COMPUTERIZED TRAINING SOLUTIONS AT GLAXO PHARMACEUTICALS

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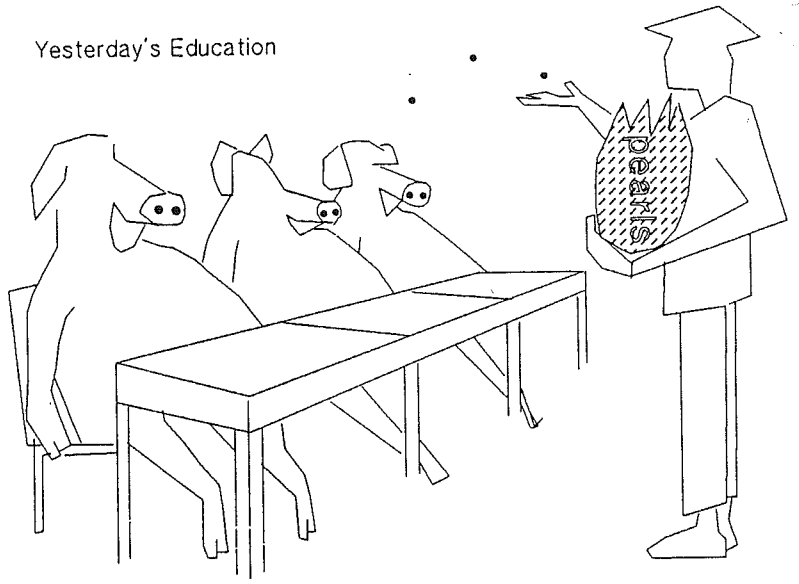


The pearls of wisdom

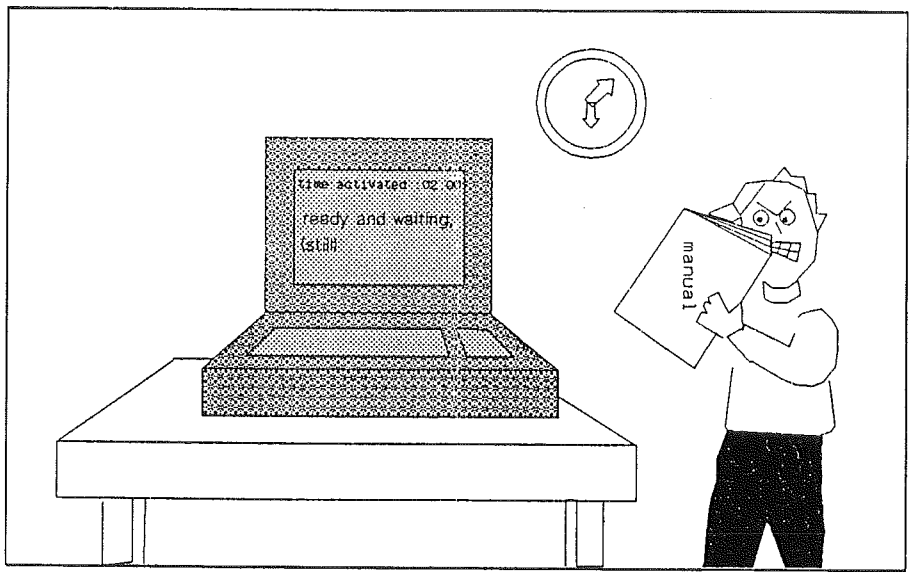
1. INTRODUCTION

Glaxo Pharmaceuticals is a company of over 5,000 employees located on four main sites in the UK. Three sites are concerned with manufacturing, whilst the fourth, at Greenford (London), is the marketing, management, administration and service centre for the firm in the UK. In recent years, a number of initiatives have been made in providing computerized solutions to training needs—training in marketing, production, management and the use of computers. It is these that are the subject of this paper.

These solutions, which concern the use of computer technology in one way or another, are dealt with in three sections. First, the development of computer-based training in the company is examined and certain guidelines for those wishing to undertake CBT in a similar organizational context are outlined.

Section 3 then discusses a range of presentation systems that speed and improve the use of computer-generated images for training purposes, whilst Section 4 makes some brief comments on new technologies that are improving the transportability of computer systems for training use. Finally, Section 5 attempts to summarize some of the salient points that recur throughout the paper.

