Computer-assisted instruction in industry

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The newest training technology is Computer-Assisted Instruction—CAI as it will be referred to here. CAI is an abbreviation for Computer-assisted Instruction; that is, instruction prepared by a human teacher for presentation under computer control. Its primary aim is to optimize the learning process.

CAI is worth consideration because, if for no other reason, it is here. With so much of business "on the computer," it is only a matter of time before the computer is used for instruction in industry as it is now used in education. Some people believe that industry, because of its pressing need to teach new job skills, will make a far greater use of CAI than academia which, in many cases, is bound by the traditional classroom.

In the United States, most of the work on CAI has been done in federally funded projects in a few large universities. To name a few, Indiana State University, Florida State University, Ohio State University, Pennsylvania State University, Stanford University and the University of Illinois. Computer-assisted Instruction has been called the first transplant in the field of education— likened to an artificial education heart!

How does a trainee in industry learn his job or obtain other kinds of information on CAI?

He goes to the terminal and identifies himself and the program he wants by typing his name and the code for his particular lesson. If I were the student, I would type "Catharine Breen" and if I were learning how to read a financial statement I would type MWFS (Montgomery Ward Financial Statement) or any other code the computer had been programmed to accept.

The computer will check its memory and immediately confirm that it knows me by responding with a code of its own which will permit me to begin my training on the computer.

And, if I were continuing a lesson previously started, the computer would find the appropriate lesson and would permit me to start where I had left off the previous day or previous week. The computer then, becomes my mechanized, personal tutor.

The trainee proceeds to read information and answer questions or solve problems given him by the computer, the computer judges his answers, helps him correct his errors, always giving him a second and sometimes a third chance and ends the training by telling him how well he has done—positive reinforcement at work!

You can see how valuable this type of training is in industry where training must, for economical as well as practical reasons, be done on a fragmented basis.

There is no need to worry about the inept supervisor or the overbearing, autocratic instructor. The computer is infinitely patient and a personal, private trainer who teaches on a one-to-one basis.

The computer does other things! It can score each employee's answers, it can compare one trainee with others. It can even point up misspellings, if that is important to the learning process.

Another feature of Computer-assisted Instruction is that the instructor is able to obtain a PRINTOUT of the employee's performance to use as a basis for evaluating his progress and the training program itself. The computer will give the trainer a complete report and analysis of a trainee's performance. The instructor can analyze the report and determine which employees need special help. Such an analysis may reveal the real reason for poor performance, a reason that may not be readily discernible in the conventional classroom-like situation. It may not be a matter of "cannot learn" or "will not learn" but may be caused by a poor learning climate or other factors not directly connected with job knowledge. The computer may reveal that an employee knows how to do a job, knows the answers but, for some reason, is not motivated to apply this knowledge. Perhaps he has had a poor "human" instructor!

Now, how does the instructional material get into the computer? How are training programs created for the computer? Keep in mind the program designer is the REAL TEACHER in Computer-assisted Instruction.

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First of all, is the information vital to the job or is it just "nice to know?" For example, a program on the electrical circuitry of a trash compactor is vital to the repair man's job but, a program on how many trash compactors have
been produced to date and what the outlook may be for their universal use, is “nice to know” information but certainly not vital to his job.

Next, is the information something that must be learned by a large population? Do a great number of people need this information to do their job? Montgomery Ward has nearly 500 retail stores spread across the country and it is very important that the 12,000 merchandise department managers in those stores know such things as how to figure turnover and maintain gross profit and understand the fundamentals of merchandising.

Obviously, Computer-assisted Instruction is ideal for this large, widespread population. It can teach critical job skills quickly, and what is most important, teach them in a uniform and efficient manner. It will also give immediate feedback so that the instructor can evaluate his training efforts and the understanding and progress of employees.

Another criterion—is the target population small but the subject matter so important and so complicated that it requires the talents of many qualified instructors who are not available at the same time or not available at all? In our case, we have such a situation in training our buyers.

