Structured training—A common-sense approach to developing ADP skills for improved job performance

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ABSTRACT

"Structured training" is a collection of instructional techniques, devices, materials, and methodologies, selected and tested by the authors, which has been successfully used to develop ADP technical skills and improve performance on the job. Structured training, in many situations, should result in more effective training than current on-the-job training programs, and standardized training courses provided by outside suppliers. Structured training has major applications inside medium and large scale production-oriented computer centers.

A major premise of structured training is that course design should be specifically oriented to performance improvements on the immediate jobs to meet training cost/effectiveness benefits. Structured training courses are therefore tailored to the needs of a specific installation. Best results are obtained when computer center objectives, course content, and student objectives are mutually consistent.

Major characteristics of structured learning are these: instructional modules are designed for an order of presentation that moves from the general to the specific. Reinforcement of learning is achieved with extensive use of quizzes, directed class discussions, and coordinated on-the-job training or job-related workshop problems.

A case study of a structured training course implemented by the authors for a multi-mainframe U.S. military installation is presented to illustrate structured training.

It is concluded that, although structured training demands a substantial development and implementation effort, the benefits derived seem to be significant and cost-justifiable.

INTRODUCTION

The structured training course approach to ADP technical training discussed in this paper has been developed by the authors over the past several years during the process of designing and implementing a variety of ADP training courses for a wide range of government and commercial organizations. Installations for which structured training courses have been developed and presented have been medium and large scale production-oriented computing centers whose primary workloads consist of "commercial" type applications.

BACKGROUND

In data processing, as in any field subjected to the stresses of rapid change and expansion, the general level of performance of personnel tends to deteriorate over time. Although, in many installations, concurrent improvements in management, supervision, technical support and training have served to arrest or even reverse this tendency, in others, such measures have not been entirely successful. In particular, training efforts have often been either absent or disappointing in their outcomes.

Thus, in far too many modern computer centers, the status of development of technically trained personnel is well below that required to apply current computer technology in an effective and economic manner. Several major factors have contributed to the development of this situation, including:

1. Substantial increases in workload volume, coupled with increasing pressures from users for improved responsiveness to their needs;
2. Increasingly diverse and complex workloads;
3. Rapid changes and increasing capabilities in hardware and software;
4. Higher levels of responsibility imposed on computer operations and problem programming personnel;
5. Continuing loss of trained personnel through promotion, transfers and terminations.

As to any specific installation, low levels of technical personnel effectiveness may be evidenced by one or more indicators:

1. Excessive or increasing production re-runs;
2. Excessive or increasing testing activity for equivalent program development workloads;
development or production requirements; but nonetheless real, observations, including:

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ments with an acceptable level of data accuracy;

requirements.

Accompanying these indicators may be more subjective, but nonetheless real, observations, including:

1. Decreasing management and user confidence in the ability of the computer center to meet development and production commitments;
2. Low employee morale;
3. Excessive or increasing rate of voluntary separations, especially of the more efficient workers;
4. Excessive reliance on a progressively smaller group of individuals in order to "get things done".

Faced with such problems, computer center managers have often turned to personnel training as one way of improving their operations. The outcomes of such training efforts have varied widely, but it seems reasonably safe to say that few managers are totally satisfied with the quality and utility of their training programs. The structured training course approach to training ADP technical personnel attempts to ameliorate the more common shortfalls of many current training programs for computer center personnel.

Of the several basic approaches currently in use for training in the center, none are objectionable in and of themselves, and any or all of them may find a useful place in a well designed and implemented training program. Among the more common techniques in current use, which are discussed below, are:

1. On-the-job training (OJT);
2. Standardized training courses supplied by equipment manufacturers or independent suppliers, including self-study courses with or without audiovisual aids;
3. Formal on-site training courses.

On-the-job training is an invaluable adjunct to any technical training program and may be the primary method of choice in some restricted situations. However, in many installations, OJT is a mere facade used to mask the lack of any real commitment to personnel training. In other installations, OJT fails to attain its objectives because:

1. It is administered on an ad hoc basis without any meaningful planning, control or evaluation;
2. The level of training that can be achieved is limited by the capabilities of the personnel who can be made available to serve as instructors and the extent to which they can be made available;
3. It is often restricted to the most rudimentary skills and most routine functions of the job;
4. It is essentially a one-on-one instructional method and, therefore, relatively expensive.

Standardized training courses available from commercial sources include both instructor-presented courses and self-study packages. Instructor-presented courses are usually conducted at the vendor's site. Because most of those courses are designed to offer a general curriculum to a wide variety of installations, they are often not specific enough to meet the unique needs of a particular installation. Even when these courses are highly specific, the diversity of interest among participants from different organizations tends to reduce the effectiveness of the program.

