An Introduction to Computer-Based Learning

By ANGUS REYNOLDS

Computer-based learning (CBL) is a growing phenomenon, both in impact and in interest. The United States has provided the theoretical, technical and practical leadership for this worldwide trend in learning.

Most human resource development practitioners recognize the need to become familiar with the basics of this new tool. Yet, to some, CBL must be as alien as a spaceship. There is a definite need to demystify CBL, its terminology, technology and environment, in order to make it understandable to any HRD practitioner (see Figure 1).

Snapshot of CBL

A learner reports to the organization's computer-based learning area. There are other learners there. They all seem to be busy and hardly notice the new learner. There are CBL terminals and other resources such as audio-visual (AV) and test equipment. A facilitator welcomes the new learner, introduces the CBL terminal and explains how to proceed through the course. The first activity is a test. Then the learner reads some pages of a manual, views a

Angus Reynolds is a senior human resource development consultant at the Education Technology Center of Control Data Corporation in Reston, Virginia.

videotape and returns to the CBL terminal to complete a lesson. One point is particularly difficult, so the learner makes a telephone call to get clarification. Then there is another test, something like the first one but not as long. The new learner seems to adapt readily to the CBL environment, and soon is as absorbed with the materials as the other learners.

This brief description of a typical computer-based learning encounter provides only a superficial glimpse of what is happening. An HRD professional must be able to see more deeply into the situation and understand it in much greater detail.

Learning environment

The learner is a member of a work group that has been identified for participation in an HRD program. He or she is scheduled to use the CBL center for a block of time (one half-day every other day).

On the scheduled day, the learner reports to the organization's computer-based learning center. At first glance, it may look like the center is over-scheduled because there are more learners than CBL terminals. This is intentional, since some of the time is spent using other resources such as the AV and lab equipment. The other learners have been in the program for varying periods of time. As one learner nears completion of the

program, another is assigned and scheduled.

In traditional block instruction, all learners start and end together. In a CBL program, a learner studies only until the required learning is complete. An organization's computer-based learning center may range from a large facility to single terminals located in work areas. In cases where learners are remote or few in number, or the total HRD needs are limited, learning terminals are shipped to work locations for a period of time while the employees complete a planned program. Then they are shipped to another site.

The learning specialist

The learning specialist role continues to be important in HRD delivered through CBL, but not in the same way as in traditional instruction. A "facilitator" of learning performs the most enjoyable task in the learning specialist role, working with other people. Though it may seem incongruous, CBL provides the learning specialist with more opportunity to work with people. In the CBL environment, facilitators coach, tutor and guide the learning activities of each individual learner, taking satisfaction from the increased opportunity to make a difference in the working lives of individuals in the HRD program.

CBL is, by its very nature, an individual form of learning. For that reason, there are areas

Figure 1.
Computer-based Learning Terminology

Computer-Based Learning (CBL)—The "umbrella" word. CBL includes all of the activities described by the terms: CAI, CMI and CSLR.

Computer-Assisted Instruction (CAI)—The use of a computer in the actual instructional process. For the technically inclined—CAI is a *medium of instruction* that may be applied in appropriate learning situations. Film, videotape and textbooks are also media. CBL, CMI and CBLR are not media.

Computer-Managed Instruction (CMI)—The management of instruction by computer. Management includes testing, prescription generation and record keeping.

Computer-Supported Learning Resources—The other supporting elements of CBL which neither directly teach as CAI, nor perform management functions. Usually limited to information storage and retrieval (data bases) and instructional communications.

Hardware—The physical items involved in the CBL process.

Software—The programs written in computer languages that make the computer components of a CBL system work as they should.

Courseware—The computer-delivered CAI lessons and CMI tests, as well as the video, audio, texts and other learning resources.

Source: Reynolds, A. Computer-based learning: Deciphering the alphabet soup. Training, January 1983, pp. 65-67.

where CBL is not the strategy of choice, for example, when human interaction is essential to learning. The obvious implication for the role of the learning specialist is expansion to accommodate this new tool.

Computer-managed instruction

Computer-assisted instruction (CAI) always directly involves learning and teaching. Computer-managed instruction provides efficiencies through management. The modes of CMI are testing, prescription generation and record keeping. CMI is not yet as familiar to many as is CAI. This is not a reflection of its inherent worth or acceptance. CMI will eventually become better known to people in HRD because it offers considerable efficiency (see Figure 2).

• *Testing.* Testing is the CMI function used to measure the learner's knowledge of the learning objectives. It is the foundation of CMI, since it provides the information needed to prescribe "learning activities." Further, it offers learning efficiency by evaluating the degree to which the learner has mastered the objectives. After the learning activities are completed, the learner is again tested to measure mastery of knowledge. This test of the objectives already identified as important to knowledge of the subject may be somewhat more detailed. If the learner has mastered them, he or she goes on to the test for the second module. If he or she does not, another prescription will be given which uses different learning resources.