Acknowledgement is given to the contribution of Allen and Hanburys, Glaxo Laboratories, Duncan Flockhart and Glaxo Pharmaceuticals' Technical Directorate in the design of CBT packages referred to in this paper. Due acknowledgement is also given to Sanjay Misra and Dr Lindsey O'Callaghan for their contributions to this paper (1), particularly in section 3.



A training requirement

2. COMPUTER-BASED TRAINING

2.1 Background

In the late 1970s, a new Information Technology strategy was introduced in Glaxo Pharmaceuticals for the company's major data processing and telecommunications functions. A network of Hewlett-Packard minicomputers was installed linking the company's four sites at Greenford, Ware, Barnard Castle and Speke. The introduction of over 1000 on-line programs over the next few years created a need for rapid and effective training, and it soon became clear that there was considerable scope for developing CBT packages to run on the new network. Although some programs were produced, the initiative was somewhat restricted by the lack of an adequate authoring tool, and the absence of a suitably staffed unit to undertake such work. By mid-1985, 8 packages had been produced (mainly concerning the use of computer systems), and were available on the company's 1500 terminals linked to the mini-computer network.

In 1985, the technical and administrative environment surrounding CBT in the company changed significantly. Hewlett-Packard, the company's chosen hardware supplier, introduced an IBM compatible personal computer (the Vectra) into their range. This machine could also be used as a terminal in the HP3000 network and ran the vast majority of micro-software running on 'IBM compatibles', including a plethora of CBT authoring systems. Many of the company's computer users, especially those in the central service units, started to use Vectras as dual purpose terminals/pc's. At the same time, managers in the company's sales, marketing and medical divisions were becoming increasingly interested in the potential of CBT and interactive video for a number of uses, including the training of sales representatives and diagnostic aids for medical training.

Indeed, in 1983, outside consultants had been contracted to produce an 'expert system' on bronchial hyperreactivity to be used in the training of doctors. The system, called ADEPT, runs on IBM pc's with special touchscreen facility, and incorporates interactive video sequences held on laserdisc. This, however, had proved a relatively expensive venture.

In 1985, a new unit, called End-User Support, was set up in Management Services Division with two main functions. First, the unit was to manage the purchase, installation, training and support for all micro-based office systems in the company; and second, it was to respond to the growing need for CBT by finding appropriate CBT software tools and developing the capability to produce packages to order for CBT users in the company. Although there were only two staff in this unit when it was founded in September 1985, these were critical changes that collectively gave the development of CBT in the company a significant boost: the newly available software tools and new administrative unit meant that Management Services Division were now geared up to respond positively to the small but growing demand for CBT in the company as a whole.

2.2 Package Details

Since October 1985, some 20 CBT packages have been produced by the End-User Support Unit, who gained another staff member to work exclusively on CBT in August 1986. The full list of packages produced to date is as follows:

The Human Body
Anatomy of the Respiratory System
Pathology of the Respiratory System
Anatomy of the Cardio-vascular System
Product Knowledge
Becotide
Ventolin
Competitors to Becotide and Ventolin
Allen and Hanburys Minor Products
Eudemine

Product Quizzes
Glaxo Laboratories Products (Zantac, Ceporex, Topical Steroids)
Cephalosporins 1 (Ceporex, Fortum, Zinacef and general)
Cephalasporins 2 (Fortum, Zinacef)
Miscellaneous
Respiratory Care Team Package
Dynamic Territory Management
Diagostic Aid for Asthma—Pilot Project
An Introduction to the Vectra PC
Production
Packaging Line Security
Permit to Work and Clearance Certificates
Getting Results and Solving Problems
Subject Overview
Principles of Result-Getting
A Problem-Solving Method

The first package produced (Eudemine product knowledge) was authored with DOMINO, which was purchased as a temporary expedient whilst a more in-depth review of available packages was undertaken. DOMINO's graphics capability was somewhat limited when compared with other systems and answer-judging was cumbersome and restrictive. In particular, the system allowed for only one answer input per screen; and the print-out of student response included *every* student input on *every* screen. It was thus necessary to sift through a large amount of irrelevant information to get an analysis of student performance. (It should be pointed out that these shortcomings have, in part at least, been rectified in the DOMINO 2 release of the product).