So-called "self-study" and "programmed instruction" packages are offered either on an actual self-study basis or an assisted basis, i.e., a "monitor" or "course supervisor" is to be provided by the center to assist the student. The experience of the authors with these materials is that they have limited effectiveness when used on a self-study basis because many students have neither the self-motivation to struggle through the technical details nor the study skills needed to acquire knowledge in this manner; however, these materials, especially the audiovisual component, may have considerable value when used as support to an instructor in a classroom situation by providing diversity of presentation and reinforcement of learning.

Formal on-site training courses may be provided by either in-house staff or vendor sources. Such courses can be very good, but often fall short of attaining realistic training goals, because:

1. Training is used only as a response to "crisis" situations with little or no planning;
2. Training is often supervised by technical or administrative personnel who have little training, interest or experience in education or training;
3. Programs are often oriented toward academic objectives rather than specifically to job related training needs.

Since the authors are actively engaged in providing training services to computer centers on a commercial basis, these problems have had considerable importance and immediacy. To address these problems, over time a large number of different devices, techniques, materials and methodologies were tried by the authors and were either found wanting and discarded, or were proven and incorporated into a set of training strategies that, for convenience, are called collectively "structured training."

STRUCTURED TRAINING CONCEPTS

The structured training course approach is built upon the premise that cost/effective training in the production-oriented computer center requires structuring of courses that specifically provide training to maximize performance on the job. The conceptual framework underlying this approach encompasses a set of ideas that are neither new nor unique, but that in current training practice are as often honored in the breach as in the observance. The more important of these ideas are discussed in the following paragraphs.

A major consideration is that each structured training course be tailored to the needs of a specific installation.
The training objectives of the installation form the basis for course design as well as for evaluation of the course outcomes. Each instructional unit must contribute to the satisfaction of one or more of the computer center’s training objectives.

Closely connected with this notion is the idea that course content must be consistent with the students’ job-related objectives. Adherence to this idea can only be attained if students either have or are about to have assignments for which the training course is appropriate. Best results are attained when the computer center objectives, the course content, and the students’ objectives are mutually consistent.

Course content must not only be consistent with student and computer center or objectives but it must also be structured so as to facilitate learning. The underlying concept here is that new knowledge is most easily acquired and retained when it can be readily integrated with existing knowledge. For this reason, the instructional modules of a structured training course are designed for an order of presentation that moves from the general to the specific.

Students are first presented with a conceptual overview of the course that serves both to forecast the material to be presented during the course and to illustrate the connections between the course content and the students’ previous knowledge and experience. Similarly, each major module of the course is introduced by an instructional unit that presents an overview of the module and relates it back to the course overview. Thus, important ideas are constantly reviewed, reinforced and related to the students’ existing knowledge.

Further reinforcement of learning is achieved with three techniques. The first of these is based on the ancient maxim that, “You teach what you test.” The development of tests and quizzes that emphasize important concepts and details is basic to the success of this approach. In a structured training course, the primary objective of testing is not the nearly realizable goals;

(3) Provide each student with an aid to self-evaluation.

Quizzes are used on a very frequent basis to achieve these objectives and the fact that such use also provides an excellent evaluation of student progress is a welcome but relatively unimportant result.

The second and related technique is the “directed” class discussion in which the instructor encourages the students to ask questions and to answer them. In this technique, the instructor serves as interlocutor: eliciting a question from one student and passing it to another to be answered. To the extent possible, the instructor refrains from directly providing answers.

A third method of reinforcement may take one of two forms dependent on circumstance: related on-the-job training or related workshop problems. If on-the-job training is used, great care must be taken to assure that such training is effectively coordinated with formal classroom sessions. Unless OJT is properly scheduled and consistent with formal instruction its effect is largely vitiated.

In situations where OJT is not practicable, workshops or laboratory problems may be used. Laboratory or workshop exercises should address problems that are based on specific operating situations in the computer center for which the structured training course was designed.

Design, development and implementation of a structured training course proceeds in accordance with a commonsense plan. Each step in the plan is necessary, but the extent to which each step is pursued is dependent on the needs of the specific installation for which the course is being developed. If the installation has a training program plan, the structured training course is developed within the context of that plan; otherwise, it is developed as a stand-alone course.

A necessary first step in development involves collection and analysis of information about the training needs of the installation. Such information may be obtained from: interviews; personnel records; management reports and planning documents; problem area analyses; and similar formal or informal sources. The output of this step is a program description document that is submitted to the installation for review and acceptance.

The program description document is, in essence, a preliminary recommendation for a training course. It contains an exposition of objectives, scope, student prerequisites, proposed student materials, instructional methodologies, and a summary statement of course content. Normally, this document also includes a detailed and time-phased topic outline. Upon acceptance of the program description, student materials are selected or developed and a detailed instructor’s guide is prepared. The instructors’ guide is designed to assist the instructor and contains:

(1) A summary description of the course content, methodology and objectives;
(2) A course schedule;
(3) A listing of student materials;
(4) A lesson plan for each instruction unit.

