ADCIS SIG CBT

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Association for the Development of Computer-Based Instructional Systems Special Interest Group in Computer-Based Training

CBT AT IBM

Lewis M. Branscomb

Editor's Note: This article is actually the transcript of part of Dr. Branscomb's oral testimony during a hearing on "information and communications technologies appropriate in education" before the House Subcommittee on Science, Research and Technology on October 9, 1979. Although this hearing focused on the public sector, the excerpt below relates to industrial training as well. I call your attention specifically to the last sentence in this article, which deals with the relative difficulties of designing instruction versus putting that instruction on-line. I invite you to write to me to express your agreement or disagreement with Dr. Branscomb's perspective.

Viewed against the great optimism of the early 1960s, the acceptance of computer-aided instruction or computer-managed instruction has been a disappointment. Nevertheless, a lot of people have strongly believed and still believe that education will yet be transformed by contemporary information technologies, and I am among them.

While discussing some of the barriers to the introduction of this technology, I think it is important not to lose sight of the role of the technological innovator. That role in fact goes back quite a way in history. Not long ago I received from a colleague a copy of some correspondence in the files of the Carnegie Corporation. This correspondence includes a resolution passed by five major educational organizations at a convention in 1936, and together with this material, a letter from Professor Ben D. Wood of Columbia University, who was the author of these resolutions.

The story behind it is that the Carnegie Foundation for the Advancement of Teaching had an inquiry into secondary and higher education in Pennsylvania in the late 1920s and they realized their first problem was how to test the product of educational institutions at critical points. The only possible instrument for the purpose was the comprehensive objective examination. But then, as now, they didn't know how to cope with a mountainous load of manual scoring and computation, a task that was tediously difficult to organize, unreliable, and very expensive and seemed likely to retard, if not prevent, the extended use of the tools.

As a result of the intervention of a leader of the Carnegie Foundation, the professors from Columbia met with Dr. Thomas J. Watson, who was then President of the International Business Machines Corporation, and he undertook a long and expensive development project, which as the authors of the resolution point out, held little hope that even if this venture were ultimately successful his organization—that is, IBM—would soon if ever be reimbursed for its extensive outlay.

The result was an invention by Mr. R. B. Johnson of IBM, which is referred to by the authors of the resolution as "a machine constructed on an entirely new principle, a miracle of simplicity, accuracy and economy, a veritable X-ray that will instantaneously penetrate a long and difficult examination and will correctly record the exact performance of the student."

That was many years before the invention of the modern computer as we now know it, but I think this story illustrates that educational technology goes back a long way and the story is one of people with faith in the importance of education and faith in the efficacy of technology as a tool for improving it.

Now, not withstanding the relatively slow pace of introduction of educational technology in public schools and in many colleges, there has been very rapid change in education and training for adults. These changes come about because, in companies and other institutions who need to train their employees to remain competitive, the teacher is paying the student's salary, not the other way around. In those circumstances, there is an obvious incentive to look for ways to increase educational effectiveness and to increase educational productivity.

So I am persuaded that if indeed computers, communication, and electronics can bring educational services into the home office and factory, if they can make education more gratifying and less threatening, if they can

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Articles on computer-based training are invited from all members of the training community. Manuscripts should be limited to one or two double-spaced pages and submitted to the editor.

Any opinions, conclusions, or recommendations expressed in this newsletter are those of the authors alone. They do not necessarily reflect the views of ADCIS, the SIG CBT, the editor, or the authors' employers.

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CBT at IBM (from page 1)

greatly increase access to education, without increasing its costs, then the evident need and the emerging capabilities will reinforce each other and a new plateau in other national life might be achieved.

Just to give you some examples from our own experience in IBM, we have thousands of students and teachers at any given time.

Back in 1969, when IBM was growing rapidly and the universities had not yet developed their full curricula in computer science, programming, and related skills, IBM had over 3,000 full- and part-time teachers and offered three million student days of instruction in a single year. This is the equivalent of a 40,000-student university. Today, much of that instruction still going on is computer-assisted, which we call CAI, or computer-managed, CMI.

For example, our Field Engineering Division, which is responsible for the maintenance of our customers' equipment, has been a leader in CAI. Some 10,000 Field Engineering Division employees in the United States spend 90,000 student days per year taking computer-aided courses at the offices where they work.