Several alternative systems were looked at in detail, the final choice lying between MENTOR 2 and TENCORE. MENTOR 2 was generally more user-friendly, but this was not *that* important as CBT packages were to be authored by data processing staff, rather than by end-users. Education Technology, who marketed TENCORE in the UK, appeared to have stronger links to related technology manufacturers (interactive video/CDROM/image capture), and offered an advanced product with a clear commitment to on-going development, customer support and training. TENCORE was purchased and has been used since as the standard authoring package for CBT development.

2.3 Future Directions

The success of CBT to date has ensured a burgeoning demand for new projects. The modest start with Allen and Hanburys has developed into a multi-project programme involving all three marketing subsidiaries, other divisions in Glaxo Pharmaceuticals and a number of possible projects for other companies in the group. Future work will thus encompass a broader range of subjects, and will see changes in both the technology and techniques used in CBT modules.

The potential of *interactive video* for training purposes is well known, but doubts remain as to its cost-effectiveness versus other CBT formats for all but very special cases. One of the major ingredients for success in the development of CBT at Glaxo Pharmaceuticals has been the 'transportability' of course material. Modules have been duplicated on floppy disc, and run on micros in a range of different training situations. Although this hardware has often had to be moved, never has new hardware been purchased for the running of CBT packages alone. (This excludes, of course, the ADEPT system mentioned above). Management Services Division have been in an ideal position to stage-manage the execution of training because of their control of company computer hardware. At the same time, a mode of practice for standard (i.e. non-interactive video) CBT is now well established, in which the time and resources required can be accurately estimated.

The incorporation of interactive video into CBT packages has major implications for resource requirements for CBT. Interactive video involves the extra costs of filming and mastering in development; and there are the overheads of setting up interactive video workstations for CBT delivery, which users would have to justify. When this has been pointed out to users, it has to date discouraged them from pursuing the IV option.

In this section there are two lists. On the left is a numbered list of trade names and on the right is a lettered list of generic names. A manufacturer's name will appear above the lists. At the ▶ symbol type in the appropriate number and letter and press ENTER.

Bristol-Meyers 3a

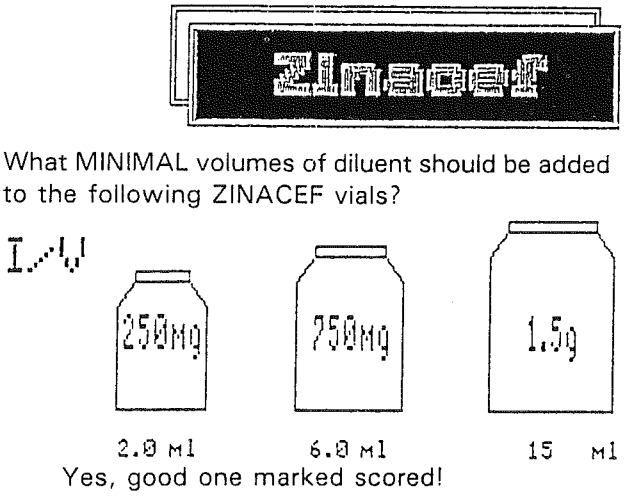
1. Moxalactam	A. Metronidazole
2. Flagyl	B. Latamoxef
3. Amikin	C. Gentamicin
4. Baypen	D. Mezlocillin
5. Cidomycin	E. Amikacin
6. Ticar	F. Piperacillin
7. Pipril	G. Ticarcillin

You got the trade name right.
The correct generic name is amikacin.
Press ENTER to continue.

Glaxo Labs product quiz: multiple answer-judging on one screen

Nevertheless, should there be a top-down decision to pursue CBT in a systematic way throughout the company, then it may well be that open-learning centres will be established on all four sites with workstations specifically set up for training purposes. These would likely include laserdisc players and high resolution monitors and give a clear impetus to IV development, with the 'delivery infrastructure' in place. This may well come as a consequence of the growing importance of CBT in the company, and the need for the training departments to get involved.

