Academics Developing Media Materials: Learning from several cases

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Abstract
Developers of multimedia and hypermedia products in an academic institution face a different set of challenges than do those developing for a commercial market. Design criteria, for example, are often looser and budgets are definitely tighter. The administration of such projects also changes when students are involved, either as paid or volunteer participants.

The authors discuss their findings from several recent projects at Central Queensland University with special emphasis on their design and management experiences.

Keywords
interactive multimedia, hypermedia, computer-based education, instructional design, tertiary education

1. Introduction

Commercial developers range in size from small boutique operations with only one or two staff to megabuck software houses. In contrast, most university courseware development is done by individual academics or small groups working, at best, on limited development grants such as those administered by CAUT (Committee for the Advancement of University Teaching) in Australia. Such academic developers tend to be 'believers' and their level of personal commitment to a specific technique, product, or platform often approaches religious fervour.

Developers of multimedia and hypermedia products in an academic institution thus face a different set of challenges than do those developing for a commercial market. Design criteria, for example, are often looser with academics who are developing courseware preferring an iterative prototype approach and those with a research focus more likely to follow a software engineering approach with design criteria and storyboards prepared well in advance of any artistic or content considerations.

Budgets are definitely tighter than with commercial projects, if only because academic institutions tend not to fund speculative or development work. Of particular concern, academics do not budget very realistically about the time requirements involved. As the 1993 CAUT National Teaching Development Grants evaluation (Hayden 1996) indicates, staff generally 'had not allowed enough time for the range of other academic and personal responsibilities which might compromise timely completion of projects'.

Academic development projects may also use student labour, either paid or volunteer. Managing such staff, whether undergraduate or postgraduate, obviously leads to quite different challenges than managing a fully paid professional staff.

The computer-based projects with which the authors have recently been involved range from a $300,000 plus project for CAL/CML (computer assisted/mediated learning) development through more moderately funded single-product projects ($35,000 for an interactive multimedia package, for example) to an unfunded single-person project to prepare a multimedia guide to a university campus.

Fortunately academic institutions are places of learning and we like to think that we learn from our mistakes. Using examples from our projects we describe some of our findings and provide some suggestions for other academic developers.

2. Background

2.1 Computer-based courseware

Computer-based courseware is the latest instructional technology and, as such, builds upon earlier technologies such as programmed learning, instructional games and simulations, audio-visual materials, and more conventional paper-based materials. Computer-based courseware has several potential advantages over earlier technologies including

- interactivity;
- ease of revision;
- ease of use (single desktop presentation machine);
- high capacity;
- true multimedia capability; and
- ability to maintain records of use and success.

As any user of computer-based courseware will understand, however, every one of these potential advantages has a corresponding disadvantage. Courseware development is often time-consuming and expensive; the requisite hardware is also expensive and often not well integrated; and users are often not familiar with the use of technology and may even be intimidated by that technology. Interactivity is often minimised, revision becomes impossible, and courseware becomes shelfware.

Multimedia design technologies tend either to closely follow a software engineering design cycle or to emphasise less formal iterative techniques. While the former requires specifications and content to be fixed before coding the project, design changes occur continually within the latter as the content develops and user testing progresses. Neither approach provides timely completion or adherence to budgets.

The tools for computer-based multimedia development are also changing rapidly. In 1989 one of the authors began planning a major computer-based instructional change project. The limitations of the then current technology resulted in the project team writing in-house courseware development tools for lecturers to prepare their own teaching modules. While the barely affordable desktop Apple Macintosh computers of the time had very satisfactory graphics capabilities and could include limited video and animation, their displays were monochrome and disk capacities were limited.

Today, a similar educational change program could also choose between networked or CD-ROM-based courseware. The existence of related resources on the World Wide Web (WWW or the Web) and the Web's potential to reach into the home would also confront the designers with the necessity to make a decision about local or worldwide distribution. For an institution such as CQU, with its distance education emphasis, the decision would not be easy for all these technologies potentially provide realtime audio and video, realistic colour, interactivity, and easy communication between lecturer and student.

2.2 Central Queensland University

Central Queensland University (CQU) is a young regional multi-campus institution with almost 10,000 students enrolled across six faculties (Applied Science, Arts, Business, Education, Engineering, and Health Science). While retaining its concern for students from its beginnings as an institute of advanced education, CQU now has undergraduate and postgraduate programs as well as a research focus.