Each lesson plan contains:

(1) An estimate of the amount of time required for the unit;
(2) A statement of the objectives of the unit;
(3) A topic outline of the unit content;
(4) A description of listing of the student materials and study aids required;
(5) An exposition of student and instructor activities for the unit;
(6) Suggested instructional aids, i.e., audiovisual materials, chalk board diagrams, handouts and the like;
(7) Suggested tests or quizzes and discussion guides to be used with the unit;
(8) Where appropriate, case study materials, problem statements and the like for out-of-class study or workshop sessions.
The first step in implementing the training course is the course announcement. Such an announcement may be either in the form of a written bulletin or may be delivered orally at a meeting. In either case, it can serve several purposes, including:

(1) Informing all potentially interested persons about the content of the training course;
(2) Publicizing the organizational and personnel objectives of the course;
(3) Providing potential students with the opportunity to ask questions and to interact with management in relation to their individual needs and the relevance of the proposed training to career progress.

Persons selected to participate in the training course should not only meet course prerequisites but should also have a specific job-related need for the training offered. Unless a participant is going to apply knowledge and skills gained shortly after the conclusion of the course, both the individual and the organizational benefits of training will be largely dissipated. Additionally, students who lack personal job-related training objectives can not realistically be expected to have the level of motivation required to accept the workload and discipline necessary to a successful training experience.

The structured training course approach assumes and requires that the students be active participants in the training experience and not mere empty vessels into which knowledge is to be poured. Classroom operation is disciplined, course content is highly structured, and the level of student participation expected is high. Each class session is expected to result in a measurable increase in each student's knowledge or skills.

A typical class session begins with a short review of the material covered in the previous session. This is immediately followed by a short quiz designed to provide reinforcement of the important features of the previous instructional unit. The quizzes are then corrected in an interactive exercise in which the students provide the quiz answers with minimum intervention by the instructor. This exercise also affords the students an opportunity to seek clarification of the subject matter or to discuss related experiences.

This dialogue is followed by a presentation by the instructor of the next instructional unit. Short duration audio or video tapes may be used as adjuncts to the instructor's presentation. Depending on the type and length of presentation, the students may next address exercises or enter the workshop mode to solve large problems. Finally, the instructor introduces and discusses the outside reading assignment that is to be completed before the next class session.

At the conclusion of the training course, each student is evaluated by the instructor in terms of the progress he has made during the course. The instructor's evaluation is based on: quizzes and occasional formal tests; student participation and performance in discussions and workshops; attendance and attitude.

Student evaluation of the course is provided by questionnaire that may be submitted anonymously. Each student is requested to evaluate:

(1) The extent to which the course satisfied his individual training objectives;
(2) The facilities provided;
(3) The course content;
(4) The instructor's presentations and workshops;
(5) The student materials.

Student evaluations are tabulated and analyzed to provide data for the improvement of future courses.

CASE STUDY

A recent application of the structured training course approach illustrates many of its features. This application was designed and implemented to train computer operations personnel in a multi-mainframe U. S. military installation.

Over the years, this installation accumulated a large number of second generation mainframes, now at a single physical location, which were manufactured by a number of different vendors and are currently being phased out. The workload presently on this equipment is being transferred to an IBM 360/65 and an IBM 370/165.

The state of both employee training and morale when the course was conceived was considerably below an acceptable level. None of the operators had received any formal training in recent years with the exception of a three day briefing in 1974 on third generation equipment. Because of the continuing press of current workloads, those operators assigned to second generation equipment were not even being considered for training on the 360/370 computers. These conditions quite naturally led to lowered work efficiency and poor employee attitudes.

In this situation, the management of the computer center consulted Computer Education International, Inc., concerning the feasibility of producing a training course to meet both subject matter training and motivational objectives. As a result of these discussions the authors undertook the design and implementation of a structured training course for the operations personnel of the installation.

After assessing the training needs of the organization, a set of course objectives was documented and approved by management. The course objectives were to:

(1) Provide intensive formal training to advance all computer operators into the third generation system 370/OS environment;
(2) Introduce or reinforce skills in the purposive use of technical documentation;
(3) Improve the capability of operations personnel to communicate among themselves and with other computer professionals;
(4) Improve employee morale.
Investigation revealed that the target student population in general lacked an adequate understanding not only of OS operations but also of basic data processing systems development and implementation methodology. Although most operations personnel could respond adequately to routine situations, they lacked the knowledge to handle the unusual or problem situations and did not have the study skills necessary for self-improvement and self-training in the new third generation equipment.