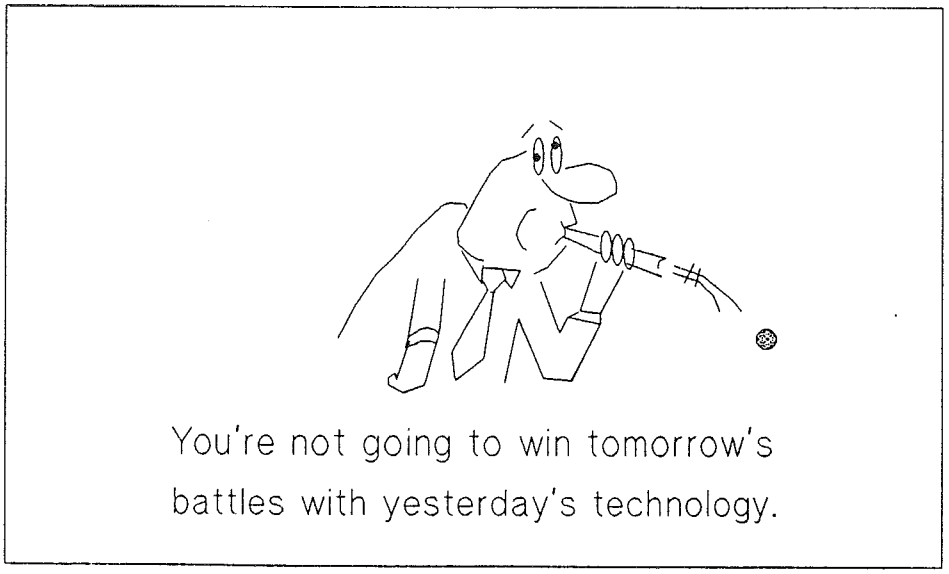
To meet this possible eventuality, an IV pilot project has been undertaken by End-User Support, using a copy of the laserdisc used in the ADEPT system. New graphics overlays have been added, and example Q and A formats have been set up with branching to text and IV sequences. This has been used to demonstrate 'what could be done' on future projects; but to date, no such 'threshold project' has been forthcoming, and is unlikely to come about until permanent CBT workstations are established.



The Glaxo Labs product quiz: more interesting and imaginative Q and A formats

So, interactive video production requires a range of skills and resources that even large companies may not have, if they intend to undertake projects by themselves from the conceptual stage all the way through to implementation. What is more likely in the immediate future is the embellishment of standard CBT with *digitally stored images*. This means that photo images can realistically be stored on magnetic media (i.e. hard or floppy discs), and incorporated into CBT packages. A pilot project has again been undertaken using an analogue RGB video camera system and interface board supplied by VISAGE. There have certainly been some 'teething problems', including the inadequacy of support software (now largely rectified) and a degree of 'image shimmer' on screen. With each image occupying around 50K, it is now feasible to include 10 to 15 digitally stored images on a 1.2 megabyte floppy (the standard disc-drive size on Glaxo Vectras), and still have enough room left for the program. A project using digitally stored images of skin disorders will be completed this year (1988).

A further technological development of relevance has been the advent of *CD-ROM and optical disc storage*. These can already be used for data and image storage, but are unlikely to make much impact in a CBT context until larger disc storage capacities are required. If there is a rapid development of CBT (and/or expert systems) using digitally stored image and/or voice files, then increased storage requirements will justify the use of such discs (limited to Write-Once-Read-Manytimes at present). CD-ROM to date has been jointly developed by Philips and Sony and has recently been rechristened *New Papyrus*. It is identical in appearance to its cousin, the audio compact disc, and boasts some 600 Megabytes digital storage capacity. This equates to some 250,000 pages of text or approximately 500 books. This is equivalent to some 1500 single sided floppy discs or thirty 20 MB hard discs! Up to 40 hours of 'telephone' quality sound can be stored. This reduces to about 17 hours of FM quality sound. Any piece of information can be located and displayed within 1-2 seconds.



Requirement for new technology

Retrieval is accurate down to one byte of data or 1/75th of a second of audio.

New developments should also see *improved presentation and structuring techniques* as CBT is used for a wider range of subject areas and in more varied learning environments. More imaginative and interesting Q and A formats, more thought-provoking and stimulating text presentations, better graphics and more sophisticated operational procedures should all be achievable as the technology improves. These developments in technique could well include 'expert system' like functions, with packages running in either 'learn mode' (i.e. as a conventional CBT package) or 'advise mode' (rather like the type of package produced by many of the expert system shells currently on the market).