CQU currently (early 1996) has five campuses in Queensland—Bundaberg, Emerald, Gladstone, Mackay and the main campus in Rockhampton—plus international campuses in Dubai, Fiji, Singapore and Sydney. Approximately two-thirds of CQU students study through distance education.

CQU has an internationally recognised profile as a distance education provider and has long been a leader in the use of alternate delivery systems. CQU was, for example, the first institution in the world to offer professional computing at a distance. Many courses now use a variety of media techniques to deliver the instructional materials, including videotapes, tele- and video-conferencing, multimedia, computer-mediated communication, and the World Wide Web. A number of courses are provided through the Australian Open Learning and PAGE (Professional and Graduate Education) consortia.

Innovative technologies are not restricted to distance education at CQU. The Sydney Campus, for example, uses value added services such as individual and small group tutoring (both unit oriented and Communication and Study Skills) and the provision of computer laboratories to supplement TVI (tutored video instruction) tapes, distance education and other teaching/learning materials.

3. Some personal examples

3.1 Adapt the materials to suit the medium

Adapt the material to suit the medium, not the students to suit the programmer—that was the lesson one of the authors of this paper learned during the production of a hypermedia document. The Guide to Cane Mud Filtration was developed in cooperation with the Mackay-based Sugar Research Institute (SRI) to serve as a reference source for filter station personnel in Australian sugar factories. Much of the Guide's content, particularly the text, was adapted from an internal SRI publication.

During the early stages of the Guide's development, the 'logical structure of the printed material' was maintained in an attempt to 'exploit... any familiarity' users had with the original document as suggested by Bechtel (1990). When a logical unit of information could not be presented in its entirety on a single screen, the text was split at appropriate intervals and distributed over multiple screens. This approach to text conversion proved to be a mistake. Useability testing resulted in rejection of the Guide, testers claiming that it offered little, if any, advantage over the printed document.

A reason for the users' dissatisfaction was identified by one of the project supervisors [an author of this paper]:

> The bottom line may be that these materials illustrate yet again what I think you discovered, but may still not have accepted, in your first work with cane railway materials—text must be written differently for the two media (paper and hypertext) (Co-Supervisor 1994, memorandum, 14 March).

The hypermedia document seemed to have failed because the structure of the original printed document was maintained without considering that few documents are suitable, without extensive changes, for hypermedia implementation. As McLuhan might have observed, here was another example where 'the medium is the message'. It is also possible that the original document wasn't wonderful, but that everyone had simply accepted its limitations as being common to all manuals. However, the 'new' computer-based format may have led to a heightened scrutiny of the whole thing—a sort of Hawthorne effect.

The content of the Guide was later reorganised and rewritten with the assistance of a technical editor. Essential details were moved toward the top of the Guide's hierarchical structure where they could be found quickly and easily, and non-essential details were moved toward the bottom of the hierarchy where they were still accessible via links but would not distract users. The feedback from the users who evaluated the final version of the Guide was overwhelmingly positive.

The need to adapt the presentation to suit the medium was again impressed upon the Guide's adaptor when modifying a mathematical procedure for use in the Guide. In its original printed form the procedure took four A4-sized pages to explain but, when imported into the hypermedia document, was distributed over eight screens. One of the project supervisors found it difficult to follow the mathematical procedure in hypermedia form because of the additional fragmentation. It is worth noting that this individual was familiar with both the procedure and the mathematical techniques involved.

> I found it quite difficult to follow the maths, largely because it was spread over about 8 pages… I couldn't get all 8 pages on the screen at once but I can look at 2 A4 pages (Supervisor 1993, memorandum, 19 November).

The adaptor initially tried to dismiss this criticism by arguing that fragmentation problems are an inherent feature of all hypermedia documents:

> I agree that the calculations would be easier to follow if they all appeared on the same screen, but that's just not possible. Fragmentation is a problem that every hypermedia document suffers from. You have to strike a balance between chunking the information and maintaining the train of thought (Hypermedia Developer/Adaptor 1993, memorandum, 22 November).