• *Prescription generation.* The test for the first module of instruction results in a prescription of learning activities unique to individual needs. The prescription will be based on the instructional objectives which have not been mastered. The learner will then turn to learning resources. These can include lab equipment, manuals, audio-visual materials, instructor conference or CAI activity. Each is keyed to the objectives to be mastered to complete the module.

Prescription generation, as stated above, is the key to the power of CMI. The system generates an instructional prescription for unmastered learning objectives for each individual learner.

The prescriptions are designed along with the instruction (see Figure 3). Individuals can be expected to master different objectives. Each will only study the materials he or she needs. Each individual learner is directed only to those learning resources that support the unmastered objective(s). This selectivity shortens the time each learner must study.

• *Record keeping.* This CMI system automatically generates and stores records of individual and group progress. The HRD department is freed from closets with shelves piled high with old records and reports. Records can be seen when, and if, desired.

The records of students or the entire HRD program can be printed out as needed. They can also be automatically posted to the organization's HRD or personnel system. In some cases, the data are available directly to the distant corporate headquarters using the same system.

Computer-assisted instruction in six modes

When CAI is prescribed as a medium of instruction, it will actually be implemented in one of six modes (see Figure 4).

• *Tutorial.* Tutorial is the mode most familiar to those new to

Figure 2.
Components of Computer-Based Learning

Modes of Computer-Assisted Instruction (CAI)

Tutorial
Drill and Practice
Instructional Game
Modeling
Simulation
Problem Solving

Modes of Computer-Managed Instruction (CMI)

Testing
Prescription Generation
Record Keeping
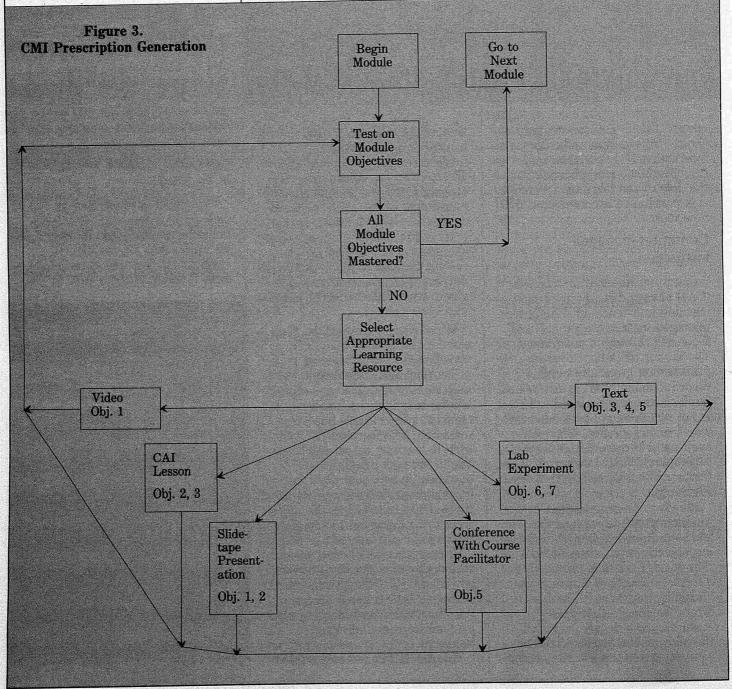
Computer-Supported Learning Resources (CSLR)

Information Storage and Retrieval
Instructional Communications

CBL. In a tutorial, the learner interacts one-on-one with the program. A good tutorial advances in the same manner as the best tutor would personally conduct the process. A typical tutorial lesson consists of a series of segments in which information is presented, and then the learner's understanding is checked. This process is repeated throughout the lesson. Based on the demonstration of understanding, or lack of it, the learner's path continues to another segment, or the same information is presented again in a new way. The reinforcement process provides corrective feedback to the learner, who then proceeds.

A poor tutorial may take a form called a "page turner." An objective in designing a good tutorial is to keep the learner actively involved in the learning process.

•*Drill and practice.* Another familiar mode of CAI is drill and practice—the repetitive presentation of problems to the learner. In an elementary example, the learner is asked, "How much is eight times eight?" When the learner responds to the question, another is presented, such as, "How much is nine times nine?" After a given number of problems has been presented, the learner is informed of the numbers of questions answered correctly and incorrectly. This is not the only form of drill and practice. In HRD, drill and practice technique is used successfully with much more complex subject matter.

•*Instructional games.* Instructional games are a valid and pro-

Figure 3.
CMI Prescription Generation

fessional method of stimulating learning. They are well accepted by instructional technologists. Unfortunately, the term "game" is associated with frivolous activity. An instructional game is not necessarily recognized by the learner as a game at all, and it need not be frivolous. While instructional games often do contain an element of entertainment, the point is that learning while playing is, nevertheless, learning.