Authoring tools themselves are forever evolving. As technology-based training methods incorporate an increasing number of training media (i.e. interactive video, interactive audio, digitized image capture . . .) the authoring tool producers are continually upgrading their systems to accommodate them. Authoring systems are evolving into authoring *environments*, providing CBT designers and producers with an increasing number of links or 'hooks' with which to control any peripheral device/media attached to the basic computer. Windowing facilities are also being provided to give added flexibility, speed and user-friendliness. Such systems currently under development include TASTE and OMEGA.

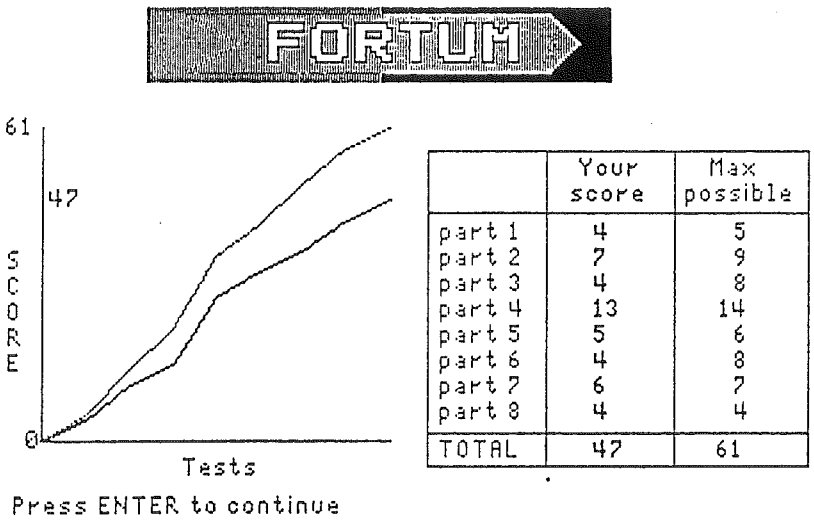
2.4 Guidelines for CBT Development

Getting CBT underway in a company environment will normally require certain prerequisites to be met concerning management support and finance. These equally apply to other technologies covered in this paper and so are dealt with in the final summary section. Assuming these are met, the following guidelines may be of use as a check-list for progressing CBT development.

1. Consider the man-machine interface (i.e. the logistics and management of CBT delivery). Find answers to the following questions:
- —Where will CBT be run?
- —Will there be training workstations in a training centre, or will multi-purpose micros or terminals be used?
- —Will it be feasible to use laserdisc players for CBT delivery?
- —Who will administer training sessions?
- —Who will pay for any hardware required?

2. Select an appropriate hardware configuration. Try to find a solution that keeps options open for upgrading delivery workstations if need be at a later date. Key questions include:
- —PC based or mini/mainframe computer?
- —If, as is increasingly likely, a micro solution is sought, will IBM compatibles be used? (What does your company already use?)
- —Will laserdisc or videotape players along with requisite interface boards and monitors be needed?
- —Will EGA boards and monitors and pallet cards be needed for displaying digitally stored photo images?

3. Select an appropriate authoring tool. Key considerations here include:
- —Ease of use (will authors be trained programmers, trainers or content experts?)
- —Cost? What can your budget stand? You can pay between £400 and £7000 for micro-based authoring systems, and more for mainframe systems.
- —What answer-judging, branching and rerouting capabilities are needed?
- —What degree of sophistication in graphics is needed?
- —Is software support for IV and image capture required?
- —Are there royalties or overheads to pay software suppliers for copying and distributing packages and/or increasing the number of delivery stations?
- —What commitment does the software supplier have to future development, and customer support and training?



	Your score	Max possible
part 1	4	5
part 2	7	9
part 3	4	8
part 4	13	14
part 5	5	6
part 6	4	8
part 7	6	7
part 8	4	4
TOTAL	47	61

Student feedback: graphically portraying student performance

4. Choose CBT staff carefully
—What qualities are required?
—What training will they need?

5. Market the CBT concept (and develop the market). It is no use sitting around expecting users to become aware of the potential of CBT. Once you have a good product, go for maximum exposure. Some excellent ideas are never carried through to fruition because of poor marketing. It might be worth asking:
—Who else in the company should know about CBT?
—How are you going to tell them?
—What training requirements are 'ripe' for CBT treatment and how can development best proceed?

