ADCIS SIG CBT

NEWSLETTER March 1983

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

THE CHAIR'S VIEWPOINT

Robert C. Fratini

I hope you will take the time to complete the "Who's Who" survey form contained in this issue of the *ADCIS SIG CBT Newsletter*. It's been over two years since we last took such a survey, and the world of CBT has certainly grown since then. Mike Szabo has graciously agreed to compile the results of this survey with a goal of distributing the results by the time of the ADCIS conference in May.

This survey should help many of you expand your professional contacts, which, after all, is one of the goals of the SIG CBT. I expect to find out about a number of CBT projects I didn't know about previously, about people I've never been fortunate enough to talk with at an ADCIS conference. I am really looking forward to seeing the results of this survey, and I'm counting on your participation to make the survey as meaningful as possible.

Trainers are a particularly pragmatic lot. Whenever we get a new idea, most of us automatically assume that it's not REALLY new, just new to us. We feel that there must be someone, somewhere, who's thought of this idea before and pursued it.

Trainers also don't seem to enjoy making mistakes. If someone else has explored an idea previously, we don't often choose to prescribe "discovery learning" for ourselves. Instead, we want to find out from the "pioneers" which parts of the idea worked and which didn't work out so well. There's no virtue in repeating someone else's mistakes for oneself. And I guess my attitude is that I'm busy enough creating unique mistakes that I just don't have the time for anyone else's.

This is the thinking behind the "Who's Who" survey—to find out who else is blazing the same trails as ourselves in different parts of the forest, so that if we choose, we can combine our knowledge and avoid as many of the pitfalls that lurk behind the next tree. Lord knows, this job is hard enough.

In another effort to make the SIG CBT a meaningful part of your professional life between ADCIS conferences, in the next issue of the Newsletter we'll be conducting a membership survey to help chart the course of the SIG over the next several years. We have enough members now that our budget from ADCIS is sufficient to allow us to tackle some substantive issues regarding the implementation of CBT. The problem is, we still have more issues than we have money to deal with them. This membership survey will help us prioritize our efforts and insure that the SIG is pursuing the course that you feel is most appropriate. It's only $5 per year that you contribute to the SIG, but we want you to feel that you're getting your full money's worth.

Plans continue to proceed smoothly for the ADCIS conference in Denver in May. I've just completed reviewing the papers submitted thus far, and am very pleased with the balance we have in our presentations. The papers deal with a wide range of issues, target populations, and hardware and software solutions. The program is being planned to organize papers with similar themes into the same session, and for presentations of a more general nature to come on the first day of the conference, to help novices up to speed.

I'm "managing" the CBT sessions for Denver in much the same way that I manage trainees taking one of my courses from a remote location—by relying on local support and by trying to anticipate as many needs as possible. Things seem to be well in hand, in much better shape at this stage than they were in 1982, so perhaps I won't feel quite as bad

The *ADCIS SIG CBT Newsletter* is published quarterly by the ADCIS Special Interest Group in Computer-Based Training. Its purpose is to encourage the exchange of information on instructional computer applications in business, government, industry, and the military.

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

Requests for reprints and/or futher information should be directed to the authors. Requests for membership in ADCIS SIG CBT should be directed to Gordon Hayes, Executive Secretary, Western Washington University, Computer Centre, Bellingham, WA 98225.

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about not being able to attend the Denver conference myself.

At this writing, at least, I don't think I'll be able to join you in Denver. It all stems from my wife's inability to appreciate my priorities for this year. I told her that I wanted to be at ADCIS in Denver the second week in May; she told me that she was planning to have our first child in Columbus that very week. I tried to get her to promise to delay the arrival until after the conference, but no . . . .

In any event, your SIG officers and I are making every effort to see that your week in May at the ADCIS conference is almost as enjoyable and personally rewarding as I anticipate my life to be around that time. I've got some pretty competent people on-site, so I have no doubt about the SIG activities being in good hands. In the meantime, activities like the "Who's Who" and membership surveys will serve to make the SIG more meaningful both to those of you fortunate enough to make it to Denver, and those of us who have, umm, prior commitments for that week.

