



A HANDBOOK OF  
**COMPUTER**  
**— BASED —**  
**- TRAINING -**



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A HANDBOOK OF  
**COMPUTER**  
— **BASED** —  
— **TRAINING** —

SECOND EDITION



**Christopher Dean and  
Quentin Whitlock**



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## Introduction



Many, if not all readers of this book, will have had some experience of 'conversing' with computers. They may own their own microcomputer; they may use a terminal from the main company computer at work, or they may own a television set with a viewdata facility. Those who do not have this experience may well have observed the staff at, for example, an airline check-in or a local bank branch office sitting at their desks, pressing keys on a typewriter-like keyboard and reading information presented on a television-type screen, like the one illustrated on page 8. In such a situation the check-in clerk or the branch cashier is using the computer to obtain information (eg to find out if a seat is booked) or to amend information (eg to change a customer's name and address).

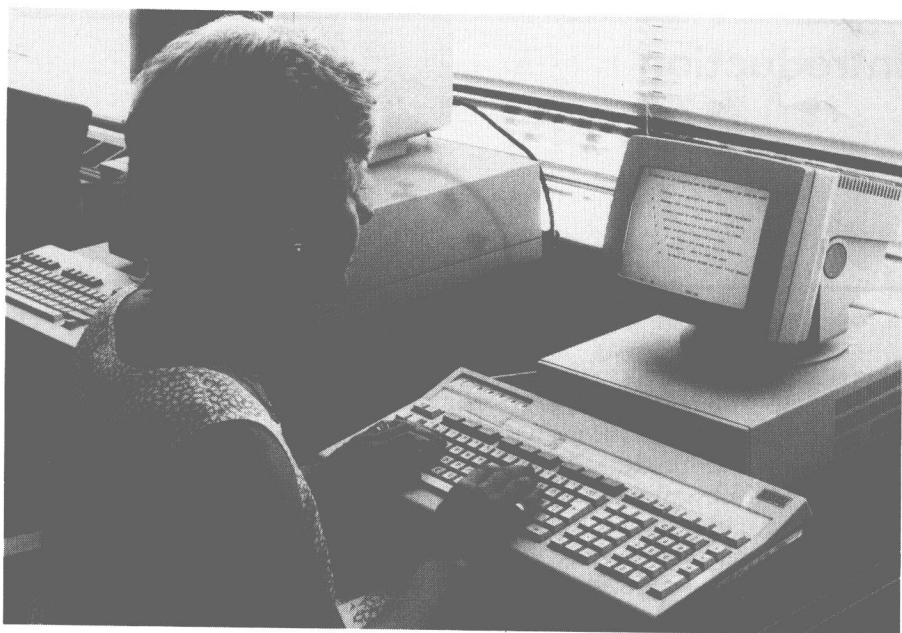
How do these operations come to be learned by the staff concerned? There are various possibilities. A colleague or supervisor can show them and then leave them to their own devices until they run into problems. They may go to a group training session where an instructor explains basic procedures, possibly with some practice on terminals, or they may be given a printed manual explaining the procedures and containing exercises. Combinations of these strategies are also possible.

One approach which has grown increasingly popular over the past few years is to arrange a situation in which 'lessons', explaining the procedures to be learned and giving examples and practice in those procedures, appear on the screen which is used for the performance of the task. These lessons include explanatory information and diagrams and set and mark exercises just like the group instructor. They will almost always require supplementary printed materials. How these lessons come to be developed is the subject of this book.

As we will show, such lessons need not be restricted only to those procedures for which computer terminals are already used. The introduction of the computer may enhance the teaching of many aspects of science, business or the arts. It is not our contention that computer-based training is invariably superior to the more traditional methods. Clearly there will be a strong case for this approach in tasks which involve the use of terminals. But even here the use is not always self-evident. In some circumstances a simple, printed performance aid may be cheaper and more effective. In others there may be good reasons for retaining a human instructor.

This book attempts to bring together relevant aspects of two specialist areas – educational technology and computing – so that the reader, who may be an





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expert in neither, one, or both these fields, can easily select the areas that are important to study in depth. Part 1 discusses the design of learning sequences with special reference to computer-based training and is particularly important for computer experts. Experienced trainers may wish to skim through parts of this section. Part 2, on the other hand, is designed for trainers who know little about computers and it aims to give an introduction to the subject and the sorts of devices that can be supported. Part 3 covers the subject of computer-based training from deciding on equipment and authoring systems through the composition of a design team, to deciding how to structure the training material on the screen and thence validating the course.

As its title implies, this book is designed to be a handbook for the newcomer to this exciting area of training as well as a useful reference work for practitioners. It is hoped that it will be of use to trainers and educators with an interest in, or requirement to learn about, computer-based training. It should also be useful to management and computer personnel.

In places, we have found it convenient to use the masculine gender. Readers should interpret this as meaning a person of either sex. We hope that no one will be offended.