6. Work closely with end-user management in development and delivery of CBT. A good working relationship with end-users is likely to be vital in CBT projects, especially if the idea is growing 'organically' in the company, rather than in response to a top-down decision to 'get on with it'. Considerations include:
—Who are the key end-user managers whose support is needed to get a CBT project authorized and financed?
—Who are the end-user content experts and how can you best work with them in prototyping the package?
—Whose help and cooperation do you need in arranging the running of CBT sessions?

3. COMPUTERIZED PRESENTATION SYSTEMS

This section deals with a range of computerized systems that facilitate the presentation of computer-generated images and displays for training purposes (in its widest sense). These encompass dynamic electronic presentations as well as slide and overhead transparency generation. Desk-top publishing systems are also mentioned.

3.1 Image Design and Projection Systems

In 1986, the VideoShow presentation system was marketed for the first time through distributors in the UK. This system comprises the following:

(a) Presentation Design Software
There is a range of software packages available that are compatible with this system, but the main two are PICTUREIT and FREELANCE. They run on IBM pc compatibles. PICTUREIT enables the user to design bar, pie, line, organization and word charts in a range of pre-determined formats. It is extremely easy to use and contains sufficient variety to facilitate the design of a reasonable presentation.

For the more specialized needs, FREELANCE PLUS can be used. This is a freeform drawing package, with a range of icon libraries, and can be coalesced with PICTUREIT images. Graphs can also be imported from other software packages (including Lotus 1-2-3 and SYMPHONY) or plotted in FREELANCE PLUS, GRAPHWRITER or PICTUREIT direct from information held in spreadsheets. Standard 80 column 25 line text screens can also be converted to VideoShow format and edited using VIP.

(b) VideoShow presentation system
Having prepared the presentation with software running on the pc, the pc can now be forgotten, for the time-being at least. Armed with the floppy disc containing the VideoShow images and the VideoShow presentation hardware, the presentation can be given to a large audience via a projector (e.g. Barco Data 3 or Electrohome ECP 2000) or a colour monitor for smaller audiences. The wide range of colours available (1000) as well as the range of formats available make this a convenient way to present material suitable for a 35 mm slide presentation.

The obvious advantages include the portability of the presentation (one floppy disc can hold as many as 200 images) and the fact that the presentation is always in the correct order, the right way round and there are no focusing problems. (Ease of editing will be dealt with in the following section.)

The main disadvantages are that the hardware is not always easily available and that photograph style images cannot be generated. Now, however, with the new Videoshow Professional, photographs can be scanned in and incorporated in such presentations.

3.2 Slide and Overhead Acetate Design and Production

The inherent disadvantages of using VideoShow are overcome, in part, with the PhotoMaker (35 mm slide preparation system) and PrintMaker (overhead and paper hardcopy printing system) options.

PhotoMaker allows a VideoShow presentation to be converted to high quality 35 mm slide format using standard colour transparency film (e.g. Ektachrome 200) together with the VideoShow computer and a CRT camera. A new system, Photometric, allows slides of even better quality to be generated direct from the design pc. Both these systems have the basic disadvantage that only PictureIt compatible software graphics can be used for slide production. With Videoshow Professional, slides can also be made from images scanned in or captured with an RGB video camera.

Other software graphics can be photographed direct from the pc, albeit at lower quality, using the Polaroid Palette camera. Using this equipment virtually any IBM compatible software can be used to generate 35 mm slides.

Generating 'in-house' 35 mm slides has many distinct advantages over going to outside specialists, the most important of which is cost. Here is a short case study.

Three hundred and seventy two slides were produced with Photomaker from February to June 1987. The cost of the film used was £78, thus the cost per slide was £0.21, excluding staff time and photographic developing. This compares favourably with a MINIMUM cost to produce one 35 mm slide through a commercial agency of £7 or £8 (a cost which excludes artistic design and courier fees). At £8 per slide the cost to Glaxo would have been £2976. The cost of the PhotoMaker camera and software is £2631

(before any corporate discount which might apply), i.e. the system paid for itself within 5 months (through producing just a small proportion of the slides used at Glaxo).