Still another criterion—is the subject best learned on a one-to-one basis? For example, our linear programming of merchandise mathematics in book form is not dynamic enough to hold the attention of Merchandise Department Managers who apparently find this subject too sterile in book form. CAI makes it a viable learning experience through the use of simulation. Interaction between the Department Manager and the computer makes merchandise mathematics come alive. And, the employee can see its relevance to his day-to-day merchandising job. The computer acts as a sparring partner . . . a protagonist . . . the devil’s advocate, to motivate the trainee to perform!

So, the computer can be a powerful teaching tool. But, to be effective, the author of the program must know how to plan the various types of teaching strategies and know when to use them.

First, CAI must, like programmed instruction, be selective, giving the learner only the information he needs to achieve the training objectives. Second, CAI must be versatile, presenting each learner with a sequence of information that is designed to suit his particular learning needs. Third, CAI must be self-pacing, permitting the learner to proceed at his own information-assimilation rate.

There are several strategies that can be used to achieve these requirements. The first, and perhaps still the most commonly used in the educational system, is drill and practice. The next most commonly used strategy or teaching mode is tutorial, followed by inquiry, gaming, and simulation.

Drill and practice is a computer presentation of problems, usually arithmetic, which are to be answered by the learner. The objective is to build skills. The learner is given three or four chances to get the correct answer. The program author may provide for an automatic help sequence, that is, a branching sequence, or may merely provide it and let the learner use it if he feels the need. The computer gives the score and stores that score within its record for that learner. A presentation of drill and practice problems such as this is essentially linear with the amount of text kept to a minimum.

The tutorial mode is very similar to linear programmed instruction. The computer presents a fixed sequence of information with or without branching to specialized help sequences. Information is given, questions asked, the learner answers, and the computer judges. The program author can provide the learner with a help sequence that can be used in two ways. Either the computer can automatically provide the help or the student can request it.

This mode, the tutorial mode, takes over the main responsibility for presenting a concept and for developing skill in its use. The intention is to approximate the interaction between a patient supervisor and an individual employee. Obviously, an important aspect of the tutorial mode is to avoid the experience of failure.

In problem-solving, the learner presents quantitative data and asks the computer to solve the problem or, the computer presents quantitative data and asks the learner to solve the problem. In the first case, the computer acts as a calculator. The second is really a form of drill and practice.

The inquiry mode of CAI is CAI in one of its very best and most efficient forms. The computer presents the learner with a problem, requires him to specify what information he needs to solve that problem, and then provides the information. When the learner has solved the problem, he asks the computer to judge his answer. Rarely will two people ask for the same information to solve the problem. This makes it necessary for the program author to anticipate the facts the different learners require and to build a comprehensive information bank in the computer.

The inquiry mode of CAI is learner-controlled and is the most exciting to me personally and the most challenging both technically and pedagogically. Learner-controlled CAI permits the learner to structure for himself the sequence of instructional experiences he will receive. Since no two learners will follow exactly the same pathway through such a program, it is truly learner-controlled. However, these programs may be extremely time-consuming to produce and may run six to 10 times as many “instructions” to the computer as does a drill and practice or a pure tutorial mode program. But the learner-controlled program is worth the effort!

Another type of CAI is gaming and simulation. Here a model of some real or idealized complex situation is put into the computer. The learner then must work with and interpret the complex relationship among the variables that represent the situation. The learner puts his solution into the computer where it is compared with the model.

How are gaming and simulation alike or different? There is a difference although many use the two terms interchangeably.

Gaming . . . the major characteristics are:
1. There need be little or NO similarity to a situation in the real world.
2. There is usually a degree of competition.
3. Payoffs are often, if not always, involved.
4. There is an element of “fun,” i.e., the learners may not consider the experience as learning.