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## Introduction to the second edition

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The main enhancements to the second edition are a new chapter on 'Aspects of screen design', additional material on management aspects of CBT development and on analysing and sequencing knowledge. We have reorganized some of the chapters and made several changes throughout the book. We had to make a large number of changes to the computer section because of the rapid developments that have taken place. It is of some interest to note that about half the authoring systems included in the revised first edition in 1984 are either no longer available or are not actively marketed today. They have been omitted but there are many others to take their place.



# Part 1

## The design of learning sequences

### INTRODUCTION

Training is very fashion-conscious. A bewildering (and expensive) variety of techniques and apparatus has appeared over the past 25 years to baffle or entice trainers and their bosses. This part of the book deals with a procedure for course design which is not new – although it may be to some – but which seems to work.

The underlying standpoint of this procedure is that effective occupational training is performance-oriented. In the words of one writer:

It is not what is presented to the student but what the student is led to do that results in learning.

Whether you choose to file this under the 'active response principle' of old-time programmed instruction or under the effects of questioning on student retention in the more recent mathemagenic research tradition, or under the new interest in levels of processing in the most recent cognitive research, the principle is axiomatic. One way transmission to passive audiences is passé in all media.<sup>1</sup>

The design procedures outlined in Part 1 lead to the development of interactive learning sequences for students working individually to improve their performance. These procedures may appear unnecessarily detailed to some. However, they have been written for the trainer with little or no previous experience of authorship of self-instructional courseware. The experienced classroom instructor, however able he may be, will find that the development of individualized materials is not simply an extension of what he does already. His absence from the scene when the student confronts his course means that the quick-wittedness and flexibility he customarily employs to deal with misunderstandings and wrong sequencing in group instruction count for nothing. He must plan carefully the content and sequence of the lesson relating these features to the learners' existing capabilities and steering towards a clearly-defined goal.

We hope that the procedure we describe will assist authors to these ends. They do not constitute an inviolable rubric; features may be adapted or pruned to suit personal styles and circumstances. We do suggest, however, that the major steps comprise a planning routine which it would be risky to ignore.

<sup>1</sup> *Teaching Conceptual Networks* Susan M Markle, NSPI Journal, February 1978



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# 1. Analysing performance and setting objectives

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## INTRODUCTION

Computer-based training (CBT), like other forms of individualized learning, is a manifestation of training technology. Technology is an overworked expression and open to several interpretations. For many people, understandably, it suggests machines and apparatus, and certainly the work of the educational and training technologist often requires the use of mechanical devices. Yet the educational technologist's own definition of his technology is unlikely to refer specifically to machines. It is more likely that he will concur with Professor J K Galbraith in that:

Technology means the systematic application of scientific or other organized knowledge to practical tasks.

Its most important consequence, at least for the purposes of economics, is in forcing the division and subdivision of any such task into its component parts.

Thus, and only thus, can organized knowledge be brought to bear on performance.<sup>1</sup>

In educational and training technology this process of dividing and subdividing problems and subject matter is known as task analysis. The planning stages of training design – of which task analysis is one – are well known to experienced trainers from textbooks, pamphlets from training boards and other bodies. Figure 1.1 is a general summary of the course design process.<sup>2</sup> Implicit in this figure is a point fundamental to the whole training process. A training scheme is developed to solve a problem. Training problems are usually caused by inadequate or deficient performance. Courses are designed to enable their participants to acquire the capability or the knowledge necessary to enhance the performance of their duties and thus make good the deficiency.

To restate this point one might say that without training, the participants could not perform the task demonstrated in the training course even if their life depended on it. This rather melodramatic phraseology is chosen to stress the point that training, computer-based or any other, should be considered a last resort.

<sup>1</sup> *The New Industrial State* J K Galbraith, Penguin Special, 1974

<sup>2</sup> Adapted from *The Sheffield System* E Hudson, PAVIC (revised edition in print)