The expense is not inconsiderable. The system has 400 remote terminals, a large computer installation in Denver, and a computer network connecting these terminals with the computer. But the cost is easily justified. In fact, it has an excellent return on investment. Just the savings from avoiding travel expenses and per diem associated with the more traditional classroom approach exceeds the cost of the equipment by a considerable margin.

I might add that our Field Engineering Division is now using a new innovation which is a small computer in a suitcase which was developed to be an intelligence diagnostic tool when field engineers go to a DP installation to repair the computer. But it has enough power that it is also used for computer-assisted instruction. In this case, the field engineer can take this computer back to his home and insert a tape cassette. This tape cassette was prepared for him individually at the Computer Center in Denver, and it contains a lesson plan, examinations, and a report back to the computer in Denver. This self-paced instruction package is tailored to the field engineer's personal needs, for the computer in Denver knows all the previous courses he has or has not taken and so his lesson plan is individualized for his personal use.

Many other businesses have had similar experiences. There are over 500 customers using IBM educational software—software based in part on the experience of our Field Engineering Division.

I might add that perhaps the most important element of that software is a program called CourseWriter, which is a tool used to create the computer lessons that the students use. The creating of those lessons is, in many cases, the more difficult technical challenge compared to the design of the actual teaching material itself.

SYSTEMATIC COURSE DESIGN

George L. Gropper

Editor's Note: You can't develop a good picture from a poor negative, and you can't develop a good computer-based training program from a poor instructional design. This invited paper describes the role of instructional design in training course development and provides valuable insight into what should take place before the computer-based course developer writes the first line of code.

The ultimate goal of DEC courses is to prepare customers to get up to speed quickly in the use of a Digital computer. To attain this goal, courses must be geared to customer jobs and needs, on the one hand, and their past training and experience, on the other. Additionally, whether delivered in a lecture/lab format at a DEC site or in a self-paced format for use at customer sites, courses must create an appropriate and effective learning experience. And they must provide customers with materials that will help them to profit from their subsequent on-the-job experience with a DEC product. Course development at DEC relies on "instructional design procedure" as an assured way of building these features into its courses.

Widely used in education, business, government, and the military, "instructional design" can trace its history back to military training efforts during World War II. From that experience, trainers learned the value of active practice, or "learning by doing." Then, in the late 1950s, research and applied work on programmed instruction established guidelines that would aid in determining what must be practiced and what kinds of materials can facilitate that practice. More recently, theorists and practitioners have begun to formalize procedures for analyzing training needs and designing programs to meet these needs. Today, based on all these sources, there are comprehensive and systematic procedures available for designing, producing, and implementing total "quality" courses.

There are numerous instructional design models from which to choose in seeking guidance for the course development process. The differences among these models are confined to the detailed "step" level; at the "major task" level, there is widespread correspondence. Virtually all models prescribe the following tasks: obtaining a detailed description of the job to be performed; analyzing job performance for those skills that have to be learned; sequencing and grouping performance elements into course units; stating objectives for course units as well as developing tests for those objectives; formulating strategies for teaching the kinds of skills that have to be learned; developing course materials and procedures based on those strategies; and, finally, trying out the entire package, revising that package as it proves

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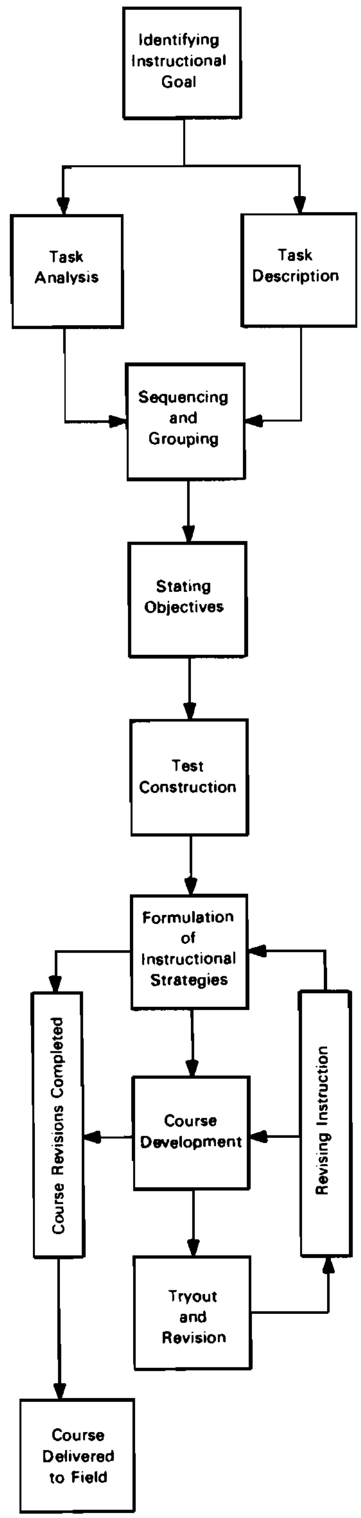

AN APPROACH TO THE SYSTEMATIC DESIGN OF INSTRUCTION

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necessary. In DEC's Educational Services Department, each of these tasks is made an integral part of the process of developing courses targeted to customer training needs.

