EDUCATIONAL INNOVATION

some guidelines for using new methods for training results

JAMES S. WINSTON
President,
Information Dynamics, Inc.,
Princeton, New Jersey.

What has happened since the early 'sixties when programmed instruction and teaching machines were heralded as the start of a new revolution in education? Certainly, an evolution has, and is, occuring but it is far from being a revolution. Today in the Rand Corporation, RCA System Development Corporation, and in other progressive organizations throughout the country, trainees are using computer-driven displays and typewriters to ask questions and to get answers, to be asked questions and to provide answers, and in other ways to interact with a computer. Although the teaching machine itself has been largely superseded both by computers and by textbooks, which are better organized and prepared than ever before, its principles of operation have been applied in the new field of computer-assisted instruction.

Some years ago most trainers regarded audio-visual devices with apprehension and much such equipment was only rarely used. Many trainers could not thread movie projectors, nor could they conveniently transport and use the giant overhead projectors. Technology has largely solved these problems. We now have self-threading projectors, light, portable overhead projectors and almost completely automated 35mm projectors. Only a decade ago the audio-visual specialist and the audio-visual resource center were available only in a few outstanding companies. Today trainers' roles are changing. Instead of being mere purveyors of information, they are becoming more concerned with determining the most effective ways to communicate with their trainees. They are, in a sense, becoming counselors rather than mere fact-givers.

However, some trainers still refuse to come to grips with the Age of Technology and justify such behavior by claiming that machines dehumanize the individual. It is not the machines that pose the threat; it is the men who program and use the machines. If these men are good, then our country and economy will flourish. If these men are bad, then they will have the capability far beyond the imagination for doing evil. If good men, because of their fear of dehumanizing people, fail to use machines, then most assuredly the evil ones will use these tools of the educational craft. In industry, programmed instruction has created a tremendous influence on profits. For example, the Olivetti-Underwood Corporation has increased its profits by presenting maintenance training in programmed format and thus has enabled the personnel to do a better job of equipment maintenance for a larger variety of machines with fewer field personnel than ever before thought possible.

It has been encouraging to hear trainers beginning to speak synonymously of training and problem-solving. That is, instead of focusing on separate, discrete subjects, they are beginning to recognize that training does have objectives and that enabling trainees to identify and solve problems similar to those they will face on the job is far more important than providing miscellaneous trivia which enables them to pass subject-matter tests.

P.I. IN INDUSTRY, EDUCATION AND GOVERNMENT

Many of the available programs are concerned with presenting well-defined subject matter, such as the mastering of concepts, specific skills, memorizations (procedures, process), pattern recognition (inspection, sorting) and problem solving (medical diagnosis). Programmed instruction could be applied to other types of learning such as attitudinal improvement, appreciation of art, understanding of literature, understanding music, and even to such abstract topics as moral and spiritual values.

Industry and education are making increasing use of programmed instruction materials in connection with remedial programs for the disadvantaged, specialized courses for which instructors are not readily available and, most especially, in courses designed for special purposes. Employee orientation, skill training, sales and product training, customer familiarization, employee upgrading,

and management development are all prime areas for the use of programmed instruction materials.

Experimentation and application are currently in progress on the use of programmed instruction in institutions dedicated to rehabilitation of the handicapped so that they can find places in industry. These programs may prove extremely helpful in training our large prison population for acceptable post-release vocations.

The non-military departments of government can make use of these materials to train employees uniformly in the application of regulations, directives and methodologies. Their application to training in underdeveloped countries is obvious. They will also find wide utilization as supplements to educational television and to small group instruction.

The Department of Defense is currently making ever-increasing use of these techniques to train personnel in a great variety of subjects, from inertial guidance to fiscal and accounting procedures. In military situations, where vast numbers of men, dispersed all over the world, require uniform and specialized training and retraining in rapidly changing military technologies, programmed instruction is singularly appropriate.

There are many other areas of education where these techniques are proving valuable, from correspondence and home-study courses to self-programmable devices which can be used by trainers to enable them to communicate better the more difficult course segments.

The greatest impact of programmed instruction has been on book publishers, as was pointed out recently in a *New York Times* article on the General Learning Corp. (formed by General Electric Co. and Time-Life Publications, Inc.) which stated that their only profitable line is their textbook publishing subsidiary.