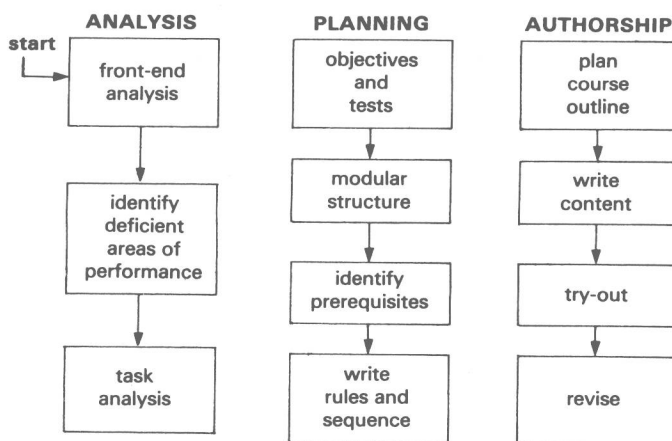


Figure 1.1 The steps of training design

## IDENTIFYING TRAINING NEEDS

### Front-end analysis

#### *Reactive*

As we have stated, training serves to make good deficient performance. This is the focus of the first step in our flowchart. A detailed description of the techniques involved in this stage of training development is beyond the scope of this book.<sup>1</sup> However it will suffice to say that the main function of front-end analysis (otherwise known as pre-analysis, diagnosis or training needs analysis) is to identify deficient performance, establish its cause and to propose an appropriate solution. That solution will often be something other than training. Occasionally people fail to perform adequately because their work is unpleasant or unrewarding or because their working environment is unsatisfactory. In other cases they may never be told how their work fails to meet standards or which jobs have priority. In these sort of circumstances the problem may be rectified by one or more of a variety of solutions, any of which is probably less costly than training. These solutions may range from redesigning the job, apparatus or documentation, to providing a regular system of feedback on achievement. The only grounds for contemplating training would be where inadequate performance is caused by a genuine lack of knowledge or skills. Even here suitable alternatives may suggest themselves. (One such alternative might be to recruit staff whose experience includes the understanding and capability currently lacking.)

<sup>1</sup> cf *Training Needs Analysis* T Boydell, BACIE; *An Ounce of Analysis is worth a Pound of Objectives* J H Harless, Stipes Publishing; *Analysing Performance Problems* R F Mager, P Pipe, Fearon

*Proactive*

The procedure employed to analyse problems of inadequate current performance on existing tasks may be called reactive analysis. A slightly different circumstance occurs when one is faced with an impending performance problem as a result of the introduction of new systems or procedures. The analysis employed to explore this kind of problem we may call proactive needs analysis. In these circumstances it may well be that few, if any, of the existing staff possess any relevant knowledge or skill. It would be rash, however, to conclude that the firm would therefore need to provide equal training for all its staff.

Consider for example the change to decimalization in the UK in 1971. This innovation impinged upon a wide variety of skills such as change-giving, writing invoices, calculating and verbal skills. Conventional, group-based training was quite inadequate to cope with the situation. The student numbers were too vast and the subject experts non-existent. As a consequence, many companies commissioned self-instructional packages or instructor-support kits to send out, comprising all the necessary lesson plans, exercises and aids for local supervisors to conduct their own training.

A common characteristic of such prestructured materials was their modular format: they were designed in units or blocks reflecting particular skills or tasks. Trainees received only those modules relevant to their own work. Ten or 12 years after decimalization this approach has become so commonplace that it hardly seems worth mentioning, yet those who were involved in training for decimalization may recall how prominently modularization featured in articles and promotional publications about the training packages. As we shall see, the modular structure is particularly suitable for administration by computer.

## **TASK ANALYSIS**

Over the past 30 years many techniques have been devised to help course designers analyse, sequence and define the content of their lessons. These techniques are often grouped under such headings as Instructional Systems Design (USA) or Training Design (UK). The inevitable elision to an acronym like ISD implies – as do PERT or CPM – a coherent and articulated set of procedures which can be applied consistently to a variety of problems. If only that were so. Unfortunately a technique which works well for procedure A adapts with difficulty to topic B or seems to require the expense of a lot of time to tell you something you knew already.

Nevertheless we think it worthwhile to introduce a limited range of such techniques. We shall try to suggest how each may be most profitably employed. However, it will be for the course designer to experiment with them whenever the opportunity occurs. Only in this way can a feel for a technique be acquired.

### **Getting started**

When the prospective course developer has identified a subject, procedure or



A radio and television service technician may be required to install, maintain, and service amplitude and frequency modulated home and auto receivers, transistorized radios, monochrome and colour television systems, high fidelity amplifiers, and tape recorders. He is able to read circuit diagrams and codes of values and to select component substitutes.

The radio and television service technician's work requires meeting the public both in the repair shop and on service calls. In order to service home receivers or equipment, he may be required to drive a car or truck. He must be able to tolerate heights, as antenna installations on rooftops are often an everyday occurrence. A service technician who establishes his own business must be able to know how to maintain business records and inventory.

**Figure 1.2a** Job description: radio and television service technician

Source: *Developing Vocational Instruction* R F Mager and K M Beach, Fearon

Bridge is a card game played by two opposing pairs.

The game has two major phases. In the first, bidding, a player attempts to agree with his partner 'a contract' to win a number of tricks (seven or more) in each hand dealt. In the second phase the partnership bidding to the highest level attempts to win the contracted number of tricks. For every trick each player plays one of his 13 cards. The highest card played wins.

In the bidding phase, since each player's cards are concealed, partnerships must have a system of evaluating hands and indicating their likely strength through the bids made. In play it is important to remember the cards played and note other clues to the likely distribution of the opponents' cards.

**Figure 1.2b** Topic synopsis: bridge

The plug wiper is employed in the service department of a large departmental store which sells and repairs electrical equipment of all kinds. He connects plugs to the power leads of all new equipment and replaces faulty plugs on items returned for servicing and repair.

The power leads are two or three-core flexes coded to both the old and the new standards.

**Figure 1.3a** Job description: plug wiper

other deficient area of performance for which a course of instruction seems called for, a useful first step is to summarize the topic in a brief synopsis. In occupational training this step is usually called the job description. The aim is to clarify your thinking about the topic. The synopsis should be written so as to explain the requirements of the job or the scope of the topic as if an entry in an encyclopaedia or similar work of reference.