Recent Newsletter Issues

This is Volume 5, Number 4 of the *ADCIS SIG CBT Newsletter*. Previous issues have been inconsistently dated. The issues published are:

- Volume 3, Number 2 Nov 1981 (should have been 4 2)
- Volume 3, Number 3 Jan 1982 (should have been 4 3)
- Volume 3, Number 3 March 1982 (should have been 4 4)
- Volume 5, Number 4 March 1982 (should have been 5 1 and June 1982)
- Volume 5, Number 2 Nov 1982
- Volume 5, Number 3 (skipped)

The upcoming issues are:

- Volume 6, Number 1 June 1983
- Volume 6, Number 2 September 1983
- Volume 6, Number 3 December 1983
- Volume 6, Number 4 March 1984

Meeting Adult Training Needs Through Computer Based Training

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A paper presented at the meeting of the Alberta Vocational Centres (Spectrum 82). Edmonton, March, 1982.

Trainers have acquired a great deal of knowledge during the past 15 years about how adults learn. But is this knowledge being applied? The author contends it is not. In this paper several training characteristics of the adult are reviewed and a role for computer based training in meeting those needs is outlined.

For purposes of this paper, I will define adult training requirements (ATR) as those individual characteristics of adults which, in a training environment, have a demonstrated and significant effect upon what adults learn and how they approach or avoid a training program.

The Adult as Information Processor

Of the three major learning theories (Operant Conditioning, Maturation, and Cognitive Science), the first has had a major influence on the way trainers think and deal with students. The operant conditioning views of Skinner and followers have made such concepts as 'reinforcement' a household word with trainers. A body of research is now being accumulated which raises serious doubts about the validity of the operant conditioning representation of how adults learn (e.g. Kulhavy, 1977). Common sense and experience tell us that adults learn better when they are actively engaged in the training process. This recent view is called information-processing, or, if you prefer, mind-active learning.

Traditional training methods are built upon transmission of information from trainer to trainee and are hence called information-transmission models. Learning based on information transmission often employs rules of operant conditioning, including the misunderstood tool, reinforcement. Now there is an alternative approach which allows us to optimize training effectiveness and efficiency by encouraging the learner to actively 'process' information.

The information-processing model assumes the adult approaches training with 1) a well-developed set of knowledge and 2) ways of accommodating new knowledge. When presented with new information, the trainee will acquire that information only to the extent that he/she can integrate it with what is already available in the mind. While we as trainers cannot know the exact details of our students' cognitive schema, there is a great deal we can and do know about certain actions which can make the learner a more effective and efficient information processor (and better learner).

What Do We Know About Controllable Aspects of Adult Training Requirements?

The simple answer is plenty. Researchers have spent large amounts of time on acquiring information about how adults learn and have tested the results in applied terms. It makes sense to examine those adult training requirements which can be influenced or controlled by trainers. If a student is undergoing a divorce and the trauma is affecting his/her work there is little we can do besides being sympathetic. However many ATRs can be modified by trainers; several of these will be discussed below.

1. Vocational Training.

Several studies have shown that adults typically seek vocational training as opposed to academic or recreational education. We certainly can and do respond by providing vocational training emphases as part of corporate training missions.

2. Prerequisite Knowledge.

Of all the variables that affect what a trainee learns, one of the most important is the amount of prerequisite knowledge and skills that a student possesses at the beginning of training (Bloom, 1976). Time and time again we have seen students fail because they do not have the prerequisites that are required for a training program.

3. Learner Control.

It is well known that adults demand and take control over what they learn. There is some research evidence that when adults exercise control over the actual training process, they learn better and retain it longer. For example, practicing the skills to be acquired aids mastery. If the amount and frequency of practice can be increased under direct control of the trainee, greater learning will occur.

4. Competency Based.

Adults prefer to receive training which will help them achieve vocational competencies. In addition, they prefer to be evaluated relative to those competencies rather than to be compared with others in the class. In an individualized training program, there may not be any 'others' at any point in time for comparison since students will have distributed themselves widely throughout. Implicit in this discussion is the fact that some adults prefer a cooperative versus a competitive training environment. A program based on competencies often embodies a cooperative environment.

5. Mastery.

The concept of training to mastery is simple, powerful and based on several years of research. In the applied sense,

mastery means that the learner must demonstrate knowledge or competence in any part before being permitted to study the next part (Bloom, 1976). Mastery is crucial for those training programs in which success in any part is dependent on success in previous parts.