THE REVOLUTION

The impact of programmed instruction upon industrial training has been characterized as a "new revolution." Thus, programmed instruction can be either viewed as a panacea or as the proverbial Pandora's Box.

Programmed instruction and the introduction of computers represent, possibly, the greatest technical revolution in education since the invention of the Gutenberg press. These exciting developments herald the first major technological innovation designed specifically for the teaching-learning situation.

This revolution is upon us now. Machines available today range from simple mechanical devices to electro-mechanical, and even electronic ones. Software availability is increasing daily and programs can now be obtained in such diverse fields as the mathematical bases for decision-making, color-coding for electrical resistors, contract bridge and the law.

The main problem of training today is not the lack of techniques, television, overhead slides and team teaching and methods. It is the *lack of vision.* When we speak of programmed instruction, all we are really talking about is the application of sound learning techniques to a given teaching-learning situation.

The most celebrated instructional programmers are not innovators. They are, rather, translators of the work of the experimental psychologists from lower to higher forms of animal life. There seems to be less and less interest in student performance on generalized tests and more concern with how he subsequently performs on the job. In this context, one is immediately led to consider some of the real problems of the teaching-learning situation. It is obvious that the variables affecting the individual's performance in the classroom may be quite different from those which affect his subsequent performance on the job.

Certainly, one key to learning is an analysis of what performance is expected from the individual in a given situation.

One of the most amazing results of the revolution has been that formal educational institutions have, in some instances, outpaced military education which, except for a few unusual examples, has laid its major stress on the "stand-up lecture" and information-giving television. There are a number of higher education institutions, such as the University of Florida, Stanford University and the University of Illinois which are using computer-assisted instruction. At present such instruction does not exist at most military training institutions.

Simulation, or a representation of reality which we have used for centuries, from the Hindu Battle Game to the Great War Game of the Germans in WW II, has come into its own as a means of providing realistic experience in a wide variety of interest areas. In the military, operational gaming is being successfully used for planning command and control, and now in industry, designers of information systems are beginning to recognize its utility in designing new information systems and improving old systems.

COMPUTER-ASSISTED INSTRUCTION

Perhaps the greatest technological gain for training with respect to programmed instruction is in the realization that only by use of a computer can trainees obtain the interaction and rapid feedback to create a dynamic learning situation.

Properly programmed, a computer-assisted instructional system permits the student to start at his level of understanding and to proceed to the desired learning outcome by the shortest possible route. By using input-output typewriters and/or cathode-ray tube displays with a keyboard and/or light pens it is possible to raise the level of student understanding to approximately the same plateau before formal classes begin.

From the trainees' vantage point, computer-assisted instruction has a number of advantages. The trainee may be tested with respect to discrete facts and by means of rapid analysis of his response he either moves forward or, on the basis of his response, may have ex-

(continued on page 38)

American Society for Training and Development
Madison, Wisconsin

BALANCE SHEET
December 31

	1968	1967
ASSETS		
Current		
Cash in bank	$ 11,760	$ 5,183
Petty cash fund	75	75
Accounts receivable	16,646	17,322
Prepaid expenses	54,149	42,575
Inventory of supplies for resale	2,528	1,977
Miscellaneous deposits	440	440
Savings accounts	230,000	215,000
Total current assets	$315,598	$282,572
Office Furniture and Equipment (Nominal value)	$ 1	$ 1
Total Assets	$315,599	$282,573
LIABILITIES		
Current		
Accounts payable	$ 30,904	$ 6,825
Payroll taxes payable	2,185	2,443
Chapter dues	16,617	9,398
Prepaid dues	78,855	69,730
Prepaid subscriptions	9,601	9,814
Due ASTD Trust Fund for Research	-----	1,961
Advance registrations and prepaid fees - Institutes and Conference	59,452	36,624
Headquarters building fund	100	100
Deferred income	-----	1,271
Total Liabilities	$197,714	$138,166
MEMBERS' EQUITY - December 31	$117,885	$144,407
Total Liabilities and Members' Equity	$315,599	$282,573

April 28, 1969

Board of Directors
American Society for Training and Development
Madison, Wisconsin

Gentlemen:

We have examined the balance sheets of American Society for Training and Development as of December 31, 1968 and December 31, 1967 and the related income statements for the years then ended. Our examination was made in accordance with generally accepted auditing standards, and accordingly included such tests of the accounting records and such other auditing procedures as we considered necessary in the circumstances.