He further argued that if a lengthy mathematical procedure was presented in a textbook, it would likely be distributed over a number of pages as well. The supervisor rejected this argument and asserted that hypermedia should make it possible to present the mathematics in a form that is superior to a textbook.

Ultimately, the eight-screen procedure was replaced with a single screen containing a schematic diagram of the process and links to relevant mathematical calculations. Figures within the process diagram served as anchor points. Clicking on the figures with a mouse pointer triggered a pop-up window containing an explanation of how that figure was calculated as well as links to related calculations (see figure 1).

In both of these instances, the key to producing an acceptable presentation was adapting the material to suit the medium. As Humphreys (1994) puts it:

> You cannot expect to display paper documents online with a few minor tweaks here and there. You must design hyperdocuments to be hyperdocuments.

The difficulty was that the adaptor, a postgraduate student, had both development and research objectives to fill with an inadequate background to adequately perform all the roles required.

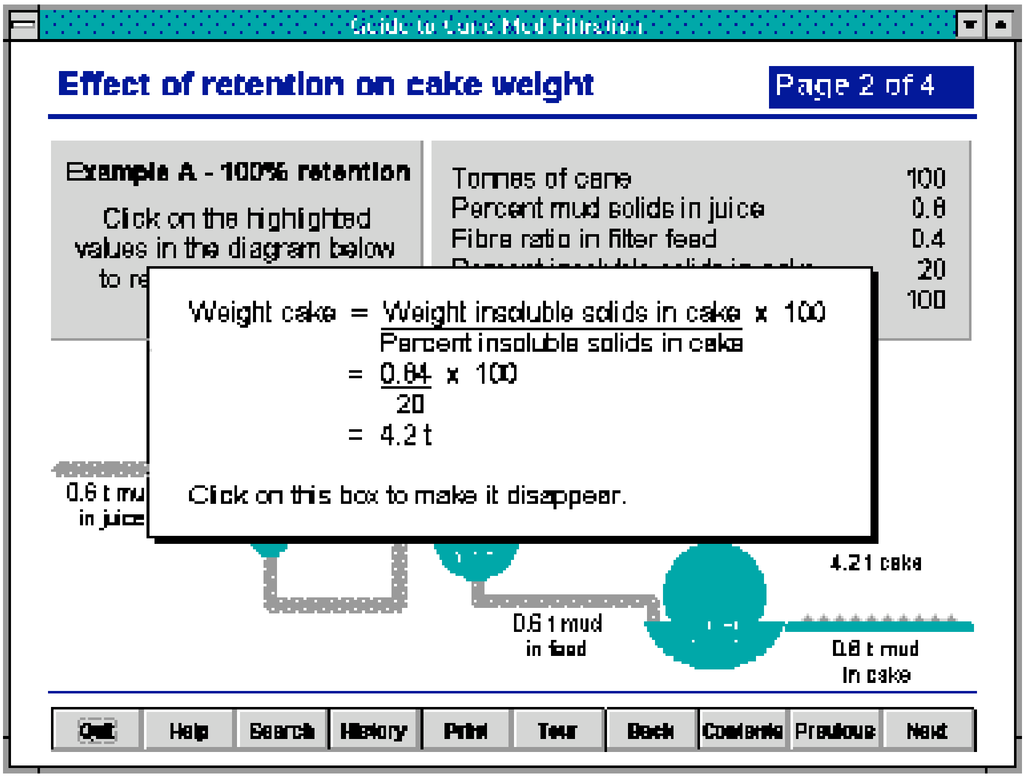

Figure 1. A hypermedia presentation of a mathematical procedure in the Guide to Cane Mud Filtration.

3.2 Training is often required for team members

Sometimes the training needs are less obvious. Two of the authors are part of a team developing an interactive multimedia package for diabetes education to assist first and second year nursing students. The instructional strategy, based on a problem based learning (PBL) methodology, has resulted in a series of case studies. Each case is divided into a number of scenarios which require the students to develop an appropriate care plan. Initially the students respond to preprogrammed alternatives but as each scenario progresses, the students must perform appropriate calculations and provide free text explanations.

Students have the flexibility of starting with any of the case studies and to different scenarios within each case. As they respond to a scenario, the program either gives immediate feedback on the selection or points them at an appropriate reference. The students' responses—models of clinical care plans—are also recorded for future discussion with the tutor or supervisor.