From this study, it followed that the course content had to be based on the assumption that the student population had no prior training in the field of data processing including hardware, software and applications. Based on this assumption, the content included six instructional units: (1) Data processing system concepts; (2) 360/370 computing system equipment; (3) 360/370 Operating system concepts and facilities; (4) OS/HASP console operations; (5) OS job control language; and (6) OS service programs. The course was conducted four times during the last six months of 1975. Each offering consisted of thirty two-hour sessions, ten hours for each unit.

The course content was structured as a set of instructional modules and units organized in a “top-down” fashion. Characteristic of this approach to course design is that both the course and its major modules move progressively from the general to the particular. The first module of the course is, therefore, a comprehensive overview of the course that relates the course content to the students’ background and forecasts the major subject areas to be covered. This order of presentation provides the student with a conceptual framework that, while it is constantly expanding, allows him to easily relate new knowledge to his past experience.

In the present case, the first ten hours constituted a major instructional module which served the purpose of providing an overall conceptual framework. The basic concepts of each of the included instructional units were covered and connected together in the presentation. Each of the five subsequent instructional modules began with a recapitulation and review of the concepts presented earlier, followed by detailed development of the current subject area.

Actual course presentation followed the structured training course model rather closely. Consistent use was made of quizzes and directed group discussions. Reading assignments were frequent, and extensive use was made of videotapes and other audiovisual aids.

Students were provided with a substantial amount of student materials, including: study texts, illustration booklets, and technical manuals. Adequate instruction and practice in the use of reference manuals for problem solving was afforded to all participants. Selected reference manuals were presented to each student for permanent use after the conclusion of the training course.

The objectives of the course were met reasonably well as determined by the installation management and by the students themselves. Because of the rather difficult personnel environment that existed prior to the class, the course was initially greeted with some skepticism; however, at the conclusion of the program, most students were pleased with the progress they had made and management was satisfied.

Computer center management indicated that, in general, employee attitudes were more positive, with operations personnel indicating an increased interest both in their work and in follow-on self development. Computer operators felt that they were able to communicate more effectively with programmers and production control personnel.

Although the course was generally well received and the course objectives were reasonably well satisfied, the authors feel that there were a number of areas where improvements might have been made; these include the following, which are discussed below: (1) Student selection; (2) Class scheduling; (3) Course design; and (4) Testing.

Subsequent to initial course design, management broadened student selection criteria. This resulted in a range of student experience, capabilities, and individual job-related objectives far wider than was desired. Work assignments of the actual student participants ranged from the purely clerical functions in production control to the highly technical functions of computer operators working at the 370/165 console.

Experience of the participants ranged from none to nearly sixteen years of operator experience. Among computer operators, participants had work experience ranging from second generation only to two years with the 370/165. Thus, for many participants, major segments of the course were not adequately relevant to either their immediate job needs or their individual job-related objectives.

Instructional efficiency would have been improved had the student population been more homogeneous. For example, production control personnel should have been assigned to one class, second generation operators to another, and so on; however, this was not possible in the production situation. This, in fact, may be a problem that cannot be totally solved in a training environment involving technical people with production commitments.

A related problem was the scheduling relationship between class sessions and the participants’ work shifts. Although most students were able to handle the heavy workload imposed by the daily two hour class session plus outside reading in addition to their regular eight hour shifts, some students who attended at the conclusion of their shifts were simply too tired to benefit fully from training. Students perform better if they attend class prior to their daily shift.

All things considered, the course design was reasonably successful. However, two major changes are suggested for future courses. The first change is to make the instructional modules smaller in scope and to increase the number of levels of detail between the most general and the most detailed. This change will assist the instructor to more readily adjust the speed and content of his presentation to the capabilities and individual objectives of his students.

The other change relates to the establishment of course objectives. In the design of the course discussed in the case study presented in this paper, the authors attempted to
assure that the design would meet management goals by delivering a briefing and preliminary outline to management for their review and concurrence. However, many students had different views as to their technical training needs. In the future, it is suggested that a preliminary topic outline and questionnaire be distributed to all potential class participants to elicit from them their views of their training needs before the course content is finally adopted.

In the initial presentations of the course, some departure was made from the structured training course approach to the use of testing. The frequent testing was thought too difficult for these students; therefore, testing was infrequent and used principally for instructor evaluation of student progress. After evaluating the outcome of these earlier sessions, the decision was made to return to the original testing concept. The use of testing was increased and redirected to reinforce learning, promote student self-evaluation and improve retention of learning. This change resulted in a noticeable improvement in student motivation and levels of performance.

CONCLUSION

Experience with this and other technical training programs has convinced the authors that structured training courses are an effective, common-sense approach to providing ADP skills training in commercial-type computer centers. While it demands a substantial development and implementation effort, the benefits derived seem to be significant and cost-justifiable.