In our opinion, the accompanying statements referred to above present fairly the financial position of American Society for Training and Development at December 31, 1968 and December 31, 1967 and the results of its operations for the years then ended in conformity with generally accepted accounting principles applied on a consistent basis.

The supplementary data included in the schedules has been subjected to the same auditing procedures and, in our opinion, is stated fairly in all material respects when considered in conjunction with the basic financial statements taken as a whole.

Smith & Gesteland

American Society for Training and Development
Madison, Wisconsin

INCOME STATEMENT
For the Years Ended December 31

	1968	1967
Income		
Dues	$145,483	$117,850
Sale of publications and supplies (net)	3,370	2,743
Journal sales	22,283	18,887
Advertising	45,037	29,290
Interest	10,693	8,641
Non-member premiums	4,575	1,760
National Conference (net)	34,144	20,683
Annual Institute (net)	20,402	15,296
Audio-Visual Institute (net)	1,049	16
Organization and Management Development Institute (net)	5,289	4,975
Sales training division (net)	210	-----
Miscellaneous	1,262	137
Total income	$293,797	$220,278
Expenses		
Salaries	$ 90,313	$ 46,980
Payroll taxes	3,373	1,500
Employee benefits	2,828	1,573
Supplies	22,434	11,396
Printing	72,324	51,642
Rent light office maintenance	15,342	10,888
Postage freight express	18,808	12,593
Telephone and telegraph	5,948	4,007
Officers' board council and committees	9,156	2,368
Staff travel	9,963	9,117
Insurance and taxes	4,365	2,270
Administrative and advisory services	15,491	10,136
Miscellaneous	2,481	1,619
ASTD Research Fund	-----	1,961
Equipment maintenance and rental	12,351	6,887
Project 25	2,996	-----
Advertising	-----	241
Theft loss	-----	1,387
Staff recruitment and relocation	3,947	-----
Organization development division	280	-----
Chapter officers' training program	5,793	-----
Total expenses	$298,193	$176,565
Net Income (Loss)	$ (4,396)	$ 43,713

plained the point that the computer detected that he did not understand. The rapid response capability of the machine causes learning to be more efficient, reducing the reinforcing quality of making erroneous answers and not securing feedback as to the errors for a considerable length of time which is characteristic of conventional instruction.

The material presented to the learner is not in the step-by-step order of the linear program, but is presented in a fixed order. It employs the branching technique. When the trainee responds incorrectly, the learning rate is decreased, and more material and questions are presented relative to the specific area of knowledge.

The computer can ascertain and recognize patterns of incorrect responses and unusually long response times which will cue it to provide more detailed explanations and questions regarding various segments of information. For example, in a physics program a student who shows an inability to master certain concepts, all of which involve the same mathematical principle, can be provided by the computer with a review and explanation of that key principle.

For the trainer, computer-assisted instruction enables each trainee to move at his own learning rate. The trainer can devise educational strategies, provide individual counseling and spend less time on examinations, attendance-taking and conceptual instruction.

Computer-assisted instruction provides a means for trainee evaluation, and, through analyses of student responses, provides criteria for continual course improvement.

The computer can be highly useful in posing problem situations to trainees, permitting them to identify and solve the inherent problems. It can help the student to successfully solve problems which is in itself reinforcing and can ascertain where the student has the greatest difficulties in the problem-solution cycle.

EDUCATIONAL REQUIREMENTS TODAY

According to the United States Department of Labor, we have slightly more than 3.6 million unemployed persons in this country. Most of them need training of some sort. More than a million of them are less than twenty-two years old. Many are technically untrained or have skills which are difficult, if not impossible, to market.

Our nation will demand increasing numbers of workers with skills and training. To quote *Fortune* magazine: "A situation could develop in which a shortage of skilled workers will eat into production and profits, while a growing caste of unemployables on the public rolls will gobble up tax dollars."