The team's initial content expert, a diabetes educator but a novice at writing computer based material, had difficulty imagining how to structure her learning materials to achieve a non-linear 'interactive' learning path. While she later realised her limitations, the first draft of the initial scenario, about helping an elderly woman with diabetes, was written in a very linear and didactic format. As the team noted, the lack of interactivity was problematic:

> I quite honestly couldn't see why [the activities in the scenario] had to be in a sequence… it doesn't allow for any interactivity… [and] the less page-turning we have the better. (Principal Investigator 1995, taped interview, 7 September)
>
> I think we need to make as many entry points, and therefore exit points as possible... it will add flexibility to the material. (Co-Investigator 1995, taped interview, 7 September)

Eventually, the working prototype for the first scenario was revised with a menu of topic headings (pre-operative, diet, exercise, and emergency) on the opening screen. Users (students) were then free to choose the desired topic and move directly to that topic in the case study without having to go through unrelated issues. Individual activities require choices and an explanation for the choices. The food selection in Figure 2, for example, must be organised into a daily menu, then a calculation of the food values involved, and a comparison with an ideal diet.

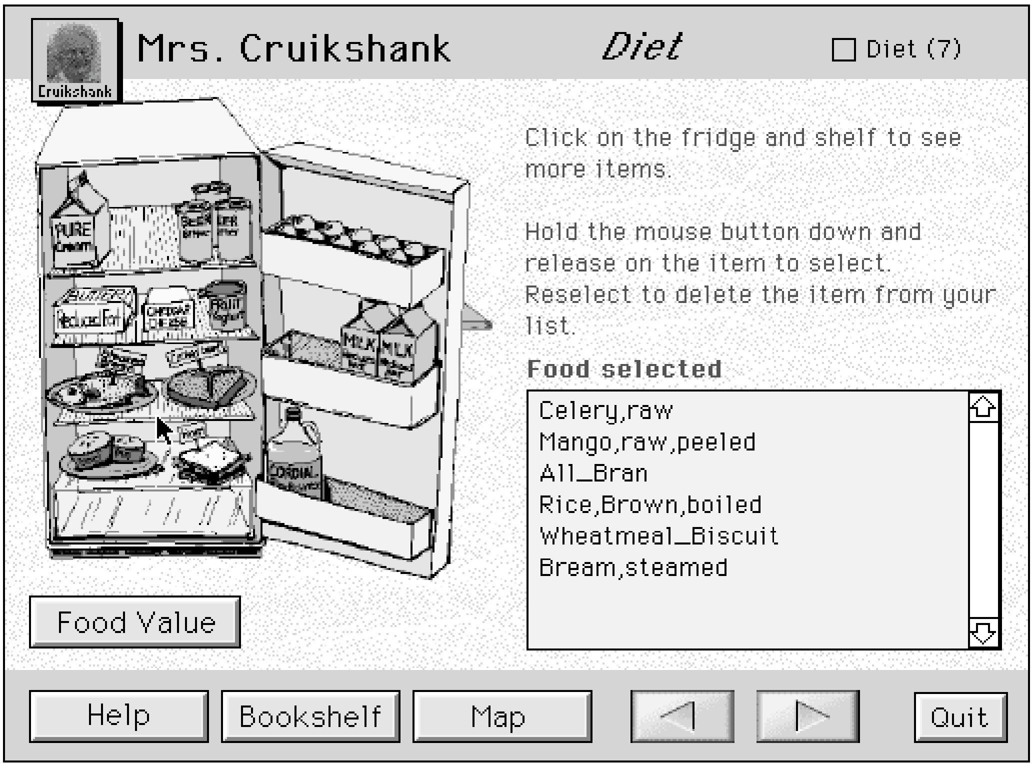

Figure 2: Screen from an interactive multimedia package. Both the Food Value and Bookshelf buttons take the user to reference materials.

The project manager had failed to adequately allow for the lack of experience of two team members—the content expert and the programmer working most closely with her translating content into prototype—in developing non-linear learning materials. As managers we often accept verbal assurances of understanding at face value; this project demonstrated the necessity to verify such assurances and provide training programs and perhaps even trial exercises, as appropriate.