In SIMULATION... the major characteristics are:

1. There is a GREAT similarity to a situation in the real world—as great as can be simulated on the computer.
2. A model of “cause and effect” of these events is implied and often explicit, i.e., what happens if “you” do this—or that.
3. Transfer of learning is assumed likely as a result of the simulation where the computer presents the work situation as it REALLY is and requires a decision on the part of the learner.

Again, both GAMES and SIMULATION involve the higher-order processes within the cognitive domain—those of analyzing, synthesizing and evaluating information. And, both are LEARNER-CONTROLLED so far as achieving the prescribed objectives are concerned. Industry will use SIMULATION because time and money are involved. GAMING, although fun, is not related to the real world of work.

Wards has used SIMULATION in a CAI Specification Buying program where it was necessary to simulate the highly complex buyer’s job and give him an opportunity to develop his buying skills ON THE COMPUTER—something we cannot afford to let him do ON THE JOB where millions of dollars are involved!

These are the basic teaching strategies. The program author selects the one or the combination of two or more that best present the subject to the learner. As far as subject matter is concerned, CAI is most effective in the cognitive areas. Affective learning may take place with a CAI subject but most likely it is not because of CAI—but merely fallout, so to speak.

CAI programs should unfold in an apparently spontaneous way. To do this, the program designer must plan possibilities rather than specific paths. A program designed for teaching with a “let it happen” approach requires a different kind of planning from that used in linear programmed instruction. Industry greater need greater versatility than THAT and can get it if it learns how to use the flexible logic and large random access memory of the computer.

In slide films, Educational Television Programs, audio tapes—the instructional sequences and the time are fixed. In text books and programmed instruction materials, the instructional sequence is fixed but the time limit is NOT—an improvement over the former. But, though an improvement, the material is NOT personalized since all trainees or students receive the SAME instruction.

An ideal situation, which CAI can provide, is instruction in which the instructional sequence is NOT FIXED and in which the time is NOT FIXED. A CAI program that has branching sequences is an attempt in the right direction—all branches being different in content but alike in their intent to help the learner achieve an instructional objective.

The next subject is hardware. What types of terminals are in use today? The most common is a teletypewriter—a machine similar to the selective typewriter and which is equipped to accept paper from a continuous roll. The learner communicates with the computer by typing and the computer communicates with the learner by typing—both communications appearing on the typewriter paper.

A newer, more complex system includes a cathode ray tube which many CAI systems use. This unit looks like a small television set connected to a keyboard very similar to a standard typewriter keyboard. The learner communicates with the computer by typing—the typing appearing simultaneously on the cathode ray tube. The computer communicates with the student by flashing information on the cathode ray tube.

The very newest type of terminal, one developed at the University of Illinois, has a Plasma Display Panel which will no doubt eventually replace the cathode ray tube for Computer-assisted Instruction terminals. The reason? The relatively simple structure of the Plasma Display Panel will greatly reduce the cost of communication between the terminal and the computer. It will bring the cost of CAI down to a point where CAI will not only be feasible but economically practical in industry.

We, at Montgomery Ward, feel privileged to have PLATO terminals and to be part of the University of Illinois' research project on the PLATO CAI system. We are indebted to Dr. Donald L. Bitzer, Director of the Computer-based Education Research Laboratory at the University of Illinois and co-inventor of the Plasma Display Panel, for the opportunity to research the PLATO System for industrial training.

Dr. Bitzer will, through his invention, make education available to large masses of people, who up to this point have had little or no access to learning. In industry, we anticipate that CAI will also provide knowledge and skills to a great number of minorities who at the present time occupy low level or entry jobs with little or no opportunity for upward mobility.

Wards, in addition to the PLATO System, is a user of the IBM Interactive Training System which uses a cathode ray tube terminal. Programs have been created for training in the operational and merchandising areas on both systems.

Back to the Plasma Display Panel. Instead of the cathode ray tube, PLATO, as mentioned before, uses a Plasma Display Panel. This device consists of two thin layers of glass between which is a rectangular array of small neon gas cells. Any cell can be selectively ignited to form part of a word, diagram, line drawing, graph, etc. Data arrives at the terminal from the computer via a voice grade telephone line.