•*Modeling.* When the CBL system is used to represent another system or process, it is called modeling or simulation. The learner can change values and observe the effects of the change on the operation of the system. For example, consider a population model. The learner can manipulate the demographic variables, such as infant mortality, birth or death rate in the model. The model calculates and displays the results that such changes would create, if they actually took place. The learner can observe the effects on the population over a period of time. A population model might be used in learning the techniques of planning. The essential difference between modeling and simulation is the degree of realism. Modeling usually implies that a realistic representation of the system modeled is either not attempted or impossible. The population model just described is one which is accurate but does not lend itself to a realistic form of representation.

•*Simulation.* Representation of a system, sub-system, situation or device, with a degree of realism, is called simulation. The simulation mode enables learners to learn the operation of equipment without damaging it or harming themselves or others. Simulation can be done manually or in hybrid form, using both manual and computer methods. Simulation is possible with a number of different levels of fidelity. It is possible to do some HRD simulation without a computer. However, the speed and complexity inherent in simulations prevented its use, as a practical reality, for most HRD

organizations, until the availability of computing power.

Simulators are very expensive, special, single-purpose (computerized) instructional devices. They are typified by simulators of aircraft flight decks or nuclear reactor controls.

In an alternative form, the implementation of "part task" simulation on a CBL terminal is a proven technique for HRD. For example, since the entire instrument panel of a modern aircraft is so complex, a CBL terminal cannot represent all of it at once. Instead, the CBL terminal simulates the aircraft's systems one at a time. The learner can master each of the systems in turn. Then, when the learner enters the big simulator, time is not wasted learning. The simulator time is spent demonstrating mastery and gaining experience operating the entire aircraft system.

•*Problem solving.* Problem solving is not used extensively in HRD, outside data processing training, even though it has good applications in math and science instruction. Problem solving includes use of the computer itself, by the learner, as a tool to solve a problem. As computers become a more common tool on the job, we may see greater use of this mode.

The CAI lessons developed using any of the five modes become "learning resources."

These are then used by the CMI component of CBL.

Computer-supported learning resources

The typical computer-supported learning resource (CSLR) is a data base or source of information. Such a resource requires that the data exist, and currently there are no development tools for the implementation of a resource in HRD.

One aspect of CSLRs is communication. Communication is possible among users of a large or small network. The network can be used by learning specialists to exchange information between learners and a remote subject matter expert. Learner and instructor comments and notes can be recorded for later use. Files can be used for sharing information among users having similar interests. Individuals and groups can exchange notes.

The adult learner—heart of CBL

Learners, as a whole, seem to appreciate the way CBL handles their learning: as adults. It can make an effective contribution to nearly any HRD program because it is inherently compatible with adult learners. It handles instruction in a highly individualized way. It provides a very close match with what we

---

**Figure 4.
CBL-Related Characteristics of Adult Learners**

The rate of learning varies between individuals.

Adults enter the learning situation with considerable previous experience and learning.

Individuals have different learning styles and preferences.

Individuals may have a variety of goals for learning.

Adults need to feel confident that they are learning what is needed to meet their own goals.

Source: Knowles, M. *The adult learner: A neglected species.* Houston: Gulf Publishing Co., 1979.

know about adults in learning situations (see Figure 4).

The idea that computer-based learning is compatible with adult learning characteristics is not theoretical. It is supported by research, as well as by practical evidence that it works. Results of an analysis of more than 75 studies showed significant gains in achievement and positive attitude.[1] Most important for cost-effective programs, learning time was reduced by 25 to 50 percent!

The adult learner sees CBL as far less threatening than school and classroom experiences in general. Individualized CBL is able to deal with heterogeneous groups far better than does classroom instruction. In CBL, the person who can progress rapidly does so and is not forced to mark time while the instructor tries to present material on a level suited to most of the group. Others, who would not be able to keep up with that same presentation, proceed at a pace they can handle. The economic advantage of this approach has been demonstrated at United Air Lines.[2]

Conclusion

CBL is a growing phenomenon with strengths for use in HRD. It can be expected to debut in more organizations each year. Since CBL offers glamor as well as important strengths, it might be tempting to tack a CBL element onto one's next HRD program. Simply adding CBL to a conventional HRD project would not be a wise way to start. Consideration for, and application of, its strengths is absolutely essential. Otherwise, it will only add a cost.

Computer-based learning is a modern, technology-based tool, but it is not a sophisticated one. No magic or mystery is involved. Alien means "foreign or strange." CBL is certainly not foreign and remains strange only if you make it so.

The bad news is that CBL is not a panacea. Success with CBL comes from intelligent application. It must be used in situations where it will produce an overall outcome that is preferable to that which can be obtained with conventional methods. The good news is that there are many such opportunities.

References

1. Kulik, J., Kulik, C. & Cohen, P. Effectiveness of computer-based college teaching: A meta-analysis of findings. Review of Educational Research, 1980, 50, 525-544.
2. Cain, J. Computer-based training at United Airlines. Training and Development Journal, March 1981, pp. 76-78.