The figures in brackets include the cost of IBM CGA card and monitor required as Polaroid Palette would not run off the HP multimode card used at Glaxo in 1987 (although the new release of Polaroid Palette will now do so). The break even numbers are calculated using a commercial cost of £8, the actual cost of £0.21, and disregard the cost of pc, VideoShow, design software, pc-user time to design slides. These extra costs will be offset by reduction in costs of graphics designers, couriers etc

Comparative costs	Photo-Maker	Photo-Metric	Polaroid palette
Cost	£2631	£5760	£1685 (£2283)
Slides to break even	338	734	216 (293)

There are some disadvantages using these systems: There is a slight loss of photographic quality compared to good agency produced slides and there are limitations to what the software can produce. Improvements in both hardware and software are reducing the importance of these problems. Also, not every pc user has the skill or taste to produce good colour images.

The advantages of using this technology, other than cost, outweigh the disadvantages. The average presentation of 20 slides takes about 3 working days to produce from scratch (we have done it in one) and repeat copies can be produced in less than 6 hours. The software is very easy to use (especially PictureIt) and takes very little time to master with non-computer personnel able to produce excellent results after only 4 hours experience. Editing is simple and very rapid thus allowing managers and trainers to take an active role in the artistic design and editing of their slides. Edits to discs have been executed within 10 minutes of presentations starting and during the process of slide shooting. Since the whole process (including photographic developing at Glaxo) takes place on site, sensitive information remains secure.

PrintMaker is a system which allows paper or overhead acetate hardcopy of VideoShow images to be produced using a colour inkjet printer (e.g. Xerox 4020). The quality is very good but the system is less cost effective than the PhotoMaker and the printing is slow with manual paper/acetate feed. Advances in technology are occurring and the newly available PrintMaker C allows autofeed and uses a high quality printer (Calcomp PlotMaster).

3.4 Desktop Publishing

With PhotoMetric and PrintMaker C turning the pc into a desktop graphics design station producing courseware for training presentations, one forseeable development in the use of technology related to training will be printing manuals and course-ware within the training department. Desktop publishing packages, (e.g. Ventura, PageMaker) with their ability to manipulate wordprocessed documents, monochrome graphics and simple pictures reproduced using scanners (the quality is still fairly basic), can already be used to produce these in black and white. Improvements in picture quality and the ability to reproduce colour images will, when available, allow the training departments to control the production of all course materials from a single pc workstation.

3.5 Overhead Projection of the PC Screen

In many training applications, it is desirable to display the actual pc screen to a large group of students. This is especially true when training students to use systems specifically developed in-house. Training manuals or print-outs of screen dumps are often not sufficiently clear and are by their nature static.

Projection of the pc screen via large projector (e.g. Barco or Electrohome) can overcome this problem but the projectors are difficult to set up and are rarely available (their high cost is often difficult to justify in a training environment). Overhead projectors are, however, commonly available and several liquid-crystal display systems have been developed (e.g. Kodak Datashow) which reproduce the pc screen via an overhead projector.

4. TRANSPORTABLE TRAINING

One of the main advantages frequently cited for computer-based training is that it allows the students to work when and where they want to and at their own pace. It is, therefore, ironic that courses involving an element of cbt frequently take place at fixed times and in set locations with a limited amount of time to complete the course. This is often a function of the limited availability of the equipment (does everyone have unlimited access to a pc?) and its lack of portability (how portable is your pc?).

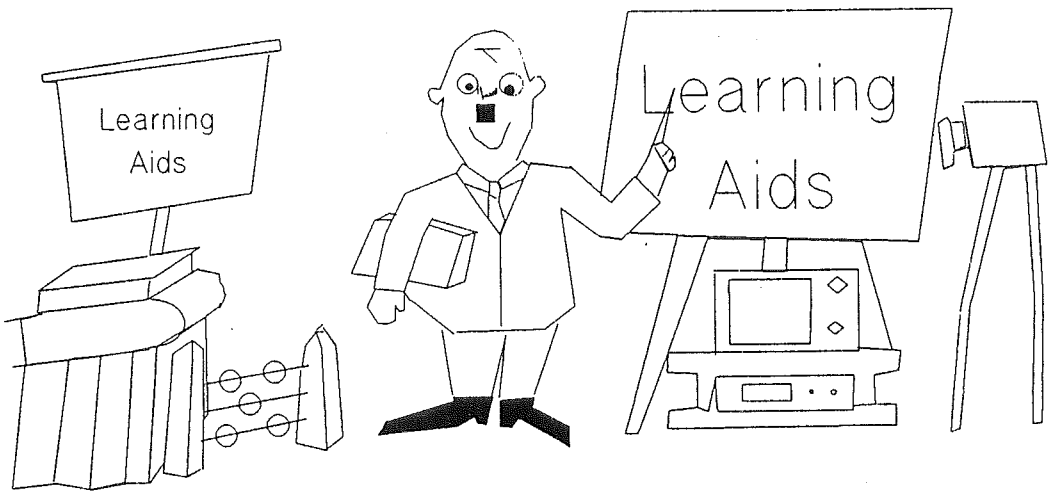
In companies with a large field force (e.g. sales reps), it may make sense to issue portable pc's in large numbers. Once this has occurred, training packages on floppy disc can be quickly and easily sent out to the field force allowing them to access the course material when and where convenient to themselves.