The Plasma Display Panel is approximately twelve inches square and contains 512 digitally addressable positions along each axis. Pictures from the terminal's random access image
selector can be projected on the display panel and computer-generated information superimposed on those pictures. This combination of static and dynamic information makes complex displays possible. The image selector's film plate can contain up to 256 images and can be easily inserted and removed by the learner.

When the terminals are outside the computer center, and this in all probability will be the most economical and practical use of CAI in industry, they will get their signal from the computer by voice grade telephone lines.

By the middle of 1974, we will have ten PLATO terminals in our Corporate Office in Chicago. Eventually we plan to share a coaxial cable or microwave installation with universities and other institutions in the Chicago area. This will greatly reduce data transmission costs. Right now there is a cost of approximately $120.00 per month per terminal for the telephone line to the central computer.

In addition to data transmission costs, there are rental and management services costs PER TERMINAL charged us by the University of Illinois. These are approximately $2500 per terminal per year.

At Wards, all training programs which are put on the computer reflect both short term and long term corporate goals. Because Computer-assisted Instruction insures consistency and objectivity, Wards plans to use this computer talent to make certain that training goals reflect Company goals. All training in industry, no matter what technology is used, must have as its prime purpose the improvement of employee skills and bottom line performance—an increase in profit!

Some of the CAI programs we have are:

**Turnover** . . . This is a merchandise training program for the Retail Department Manager which shows him the effects of sales on inventory, inventory on sales, and gives him an opportunity to experiment with sales and inventory figures so that he can LITERALLY see the effect on his merchandise turnover. For example, if the Department Manager wants to increase his turnover, he will find that he must increase his sales if he keeps his inventory the same or will have to reduce his inventory if his sales remain the same as budgeted. The computer quickly calculates the turnover based on the trainee's input—a simple but meaningful application of the PROBLEM SOLVING teaching logic.

**How to Read a Financial Statement** . . . It is imperative that our buyers understand the balance sheet in order to select the best manufacturer for our merchandise.

**Determining Price Points** . . . One of the things a buyer must do when planning a line is establish promotional selling prices as well as basic selling prices. This program lets the buyer trainee experiment with different price points and shows him the effects of his pricing on his total profit goal.

**Return on Merchandise Investment** . . . This is a program designed to help the Retail Department Manager understand the effects of turnover and maintained gross profit on the total profit goal.

**Merchandise Mathematics** . . . As I said earlier, this was formerly a P.I. program which was too lean—it did not have enough practice problems for most people. The CAI version uses SIMULATION to relate the mathematics to the real life situation. We also use DRILL and PRACTICE problems—perhaps one of the fun instances where we will use that teaching mode.

Right now, we are going to show you portions of two Montgomery Ward programs on PLATO IV and two or three programs developed by the University of Illinois.

**Montgomery Ward Specification Buying** . . . This is a program for the buyer trainee which teaches him, through the TUTORIAL and INQUIRY and SIMULATION modes, how to develop performance and technical specifications for a product. In this program, we have used a portable, electric drill as the product.

**Montgomery Ward How to Repair a Trash Compactor** . . . The trash compactor is a new product which compacts trash into a relatively small space—a product developed because of our country's need for pollution control. Since the product is new, it is important that our service repair men all over the country know how to install and repair it. In this program we have used the great capability of PLATO IV to show colored slides and superimpose computer-generated material on those slides. For example, the trainee is asked to identify the controls of the compactor. He is shown a picture of the control panel, and superimposed on the picture of the controls is a computer-generated question which asks him to list the types of controls.

**University Programs** . . . First, we will show you a course in College Genetics to illustrate how the computer can simulate a testing laboratory. Then, we will show you a number of designs that have been “drawn” by the computer.