Task Description

To be useful to customers, a course must teach them the on-the-job skills they need. The primary purpose of a "task description" is to identify those skills. Based on observation of job holder, on questionnaire or interview reports concerning job holder performance, or on a rational analysis of job performance, a task description identifies what is required for one to be competent at a particular job. For example, a task description for a word processing operator identifies in detail what the operator does on the job.

Task description results constitute the starting point for all other course development tasks. Along with the tryout and revision of courses, performed at the very end of the design process, it is, perhaps, the most important instructional design task. It ensures that all other tasks address goals that are relevant to customers' jobs.

Task Analysis

Jobs vary in the types of demands they make on job holders. The system programmer who has to understand or explain "internals" to others must master different *types* of skills than would the system programmer who has to write a device driver. Such different types of skills need to be taught in different ways. The primary purpose in doing a task analysis is to analyze task description results for the types of skills involved. Such categories as "recalling facts," "defining concepts," "following procedural rules," or "problem solving" are sometimes used to differentiate among skill types. Task analysis results, as well as an estimate of the difficulty a particular target audience might have in learning the identified skills, are used at a later stage in course development as the basis for formulating a teaching strategy suitable to the types of skills to be learned and to the target audience that will have to learn them.

Sequencing and Grouping

Some skills have to be learned before others simply because they are prerequisites. In other situations, it may be more desirable to schedule the learning of one set of skills before that of another because that sequence will make it easier to learn. Based on both kinds of considerations, sequencing decisions about all the skills to be learned are made early in the design phase. Then, blocks of skills that go together and are of manageable size are packaged as lesson units or modules. Such systematic decisions about the timing and sequencing of skills to be learned are key contributors in the design of effective learning experiences.

Stating Objectives

The skills to be learned in each lesson unit are then summarized in statements of objectives. Each objective usually includes an identification of the range of situations, or problems, a job holder might encounter; the action that must be taken in response; and the expected result. For example, an objective might read: "Given the name of a directory, you will be able to produce a diagram of the directory structure that controls access to files listed in that directory."

Statements of objectives serve a dual function, and are meant to assist both the course developer and the learner. The developer can use them to keep on track, gearing the *development* effort to relevant goals. The learner can use them to keep on track, gearing *study* effort to what is relevant. Objectives also serve as the starting point for test construction.

Test Construction

Tests also serve a dual function. When geared to the objectives and to the task description on which objectives were based, tests will inform both developers and learners which job-relevant skills have been effectively learned. Developers use tests during the course tryout in order to identify which sections of course materials do and do not work. Learners use them during routine course administration in order to identify which objectives they have and have not mastered. Thus, the developer and learner alike rely on test results as a principal source of evaluative feedback.

Formulation of Instructional Strategies

Different types of skills call for different teaching approaches. The same is true for different types of target audiences. It is common to encounter classes consisting of learners who differ widely in ability, training, or experience. A primary goal in formulating an instructional strategy is to design learning experiences capable of accommodating distinctive subject matter and target audience requirements. For example, a strategy for teaching such concepts as virtual and physical address might stress reliance on varied examples; for teaching such procedures as operating equipment, it might stress the use of a model demonstration or the explicit listing of the required procedural steps. For some target audiences—for example, one with low verbal skills—it might stress the use of pictorial or graphic materials; for other, more verbal audiences, it might stress analytic explanations.

Equally important as the design of a learning experience delivered by course materials and procedures is the strategy of assisting learners to profit from subsequent on-the-job experience. Study materials that serve both as learning aids and as job aids are frequent options for this purpose.

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Course Development

Strategies are then translated into actual training materials and procedures. In the lecture/lab format, lecture materials, transparencies, manuals, and student handouts are packaged to provide the planned-for learning experience. In the self-paced format, all training materials are self-contained—requiring no formal instructor—and are designed to provide a learning experience comparable to that provided by the lecture/lab format which does rely on an instructor. Both formats provide learners with the types of practice opportunities needed to build required skills.