Not only do we have a tremendous shortage of qualified teachers, but we also have the ever-increasing burden of training and retraining more of our youth and adult population to keep pace with the rapidly changing requirements of our dynamic society. Moreover, we have an increasing desire on the part of a large segment of our society to improve themselves and to learn avocations as well as vocations. The problem is a mixed blessing. The current market potential for programmed instruction and teaching machines is virtually unlimited.

EVALUATION

For many years a controversy raged over establishing criteria to provide merit increases for teachers. The chief argument to which the proponents have been heretofore unable to respond convincingly is that it has not been possible heretofore to evaluate teacher performance. The management-by-objectives concept used in industry may now be applied to the instructional field. This has occurred as a result of developing programmed instruction materials which specify desired learning outcomes.

Measuring gains in trainee performance has become a valid way to assess whether learning has occurred, and whether the instructor warrants a merit increase. Instructors thus may be gently encouraged to abandon less effective methods of instruction for better approaches. This can be accomplished in a way very similar to the achievement of management by objectives. That is, the training director will get together with each instructor at the beginning of the instructional program and mutually establish desired learning outcomes. The trainees will be evaluated before embarking upon a course of instruction with an entry level test and after the course is completed by a performance validation examination.

The measures of an instructor's performance will be based on the change that occurs by comparing the threshold or entry-level test results with those attained by an instructor's efforts after the instructional program.

A decade ago education and training seemed more of a mystery and many people in the field liked it that way. Now we are beginning to see that some instruction is effective and some is not. Frequently, great textbook authors who occupy exalted positions in education are far less effective instructors than those who spend their time in preparation for their classes and in working with their trainees. Many poor trainers now have an array of audio-visual equipment and materials at their disposal with which they can be more effective than ever before.

There is no excuse for learners not learning in this day of increasing educational opportunity. The American Association for the Advancement of Science has successfully demonstrated that advantaged and disadvantaged students can learn equally as well if provided with properly constructed materials. The age of creating a pseudo-aristocracy by means of the intelligence tests, which measure nothing, is on the decline.

No longer need we have educationally disadvantaged. Persons characterized in the past as mentally retarded, educably retarded, trainable, or untrainable are now being trained and can perform many of the jobs that their more gifted

fellows are now performing, but who in turn, should be performing tasks requiring better use of their abilities.

IMPORTANCE OF CONTINUED EXPERIMENTS

We should see more controlled experimentation, showing the "trade-offs" and "pay-offs" relative to programmed instruction and computer-assisted instruction. If a program is run on soldering plug-ins, we want to know not only how much was saved with programmed instruction, as compared to other training techniques, but what "pay-off" on the soldering of plug-ins is obtained throughout the organization. Does it cut training time? Is it more convenient and consistent? Is it truly a superior training method?

Unfortunately, with some exceptions, emphasis has been placed on technique rather than on training goals. Much of this research has been concerned with comparisons between this method and that. Actually, if one is concerned with performance the selection of a method must occupy a secondary role.

We can lecture, use audio-visual materials, educational television, and even conduct buzz sessions but is is unlikely that such methods would enable us to persuade a rat to turn on a light, hit a bar and thus secure food. Almost all conventional approaches and the most commonly-used techniques in the field of programmed instruction, i.e., constructed response, tab-item method, or scrambled book, would be inappropriate for training Mr. Rat.

It is not that there is but one way for people to learn, but that there is a way in every situation which is the best for teaching people to perform tasks well and quickly.

There are many programs that work. There are many conventional techniques that work. What we should be concerned with is the best technique for presenting the material.

Today we see the use of before-and-after testing as one approach to developing data in support of the introduction of programmed instruction courses in industry. Let us suppose that we could extend this research to show the actual performance on the job and the actual transfer of learning. It might then be helpful to analyze this performance on the job, together with a great variety of variables such as the age of the learner, the learner's education and experience, the type of industry concerned, the position the learner holds, and a host of other such factors.

Would it not also be of considerable value to determine the effectiveness of the instruction over a period of years? We could also, through experimentation, increase our knowledge with respect to the appropriateness of the use of various training methods in a variety of subject-matter areas.