The above programs were selected to illustrate the teaching, slides and graphic capabilities of PLATO IV. The complete PLATO IV System also has an audio attachment and a touch panel, both of which are accessed through the computer program.

Let me emphasize that as a training director using PLATO IV, it was not necessary for me to have prior knowledge of a programming language or computer technology.

The PLATO IV System uses the TUTOR language a simple, pseudo-English programming language which permits a trainer to “type” his lessons directly into the computer.

The trainer can compose, edit, test lesson material as well as analyze student responses using the same terminal the learner uses.

No traditional computer program need be written—no systems programmer need be employed. All the trainer or
would-be trainer needs is his own well prepared lesson plan containing all information to be presented and all answers to problems and questions to be presented.

Any trainer or would-be trainer who is thoroughly familiar with his subject could, knowing the TUTOR language, type his material into the computer without first having put it on paper! For example, a Comptroller at Wards could teach payroll control, a Merchandise Manager could teach merchandising replenishment, a Field Auditor could teach retail auditing, a Corporate Office training staff member could teach management skills.

Wards is conditioned to the use of Computer-assisted Instruction. About six years before working with PLATO, Wards designed a Decision Making CAI program for Retail Store Management Staff using SIMULATION as the teaching mode. However, they were restricted to the use of the teletypewriter and a computer mathematical model. In this Decision Dynamics program, two teams of retail store management staff put into the computer, their “merchandise-operating expenses” for each month of the two six-months periods of the program’s fiscal year.

Figures are then compared with the ideal model stored in the computer and the participants told via the resulting printout whether they have made a profit and if they have met their goals for that year. Now, that Wards has the versatility of CAI it plans to use case studies, role playing and other teaching modes which will more clearly illustrate the real merchandising situation in retail stores.

Once CAI systems are exposed to Management, there will be many demands for training programs and there will be a temptation to put EVERYTHING on the computer! However, it is important to resist that temptation and apply the criteria presented here.

Presently bottom-line uses of CAI for are:

- A Comprehensive Buyer Training Program covering such critical areas as Analyzing the Market, Selecting a Supplier, Contract Buying, Implementing the Buying Plan, etc.
- Retail Department Manager Training including Sales and Inventory Budgeting, Inventory Control, Operating Procedures, Promotional Planning, Determining Basic Needs, and Management Skills.
- Sales Personnel Training to include cash register and salescheck training, product knowledge, customer service, and handling of refunds and exchanges. Salesmanship is not included at this time; it is not certain that the computer can do a better job than a “live” instructor! It is important to reserve judgment as to the effectiveness of computer training in the Human Relations area.
- Retail Store Manager and Staff Training—Here we anticipate a real breakthrough and hope the computer can shorten the orientation period for these critical personnel. I wonder how much time and money is wasted while middle management, and even TOP management, familiarize themselves with the complexities of their new positions?
- Basic Skills Training—These will cover the knowledge areas necessary for minorities to attain upward mobility and career ladder planning. Included are basic English, arithmetic, human relations and supervisory training.

Much is being said today about ORGANIZATIONAL DEVELOPMENT and a lot of time and money is being spent on programs to create the kind of climate that will allow employees to operate more efficiently and more courageously. Basic to the concept of ORGANIZATIONAL DEVELOPMENT, is the security created by a knowledge of job skills. Computer-assisted Instruction will be a strong partner in the area of ORGANIZATIONAL DEVELOPMENT!

Trainers in industry must be constantly alert to new developments. SECONDLY, education and industry can learn from each other. Education for many has lost its mystique. Young people regard it as a “necessary evil” to enter the world of work—a “tribal rite” which earns them a license to hunt, fish and procreate! They look for short term goals, early responsibility and what is MOST important, feedback. Any educational experience must be relevant and simulate more accurately than it presently does, those problems encountered in daily living. Hopefully, CAI will act as a communicator—as a sharing mechanism—which will enable both industry and education to satisfy these needs!