The developing technology in smart cards (e.g. GEC Card Technology) has some implications in the field of training. Firstly, the cards can hold educational records (courses attended and when, course assessment etc). With even fairly small memories the cards themselves could hold the course-ware with several advantages. The cards are less fragile than conventional floppy discs, an important consideration in field training. They also occupy less space and will not constrain the physical size and shape of course-ware as some disc systems do at present.

This increase in the portability of training will have profound implications for its format. Increasing reliance on disc (or card) based courses and emphasis on distance teaching skills may require major changes in the course-ware, equipment and personnel used in training departments.

5. CONCLUDING REMARKS

The development of computerized training solutions at Glaxo has highlighted certain issues which are pertinent



Training media

to outline in conclusion. These are likely to be of particular interest to those working in similar organizational situations.

There would seem to be certain *basic pre-requisites* for using new technologies for training in an organization such as Glaxo. First, there must be *appropriate training needs*. This might seem to be stating the obvious, but certainly not all training lends itself to CBT, for example. CBT can never fully replace all other training formats; rather, it needs to be seen as one component of training, and it is clearly critical to identify appropriate subject matter. Using *new technology* for *new technology's* sake is unlikely to be successful. At Glaxo, Management Services have attempted to show what is possible, and to evaluate different options for using new technology in training; but each project has been undertaken specifically on the request of users, who have themselves identified specific needs for which computerized solutions have been provided. Indeed, at times, non-computerized solutions have been suggested, and are still used extensively throughout the company (2).

Second, *support from top management* must be forthcoming if any lasting impact is to be made. Small initiatives can be made by DP and training staff working as it were, 'in their own time', but at the end of the day finance and time will have to be set aside if any significant role is to be played by in-house staff. At Glaxo, support from the Management Services Director for using new technologies in training was critical in getting the initial pump-priming finance for setting up CBT evaluation and pilot projects, and support from end-user management has come in the form of requests for more work.

Closely linked to management support is the *need for adequate manpower*, which has already been mentioned. It is important to note the need for high calibre staff if any of these potential new developments are to be realized. The market place is a little contradictory in its valuation of micro-computer specialists (cf. mainframe analyst-programmers), but the indications are that micro-specialists will increasingly be able to command higher salaries because of the current skills shortage in this area and the growing importance of micro-based systems in data-processing in general. At Glaxo, we have been fortunate in having two excellent CBT designers/programmers in-house to undertake the bulk of work completed to date and provide support on systems such as VideoShow. Suffice it to say that CBT content design and programming, if undertaken as one function, as has been the case at Glaxo, requires a mix of skills not normally held by either training officer or analyst programmer. Some retraining will almost certainly be required, and attributes such as flair, imagination and aptitude to learn quickly are particularly important.

It is hoped that this paper may help others in their efforts to provide new and improved solutions to training needs in a commercial environment. The paper reports on experience gained in the implementation of computerized solutions at Glaxo Pharmaceuticals over the past 2 years, which, it is hoped, has been as rewarding for the students as it has been for those involved in technology research, development and implementation.

NOTES

1. See M. Wynn, S. Misra and L. O'Callaghan, 'New Technologies in Training', Proceedings of the 14th AIOPI Annual Conference, Brighton (1987), AIOPI (Association of Information Officers in the Pharmaceutical Industry), 1987.
2. See, for example, M. Wynn and N. Hiley, 'The MENTOR Game: Stock Control and Production Planning in Manufacturing Industry', *Journal of Industrial and Commercial Training*, Jan-Feb, 1988 (forthcoming).