6. Guidance.

I am going to focus on guidance during the training process as opposed to other forms of guidance. When the student is engaged in acquiring competencies, there is a need to know which competencies have and have not yet been met. Traditionally we rely on the student to make this determination: tests are primarily used to evaluate the student. Testing is not frequently used as a diagnostic tool. There is considerable evidence that when a student is allowed to terminate training during a training sequence, termination often occurs before mastery has been acquired. (Tennyson, 1982). Giving students frequent and valid information about their progress is a way to avoid premature termination. If the information-processing model is correct, the student will utilize this information and recognize the need for corrective action. At this point, further guidance may be necessary. Thus, guidance is seen as an iterative and continuous process in which the trainer and trainee progressively zero in on and eliminate inadequate training.

7. Self-Pacing.

When adults are forced to progress at a pace set externally by the instructor, the tremendous variation in learning rates are not evident. When trainees are permitted to pace themselves we see the five-to-one learning rate variations (Bloom, 1974). The effect is so powerful that someone has defined aptitude as the time it takes a student to master something we have to teach!

Because of the variation in learning rates, students allowed to set their own instructional pace complete instruction in 20 to 50% less time, on the average (Kulik, Kulik, and Cohen, 1980). This finding is consistent and accompanied by no measurable loss in learning. If we are interested in increasing the efficiency of our training systems, self pacing has much to offer.

8. Feedback.

The area of training most profoundly affected by reinforcement ideas is feedback. It is commonly believed that positive reinforcement after practice examples and tests will lead to better subsequent performance. The fact is however that feedback has its greatest influence when given after incorrect responses or practice. Feedback given after correct responses has little if any effect upon how much a student will retain (Kulhavy, 1977).

It seems that feedback can be explained by the information-processing model in that it provides corrective information which the student uses to take remedial action. Further evidence comes from delayed feedback studies. When feedback is not given immediately after practice, students spend more time studying the feedback and score higher on retention tests, regardless of the 'reinforcement' they receive (Kulhavy, 1977).

Does this mean we should not be supportive of our students when they do not master the objectives? Certainly not! The point is that we can now go beyond simply being supportive and use feedback to help students exercise some independence from teachers and learn more in the process!

9. Flexible Study Time

One of the greatest barriers to efficient adult training is lack of availability of trainers at times when the learners can receive training. Due to work and family schedules, adults cannot easily meet schedules which are convenient for trainers. The ultimate solution envisions students completing significant percentages of their training individually and on their own. There is ample evidence this has been successfully accomplished several times and in different settings.

10. Questions and Practice Items.

One way to utilize feedback is to provide for extensive practice questions and items during training. It has been shown that when questions are embedded in text materials and trainees process those questions, learning is significantly improved (Rothkopf, 1974). Questions given prior to the study of text materials can be useful in helping students focus on the important parts to be learned and de-emphasize the less important parts.

11. Training Objectives.

Training objectives have been greatly misunderstood and misused by educators since their first appearance. Used properly, they should be treated as evidence that learning has occurred. Second, it has been conclusively shown that students who receive and study objectives before training will learn more (Duchastel and Merrill, 1973). Thus it is clear that the simple act of having students study the objectives is an effective training aid.

12. Graphics.

My own research into graphics shows the power of graphics to improve learning. Specifically, we began with textual materials designed to teach the function and structure of the human heart. We added graphics which were derived from the training objectives and found that the graphics version resulted in significantly better performance in visual and conceptual criterion tasks (Szabo, Dwyer, and DeMelo, 1981).

We then carried the study one step further and added the same graphics to one version of the test. We found that for visually oriented tasks (location of the parts of the heart on a diagram), students learned more if the testing was visual.

Individual Learner Differences

Providing effective training to meet these adult requirements is immensely complicated by the fact that in each of these requirements there is tremendous individual variation among our students. This variation cuts across vocational training

needs, prerequisite knowledge, learner control, specific competencies to be attained, level of mastery, guidance needed, pacing rates, feedback, study time, questions, objectives, and graphics.

For example, when students are allowed to learn at their own pace, those with the slowest learning rates will take five times as long to achieve mastery as others. Providing feedback after practice questions gives another example of individual variation. Each trainee learner will exhibit a unique pattern of correct and incorrect answers to a set of questions. Since the research suggests that we should concentrate feedback efforts on the wrong responses, we are faced with the difficult task of giving feedback specifically tailored to each students' performance pattern.

Management of Adult Training

The task of effectively addressing adult training requirements under conditions of high individual variation poses new and different requirements for corporate trainers. In general, it requires a major shift from instructor-centered and group-paced learning to trainee-centered and individually-paced learning. There are two implications which immediately arise: curriculum requirements and the logistics of managing the whole process.

