



THE THREE-PRONGED COMPUTER-BASED  
COURSE DEVELOPMENT PROCESS

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TECHNICAL REPORT

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ABSTRACT

The development of computer-based training materials is at least as complex as the development of materials in other formats. Several different skills are needed, including subject matter expertise, instructional and media design, and computer programming. This paper describes the components of the required skills, explains why they are needed, and discusses how people who possess the skills interact to produce computer-based training materials at Digital Equipment Corporation.

### THE THREE-PRONGED COMPUTER-BASED COURSE DEVELOPMENT PROCESS

Development of computer-based training materials requires at least three types of expertise. Subject matter experts are needed who can understand the material to assure that the courseware is technically correct. Instructional media specialists are needed to assure that the computer media is used appropriately and creatively. And computer programmers are needed to assure that the processor is used efficiently and intelligently. For large projects, a project manager is also needed to set goals and schedules and to assure that there is ample communication between the various development team members.

This paper discusses the types of skills that each of these specialists possesses and how they work together to produce computer-based training materials at Digital.

#### Subject Matter Experts

While training course developers are the people who must teach others, there is seldom anyone to teach the course developers. At Digital, hardware and software training must usually be available as soon as the first systems are shipped to customers. Course developers must therefore be able to talk the language of hardware or software engineers and interface with them to extract the material that students need to know. These people must understand computer systems in depth, but they must also be sensitive to the needs of the target student population and sound educational practices.

Through interaction with many different people and prototype systems, course developers strive to become subject matter experts in the topic to be taught. They then work with the project manager and other team members to write "training specifications" for the courseware to be developed. These specifications include the objectives that students will be expected to achieve, an outline of the presentation strategy, and estimates of the project's schedule and costs.

Once the training specifications have been approved, the subject matter experts begin to develop materials for delivery via computer-based instructional techniques. In all cases, the subject matter experts review the technical accuracy of any materials produced independently by other team members.

#### Instructional Media Specialists

As an instructional medium, the computer has several unique characteristics. It can allow an instructional program to branch

from one lesson to another so that courses can be individually tailored for each student. Student responses may take many forms so that the system as a whole is "human-engineered" and provides a friendly environment conducive to study. And some of the characteristics of television can be mimicked by moving characters and graphics around on a terminal screen.

Effective use of these characteristics requires the skill of instructional media specialists trained in visual theory, human-engineering, educational psychology, and instructional systems development. The instructional media specialist works with the subject matter experts on an equal footing to plan the entire program and the types of interactions that students will have with the computer system.

As media specialists, these team members specify the type of media to be used for various topics (which may include non-computer media) and design displays for computer screens. As instructional specialists, they review the validity of the instructional strategies implemented by the other team members and administer developmental tests of prototype instructional materials.

#### Computer Programmers

There are a large number of computer-assisted instruction (CAI) "authoring languages" available on systems made by most computer manufacturers. These languages are usually designed so that they can be used by persons with little or no computer experience. When implementing large and sophisticated CAI applications, however, one often finds that these authoring languages are just not powerful enough or are too restrictive to do the types of processing needed. In addition, these languages often make inefficient use of the computer system.

Computer programmers are employed so that the full power of the host computer system can be exploited. The programmers may work in a high level authoring language, but they are expected to be able to use lower level languages, if necessary, to implement routines which the subject matter experts and instructional media specialists decide are necessary to achieve the objectives of the program. For example, in one of our computer-based courses we found it necessary to simulate the performance of the system editor under program control. While very difficult to do in the commonly available authoring languages, this task was programmed in BASIC-PLUS-2 with a reasonable amount of effort.

The presence of computer programmers to concentrate on implementation issues has other advantages. The subject matter experts are able to concentrate on what should be taught rather than how the computer will teach, and the instructional media specialists are able to concentrate on what is the most effective way to

present that material rather than how hard it will be to imple-  
ment that strategy on the computer. Programmers worth their salt  
never say "it can't be done", they just tell you that certain  
tasks take longer to program than others. It is the project  
manager's responsibility to set priorities and determine which  
strategies the team can afford to implement.

The computer programmers have one other very important job: they  
set up the database that will store student records and write  
routines to update and access this database. This task has  
received very little attention in the literature, but it is of  
vital importance to a fully operational computer-based training  
system. The programmers are expected to make the database man-  
agement portion of the system powerful and efficient. It must  
provide enough data to evaluate the system fully, but it must not  
restrict the course developers or get in the student's way.

### The Project Manager

The complexities of project management are often underestimated.  
Many steps are involved in bringing a computer-based training  
product to fruition. The subject matter must be researched. A  
proposal must be made to a funding agency. Plans must be drawn  
up and approved for technical accuracy and marketability. Sched-  
ules must be coordinated with various departments and persons  
outside of the authority of the training development organiza-  
tion. Instructional materials must be synchronized so that they  
look consistent, reviewed to assure that they meet applicable  
corporate standards, and critiqued for technical accuracy, in-  
structional validity, and presentation style. Packaging must be  
designed and arrangements made for course duplication. And  
finally, the product must be presented to the market through  
public announcements, brochures, and advertising campaigns.

The job of the project manager is to set schedules and manage  
progress toward each of the project's milestones. This involves  
working with each member of the team to determine individual  
capabilities and estimate the number of man-hours necessary to  
complete each of the project's component tasks. The project  
manager also coordinates the course development with related  
projects in other corporate departments and is usually the sole  
team member to deal with marketing issues. In addition, it is  
the project manager's responsibility to review all of the mate-  
rials produced by each of the team members to assure consistency  
of message and a smooth blend with other computer-based training  
products.

### A Team Process

Computer-Based Course Development at Digital is a team process.  
It involves the blending of many talents and the cooperation of

many people on a single project. The blend assures that the materials are not only technically correct and instructionally valid, but also that they make interesting use of the computer as an instructional medium and efficient use of the computer as a delivery system.