detail and order of the various developmental activities. There is a common core of elements in an instructional design model, however, with which most developers would agree. These are the following:

1. Analysis of tasks
2. Derivation of behavioral objectives
3. Composition of instructional materials
4. Development of test items
5. Evaluation of instruction
6. Revision of instructional materials on the basis of evaluation.

It is my belief that each of these major instructional design activities may be enhanced by the utilization of computer technology. The use of various

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computer terminals, interfaced to a large computer with suitable software support could aid the instructional designer in many ways.

What I would like to do now is step through each of these six elements and suggest ways in which existing computer technology could be used to assist in the completion of each step in the instructional design model.

The first element, task analysis, refers to the identification of the component activities which constitute each of the tasks which the instructional materials will be designed to teach. If we assume that the instructional designer is not a subject-matter expert as well, the job of identifying the component activities could be substantial. The subject-matter expert could also find the job somewhat of a chore. If the results of previously performed task analyses were available and suitably identified and coded, then much effort could be saved by referencing these and adapting the task structures of previous tasks to the tasks being investigated. The success of this kind of computerized searching for similar tasks will of course depend on the magnitude of the data base and on the particular tasks involved. Perhaps an example would clarify the operation of this data base.

Suppose that a task analysis has been performed for the job of radio repairman. You can easily imagine the tasks involved, such as trouble-shooting, soldering, identifying components, tracing circuits, reading schematic diagrams, and so on. Prerequisite to some of these tasks are certain knowledges such as radio and electron theory, logic, various symbols, etc. Those task structures could be coded in the computer and retrieved at a computer terminal by someone performing a task analysis of a job such as a guidance system technician who would perform many of the same tasks. The effort involved in constructing details of the tasks may be saved by using the computer as an aid. An additional service might be to cross-reference existing instructional resources with each task.

Behavioral objectives, or the precise specification of student behaviors which will indicate mastery of the tasks following instruction, may be considered in a way similar to the task analysis. Objectives relating to previously evaluated subject matters could be stored in computer memory and referenced by the appropriate task. The instructional designer could then supply key words indicating the task, saying "soldering", and receive a listing of objectives that had been used to indicate mastery of this task. Some of these objectives would not be appropriate for his purposes, others would be appropriate if modified, and some could be used as is. Certainly, the designer would have to construct other objectives for his needs but the computer would make his job easier. Of course, the behavioral objectives for some tasks would probably not be stored in the computer at all and these would be derived from scratch as is currently the practice. These new objectives would later be entered into the system for use by others.

It would be valuable to cross-reference the objectives to the instructional materials to which they relate as this information could be of use to the materials writer. He may wish to utilize the existing materials as references for students, or for himself, or it might be desirable to purchase the existing materials for those objectives rather than creating new materials.

The actual composition and production of textual materials may be greatly faciliatated by using the storage and editing capabilities of most large computer systems. The most obvious capability is similar to that provided by an IBM MT/ST typewriter. In contrast to this device, however, faster display is possible utilizing a cathode-ray tube terminal, and internal transposition of large blocks of text is faster than that possible with the MT/ST tape device. The text author could quickly review texts at the CRT terminal and revise or edit the text instantly. This capability would also permit faster compilation and review of text segments composed by more than one author. A variable format control could easily permit the author to experiment with various arrangements of text questions, illustrations, or perhaps eventype faces. A computer terminal supported by appropriate software could also be used to implement formative evaluations of the newly composed materials at low cost. A student could read textual materials directly from a CRT or teletype terminal, entering his responses to embedded questions into computer memory for later analysis, or a formatted computer printout of the text could be used for formative evaluation.

The computer has another use in production of a final text. When the format for the text has been finalized, the actual production copy could be produced by the computer. Outputs from a line-printer could be used as the basis for Xerox copies if the production run is small, or a Selectric typewriter could be used to produce multilith mats for larger production runs, and computer-controlled setting of type could precede the run of very large quantities of materials. Provision can easily be made for insertion of figures, charts, and photographs in the final copy. As another aid, these figures and tables can be easily composed and displayed on a CRT for photographic reproduction.

Test items, like behavioral objectives, can be stored in a central bank with each test item accompanied by a reference to the behavioral objective it measures, and experiential data on its use. As an aid to the construction of tests, item data such as item difficulty, efficiency of distractors, and other parameters could also be retained in the data bank. For items written locally, a crude formative evaluation of the items is possible by using the computer to process the item data obtained during the formative evaluation of the accompanying materials.

The instructional designer employing the computer system for securing test items would provide the computer with a series of key words to identify the task or behavioral objective for which he desired test items. A search would then be made of the computer files until the task or objective, or similar ones, were located, and test items thereby retrieved. If no appropriate items were located, a message would be provided. Again, any items retrieved could be used or not at the discretion of the author.

The design of instructional materials is a continuing process. After the materials have been written and test items compiled, administration to students follows. If one takes the point of view that formative evaluation is a continuing process, even on a "finished product", then the computer system can be used to perform periodic analysis of student performance on each logical section of the finished materials. The relative performance level or each logical section is an indication of the effectiveness of each part. If the performance level is consistently low on some sections, these can be

automatically flagged for revision. If a large quantity of instructional materials are being evaluated, the automatic identification of low quality materials by the computer could save considerable effort. The computational and storage capabilities of the computer could maintain both short term and long term trends on the effectiveness of each logical segment of an instructional resource.