Training Curriculum Requirements

Curriculum requirements for individual differences are not well understood at this time. A modularized curriculum structure is clearly needed. Each module consists of a self-contained unit which teaches the content or process associated with a particular set of objectives or competencies. Each module includes instructions, assessment items on which to judge competency, several alternative forms of training, and directions how to proceed within and between modules. The content of the modules must have been validated with actual student trials. Thus, the adult can, with guidance, select those modules he/she needs to study in order to meet the objectives. The student is guided in the selection process through an understanding of his/her own goals, advice from the trainer, and results of the diagnostic performance assessment on the competencies and their prerequisites. One should not feel that such a learning system is far fetched or futuristic: indeed such a curriculum now exists on PLATO for literacy training for adults who function between grades 3 and 12 in math, reading, language, social studies, and science.

Logistics Management

The problem of managing many trainees studying several different modules at the same time and providing meaningful guidance and support to each individual is a logistics problem of immense proportions which poses a tremendous drain on the trainers. In remedial instruction, less than 40% of the trainers' time goes toward teaching and over 60% toward management functions (Poore, Qualls, and Brown, 1982). Fortunately, the modern high speed computer can solve these problems. It does so through its capacity to track and record the performance of each individual in a highly detailed fashion and provide individualized response to each decision taken. It diagnoses individual specific strengths and weaknesses and prescribes alternative training activities to help the student meet the course competencies.

Computer Based Training

Computer Based Training (CBT) is the delivery of training systems materials to individuals through a computer system specially designed for learning. It consists of two major components: Computer Assisted Training (CAT) and Computer Managed Training (CMT). In the former, the computer acts as an individual tutor to the student, training and testing in a patient manner. In CMT, the computer manages the learning program of each individual student through a diagnostic and prescriptive assessment system. CBT is individualized and can maintain and display detailed records for trainers and their supervisors. In addition, individual records can be made automatically available at any time.

CBT Meets Adult Training Requirements

Earlier in this paper I briefly described 12 different adult training requirements shown to be important in the training process. CBT has been demonstrated to meet each of these ATRs in applied situations. Furthermore, it does so in a highly individualized way, capitalizing on the ability of the computer to adapt to the model of the trainee suggested by information-processing research.

A CBT system designed for a wide variety of content areas certainly can incorporate vocational training and, through simulation, provide training that otherwise might be too dangerous or expensive to use.

Mastery and attainment of specific training prerequisites can be dealt with through the computers' ability to identify weaknesses on objectives (diagnosis) and direct the trainee to materials which are capable of removing those weaknesses (prescription). Diagnostic and prescriptive assessment is highly adaptable to individual adult trainee requirements, engages the trainee in information-processing activities, and can be used with little or no trainer effort once set up. The results can be used, along with intuition, in the decision of whether more work is required by the learner.

CBT permits individual pacing to accommodate different rates of learning. Carefully designed lessons can be made available regardless of trainee availability virtually 24 hours each day.

Each trainee receives objectives, questions and feedback based on his/her unique pattern of individual differences. High resolution interactive computer graphics make it relatively easy to incorporate training visuals.

All is not beer and skittles, however. The effectiveness of a training system is a function of the author's anticipation of the learner's thought processes. Years of dealing with

group training does not necessarily prepare one for designing individualized and interactive CBT lessons.

It is believed the demonstrated effectiveness of graphics may be limited to the extent they are complex (e.g., fully detailed and full of irrelevent visual information) and not directly related to training objectives. Color is highly valued as a training tool and has been extensively researched. Not only does the research generally fail to support this optimism, there may some color combinations which reduce training effectiveness.

Is CBT Effective?

This question is often asked by someone who is investigating CBT, and rightly so. The question is an important one and should be asked in conjunction with the corollary question "What evidence is there that current methods of training are cost-effective?" In the 23 year history of CBT, substantial amounts of research have been been conducted. A fairly recent publication on CBL research summarizes 59 studies in postsecondary education which compared CBT with other forms of training. It concluded that CBT results in significant gains in achievement and significantly higher positive attitude toward both the content and method of training. The strongest finding of all is that students' learning time is reduced by 25-50%! (Kulik, Kulik, and Cohen, 1980).