3.3 'Ideal' versus iterative courseware development model

One of the authors was the programmer developing the interactive multimedia package described above. Trained as a programmer and proficient in a storyboard and script methodology for developing computer-based educational materials, a high level of frustration was predictable before she realised that pre-scripted and didactic techniques differed greatly from the team's iterative prototype methods, adopted because of the open-ended nature of the project.

> Usually before a programmer starts coding the program, it is important to get the program specifications and requirements… then only do you start to design the program structure, do testings and debugging…
>
> The problem with the current process [the interactive multimedia project] is information or specifications come in bit and pieces fashion every now and then, it made me very difficult to work! And also the program needs changing very often... As a result, the (development) speed was not going [as] fast or [as] smoothly as I expected... [resulting in] frustration for me... (Programmer 1995, taped interview, 7 September)

Being relatively inexperienced, this author failed to see the importance of having flexibility in the design and development stages, especially the probable need to make adjustments as a result of user testing. With relatively few resources and limited time, iterative prototyping had the potential to allow the team to experiment with alternative techniques as they tried to achieve a high level of interaction. It also provided an earlier opportunity for the team (and user testers) to visualise the courseware appearance and improved the process of formative testing and subsequent refinement. As Alessi and Trollip (1991), themselves advocates of traditional instructional design methodologies, indicate:

> Being familiar with methodology is essential for developing computer-based materials, but the developers must be flexible to adapt to their own individual needs and style of work by reordering, adding, or deleting steps.

3.4 Students as employees

All of the authors have been involved in projects which used students as the primary source of labour, one as a supervisor and the others as the labour source. From an educational point of view such projects can be extremely valuable as they provide a 'real' situation in which to practise skills learned in the classroom. From the students' point of view they are often very time consuming activities and the pressures to do well can distort other priorities.

Perhaps the most important difficulty with the use of student labour is the ethical dilemma which results when there is a conflict between the demands of the project and the student's studies. Projects simply have to be designed so that their timelines are flexible enough to accommodate exam and assignment schedules. Both staff and students must realise that students working on projects, even though they are usually being paid in academic credits rather than dollars, are staff with all of the rights and responsibilities which that entails.

For some academics the idea of using students as technicians, programmers, writers, and in other roles on a project raises the spectre of poor quality as exemplified in many student assignments. The point was forcefully brought home to two of us at a recent workshop when one of the speakers (1996 Queensland and Northern Territory CAUT Workshop, Brisbane 1-2 February) questioned whether students would complete a project successfully and 'Can you *guarantee* quality?'.

Circumstances obviously vary with time and place but in the experience of the senior author, many students involved with projects, particularly those for a 'real' client rather than a 'make work' project, have a greater sense of obligation—awareness of the need for and desire to deliver quality—than do many of the professional staff.

4. Conclusion and implications

As one of the authors has previously noted (Zelmer 1993 and Zelmer et al 1993), there are a number of requirements for a successful computer-based courseware or multimedia project which, when omitted, can lead to disaster.

Anticipate failure: since some mistakes will inevitably occur it is necessary to structure a project so that the participants learn from mistakes, both those reported in the literature and encountered in the project itself. Students, both the intended recipients of the materials and any student staff involved, must also be protected in the event of the project's failure to meet deadlines, objectives, etcetera.

Goals must be explicit: without indicators of success or failure the project has a high risk of either floundering or producing an unusable product.

Projects will always require more resources than expected: while this is particularly true of staffing resources and the time to completion, other resources are also typically underestimated. The lack of specific (and always the most critical) skills leads to the necessity for staff training programs; people problems, often the result either of poor team communications or lack of commitment to the project's goals, also divert critical resources.

Plan for change: the necessity to plan for change is implied in a number of the other points but requires added emphasis. Technologies are constantly being 'upgraded', staff depart for better career opportunities, and the project's design criteria will be modified by user testing. The wise project leader plans for change and is able to adapt when it occurs.

Quality control may be everything: the project manager needs to constantly focus on objectives and ensure that they are being met in a timely, appropriate and effective manner.

Following these guidelines, distilled from the literature as well as the authors' experiences, can lead to significantly increased productivity and a more useful final product. The experienced project leader is confident that the endeavour will succeed because the project team has a shared commitment to a clearly defined set of goals, is aware of its limitations, and has adequate support—budget, staff, administrative approval, and academic approval.

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