The final element of discussion pertains to revision of ineffective materials. When a logical segment of instruction has been identified as ineffective, the revision can present many fewer problems when the textual materials are resident in computer memory than when they are not. If the revision is a minor one, it can be completed quickly and the revised text immediately reformatted for production. This capability should stimulate more frequent revision of materials shown ineffective. The revisions themselves could be carried out at a computer terminal using the same capabilities described in connection with materials development.

The elements of instructional design and the capabilities of the computer which may support the design effort are summarized in Figure 1. In general, three major capabilities are evident from the descriptions given previously and may be labeled (1) Information retrieval, (2) Composition and Editing, and (3) Computation and Analysis. As is shown in the figure, the activities I've described for Task Analysis and the specification of behavioral objectives, and, to some degree, the collection of test items, is the activity of information retrieval. The composition and editing capability of the computer relates to the writing and reproduction processes for test items and other textual materials. Evaluation of the instructional effectiveness requires the use of a computation capability coupled with specific analysis routines to provide summary effectiveness information to the instructional designer. Finally, the revision process can involve both an information retrieval function and a composition and editing function.

The ideal system described does not currently exist to my knowledge. Various portions have been implemented, for example CAM at the University of Massachusetts which catalogues test items and Interface at HumRRO which provides evaluative module summaries. Many features similar to those described are being considered by the Air Force as part of a large-scale insturctional system, but a complete system is not available for general use, but it could be.

Requests for presentations by other participants should be addressed to:

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COMPUTER - BASED INSTRUCTIONAL DESIGN[1]

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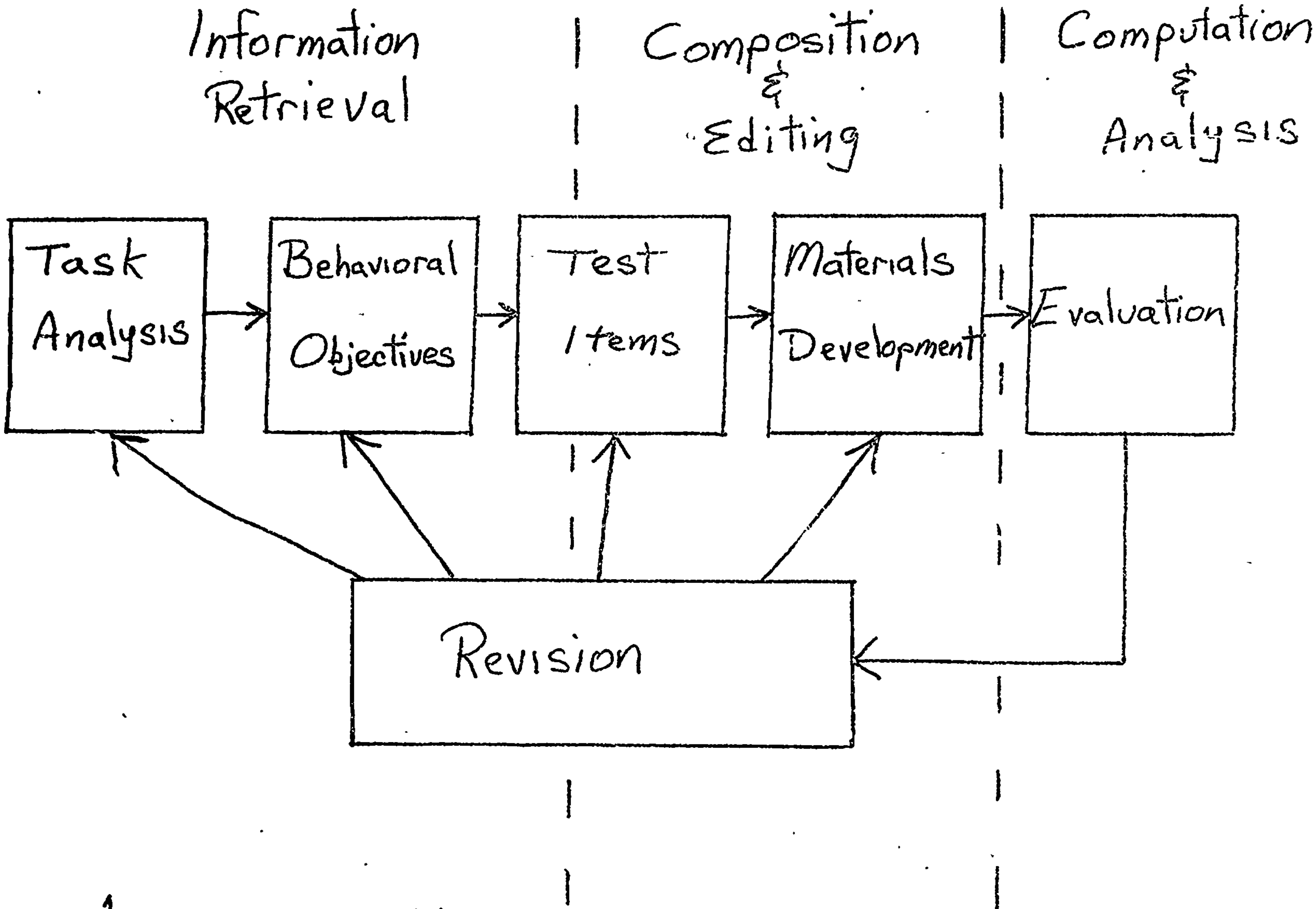

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