These conclusions are powerful for two reasons. First CBT is relatively young and much of it does not systematically address ATRs. Second, most of the learning research through the years has yielded nonsignificant findings. In spite of its infancy, CBT seems to have great potential for corporate training.

Barriers to Widespread Use

There are several barriers to widespread application of CBT. The vast majority of these barriers fall into the category of political/administrative. The technological problems, at least with the PLATO system, have been successfully addressed. One political problem is the lack of awareness on the part of trainers and their supervisors of the major role that CBT will play in the field of training. As a result, they do not spend enough time with CBT to thoroughly familiarize themselves with what it can do, i.e., what needs it can solve in training.

A second barrier is that CBT is a medium which is individualized, learner-centred and can meet ATRs quite readily. There are substantial differences between CBT and our current training system which tends to be group-paced and centred around the trainer. It will require major but not impossible reorientation of training departments to make the transition to CBT.

It has often been said that computers can't replace the trainer for teaching is basically a human act between humans. While anyone who advocates CBT realizes the need to adopt this position (and I personally subscribe to its merit) we must recognize that the world of corporate training is changing quite rapidly. The fact of the matter is that in the near future CBT programs may be developed to operate independently of the instructor. The technological possibilities and political realities of such a venture appear to be in conflict.

Another reason that CBT is not widespread today is the characteristic time lag between discovery of an innovation and widespread adoption. For high technology, such as the laser, that time lag is about 20 years. For training innovation, it is about 50 years. Since CBT is a high technology training innovation, its widespread adoption should occur between 20 and 50 years after its invention. CBT was born 23 years ago, leading to the prediction of major inroads for CBT in the next decade.

Cost has been cited as a barrier to CBT. This argument is misleading for several reasons. First, we have little knowledge of costs of our present mode of postsecondary training. If we made a careful analysis of actual costs, my speculation is that we would be amazed by the staggering costs of doing business 'as usual'. More importantly, the costs of computer hardware are rapidly dropping and are predicted to continue to decline for at least a decade. Authoring Systems predict savings of 60-90% of labour time to produce CBT curricula. Costs of current modes of training are tied to travel, lost opportunity, wages, and instructors' salaries which are rising at a rate equal to or greater than inflation. It appears that those cost curves can and will cross, giving the advantage to CBT.

One cost factor related to CBT is the production of courseware, still very much a labor intensive operation. In the next five years, software systems which significantly reduce the manpower required to produce good quality courseware will appear on the market. These packages will further accelerate the day when the cost curves cross. Several such packages exist on PLATO and most major computer vendors are developing similar user-friendly software packages to make computing accessible to the general public. For those interested in man-machine interactions using natural language, this system deserves examination.

Conclusions

In this paper, I have tried to show that our current mode of training of adults falls short of quality. There are several factors known about how adults learn which call for re-thinking of the way we organize our training and manage its implementation. Without the power of the computer, we are limited to continue our current and outmoded methods.

Societal Dislocations

The technological revolution has already had a major impact on society and future dislocations will be traumatic (perhaps less so than the alternative of ignoring the information age). Many adults who aspire to training for skilled job positions do not possess the basic skills to permit them to be trained successfully. Another factor is the rapidly growing service sector of the North American economy. The biggest

consumable of this sector is training. The demographics of our population show decreasing graduation rates due to the end of the baby boom. The implication is that we will have to do more training with fewer resources. The efficiency afforded by CBT cannot be overlooked in this context.

It appears that chip technology may replace people in jobs, much as robots are now being added to auto assembly lines. The good news is that technology will create more jobs that it displaces. The bad news is that those displaced will have to have extensive retraining in order to fill the new jobs created. Once again, the technology of CBT holds the potential to provide a significant proportion of this retraining.

Will we as corporate trainers be able to step in and deal with these problems facing society? What will be our response? And will we attempt to prepare ourselves with the best and most appropriate technology to help us solve these problems? It is my hope that the answer will be yes.

The Age of Innocence

Years ago, Japanese manufacturerers dumped industrial wastes into drinking water and caused horrible birth defects in the population. They did so not knowing the horrible consequences. Some would argue that they were 'innocent' of wrongdoing because they didn't know. Today, all manufacturers know the consequences-they are no longer innocent. If you have stuck with this article thus far, you are no longer 'innocent' of knowledge of valid methods of teaching adults nor are you innocent of knowledge of how these methods can be carried out using CBT. Welcome to the 'Age of Accountability'.

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