Tryout and Revision

Pre-planning alone, however skillfully performed, cannot ensure that courses will meet all goals. Systematic design must also rely on an actual tryout of course materials and procedures. A field test of a new course is used to identify what works and what does not work. Changes are made whenever and wherever the evidence indicates such a need. Course developers use test results, questionnaire results, and interchanges between learners and instructors as the basis for revisions in course materials and procedures.

An Instrumental Tool

The design of instruction may be characterized as "systematic" when it consistently follows prescribed development procedures such as those described here. An approach that starts with a study of customer jobs, then tailors instruction to those jobs, and finally, relies on corrective feedback to ensure that instruction is effective is instrumental in aiding Educational Services to reach its ultimate goal: to prepare customers to get up to speed quickly in the use of a Digital computer.

THE CHAIR'S VIEWPOINT

Jesse M. Heines

I have recently attended a number of conferences on instructional computer applications and, like everyone else, I have been impressed with the capabilities of the new microcomputers being marketed by Apple, Atari, Texas Instruments, Radio Shack, Pet, and others. At some of these conferences, one might even get the impression that IBM and CDC and perhaps even DEC will soon become the Chryslers of instructional computing as more and more mainframes are replaced by micros.

Educators and trainers are attracted to these machines by their low cost, dazzling graphics, and ability to stand alone. They don't need telephone hook-ups, and the loss of one system will not cause an entire instructional computer site to go down. By merely taking a glance at the sales figures for micros over the last four years, one can quickly see that the instructional computing pendulum has taken a strong swing toward these small systems.

But now that the number of micros out there is getting truly large, the same old instructional computing problems are starting to pop up: cost of software development, program transportability, and methods of sharing courseware. One of the most informative discussions that I have heard on these topics as they pertain to micros was led by Sylvia Charp of the Philadelphia Consolidated School District at a WICAT/NSF Conference in New York on November 9, 1979. The basic focus of this discussion centered around distributed processing and down-line loading.

The reason that I found this focus so fascinating is that these topics also came up at last year's ADCIS Conference as methods for reducing the cost of using large mainframe CBT systems such as PLATO. Several papers presented in technical sessions of the MINI/MICRO SIG discussed these capabilities, and Regency Carroll demonstrated their micro-based PLATO terminal which is down-line loadable.

Thus, perhaps the advocates of micros and those of mainframes are getting closer together. It is clear that both have much to learn from each other, and I believe that it is one of the main purposes of organizations such as ADCIS and the SIG CBT to provide a forum for exchange of information and ideas. Come to Washington and express yourself!

1980 CONFERENCE UPDATE

Jesse M. Heines

Preparations for the 1980 Conference on March 31 to April 3 in Washington, D.C., are nearly complete. Six papers have been accepted by the Review Committee for presentation at SIG CBT technical sessions:

- Job Aids for the Analysis, Design, and Development of Instruction. Russell Schulz, HumRRO.
- "Good Judgement" and the Computer. David McMullen, Stonybrook.
- Course Development in an Industrial Environment. Patrick DeSabia and Thomas Schaefgas, Courseware Applications, Inc.
- The Three-Pronged Computer-Based Course Development Process. Jesse Heines and Ken Moreau, Digital Equipment Corporation.
- Touch Tone CMI. Harold Rahmlow, The American College.
- CBT Breaks Ground in the Oilfield. Thomas Rebstock, CDC.

All papers were rated on a scale of 0 to 4 on 27 characteristics. The BEST TECHNICAL PAPER was judged to be "CBT Breaks Ground in the Oilfield" by Thomas Rebstock, and he will receive an award for his contribution at the SIG CBT Business Meeting to be held during the 1980 Conference. An additional award will be made for the BEST TECHNICAL PRESENTATION, to be judged at the Conference.

New members of the CBT community are encouraged to attend the Conference Presession scheduled for March 31. The Presession program is being coordinated by Harold Rahmlow, a SIG CBT stalwart.

All members are encouraged to attend the SIG Business Meeting to be held during the Conference at a time to be announced. In addition to the presentation of awards, this meeting will be used to review committee activities of the past year and plan for next year's activities. Several decisions should be made to manage the SIG's growth, coordinate the professional activities of its members, and assure efficient use of its resources.

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