Re-examining the Myth: Developing Truly Affordable Multimedia

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Abstract

Staff and students of the Department of Mathematics and Computing have developed a number of computer-based educational / multimedia packages over the last decade. As a result of funding limitations and our own preference these projects have generally been low budget and involved student labour for a significant portion of the development.

The author was a co-author of a paper (1994) which examined a number of practical and affordable techniques for developing interactive courseware and reported that expectations had not been realised in projects then in development. This paper re-examines the topic in light of subsequent developments. In particular, the author discusses current (1995) technologies and tools as used in a CAUT funded project to develop an interactive multimedia package for diabetes education.

Keywords

multimedia, interactive, low-cost, courseware development, World Wide Web

1. Introduction

The Department of Mathematics and Computing at Central Queensland University offers several programmes in applied computing (now more normally labelled as information technology). In order to maintain this applied focus many of our staff and senior students are involved in both industry consulting and courseware development. The resulting tools and courseware packages are often also used in our teaching as we consciously strive to use IT to teach IT.

Central Queensland University is an ex-Institute of Advanced Education and does not have extensive resources for developing either conventional computer-based learning materials or more expensive multimedia packages. The University's Distance Education Centre has a well deserved reputation for developing state-of-the-art training materials for their commercial clients but Department staff must usually find their own funding and, as a result, many projects use student labour (Young and Zelmer, 1992) and low-cost techniques to minimise costs and maximise learning possibilities.

The University has been reasonably successful in obtaining outside funding for some projects. The author, for example, assisted the Faculty of Health Science to develop computer-based teaching materials for nursing education under a National Priority (Reserve) Fund grant (Zelmer, 1993, and Zelmer, Carss and McLees, 1993), and is the current recipient of a Committee for the Advancement of University Teaching (CAUT) grant to develop an interactive multimedia package for diabetes education. The basic development for this package follows the low-cost norm of the Department and relies heavily upon students for development (Zelmer, Zelmer and Lye, 1995). Other staff have

received funding for the development of bridging materials for mathematics and computing and for materials to encourage more women to study computing. Other projects, such as the development of CapGraph, a tool to assist students to understand standard graphing theory, is self-funding and the software can be found in schools throughout Australia. The development of the diabetes package, however, provided much of the background for this paper.

2. What is Multimedia?

The definition of multimedia has varied greatly over the years. Back in the 1960s the term generally meant a multi-screen production utilising some combination of audiotape, slides and film. Some presentations had the audio synchronised with the pictures using an audible tone (operator changed the slides) or an inaudible signal on an audiotape or the sound track on 16mm film. More sophisticated presentations included government funded exhibitions at the 1967 World's Fair in Montreal where audiences were introduced to the forerunner of Imax-type films and plots determined by audience interaction.

More common, however, was a short (20 minute) presentation on resources for drug education resources by the State University of New York at Buffalo School of Library and Information Science to the 1969 American Library Association National Convention. Armed with a brand new degree in audio-visual communications, the author manually changed approximately eight slide projectors in time to the stereo beat of a Gregorian chant. That was state-of-the-art multimedia in the late 1960s when an intelligent controller meant a human operator coping with an array of projectors, fade-dissolve units, buttons and switches.

More recently, computers have defined the genre in a different manner. A tourist attraction might use computer-based presentations to supplement more conventional displays and human guides in an interpretation centre. The Gondwana exhibit on Brisbane's South Bank, for example, has a number of computer-based kiosk displays to help patrons identify the flora and fauna which they are viewing as well as games to hold the attention of younger patrons. The computer-based sounds and images are also available for purchase on videotape for non-interactive home viewing.

One of the advantages of a kiosk is that it hides the cables, adapters, and other paraphernalia which make up the usual configuration of a multimedia computer. Conference presenters or even the desktop multimedia user, however, typically find computer-based presentations a major challenge. The minimal standards for multimedia computers do not necessarily guarantee that presentations will run, particularly if the presentation includes large amounts of audio or video materials. Even leaving aside the question of platform (Macintosh, Intel, or workstation), major decisions are required to determine the level of audio (8 or 16 bit) and thus the audio cards required, colour (4, 8, 16, 256, thousands, or millions of colours), storage (hard drive, removable media, CD-ROM), and presentation facilities (multiple monitors, projection panel, video projector), etc. Software tools are even more problematic, especially if materials produced on one computer platform were needed for delivery on another. Finally we have the challenge of connecting an amazing variety of pieces of hardware together using an almost infinite number of incompatible connectors.

That is the now dated state-of-the-art from the early 1990s! During the mid-90s the educational world is awakening to the benefits of WWW, the World Wide Web.

Offering an integrated platform for the delivery of any type of multimedia material—text, database, audio, video, animation, simulations, interaction, free form or hypermedia—twenty-four hours per day the Web appeals to several audiences. Students see the Web as an escape from conventional classes and the necessity to access library resources. Teachers see the use of computer-based resources as a means of motivating students, more easily maintaining the currency of materials, and releasing themselves from the tyranny of scheduled classes and limited resources. University

administrators see the technology as a means of reducing costs—let the students provide their own access (computers and OpenNet accounts), reduce the necessity for under-utilised classrooms (24 hour access), and permit fewer staff to teach more students with reduced resources. As well, the technology allows user / student progress to be easily monitored if required.

Depending upon your viewpoint, therefore, multimedia in education may mean the use of a variety of input types to improve instruction or the use of technology to reduce costs and improve administrative control of instruction.

3. Low Cost Multimedia: the Myth

In paper early in 1994 the author and another colleague from the Department (Zelmer and Pace) discussed the difficulties of developing multimedia and hypermedia materials using the then current (1992-1994) development tools. While that paper discussed the problems in developing a multimedia product with inexperienced staff and in converting existing materials for use in a computer-based package, the incompatibilities between a typical Macintosh-based development environment and the still immature Intel ‘multimedia computer’ delivery system were more significant. As well, the combined costs for the requisite hardware and software kept multimedia development out of the reach of most desktop computer users.

Many users now (1995) have the requisite hardware for displaying a multimedia product (at least a 486SX-25 with 4 MB of RAM (8 recommended), 160 MB hard drive, standard VGA, 16 bit sound, and a 300 KB / second CD-ROM drive or the Macintosh equivalent). CD-ROM drives seemingly also have enough market penetration to make them viable for multimedia distribution. Many of our distance education students, however, have not upgraded their computers to this standard, many of our on-campus students are not willing to purchase their own computers, multimedia-capable computers for student use on campus are almost non-existent, and some lower cost machines fail to meet multimedia requirements, particularly in delivering acceptable audio and video.

Writing in a recent Desktop magazine, Foxworthy (1995) reported on a 1994 US study indicating that of the 6% of US households which owned CD-ROM drives, only one in three were fast enough to run the then current software. While the CD-ROM penetration in Australia is undoubted much larger than that of the US in 1994, many drives will be older models purchased at bargain prices to enable user’s to load newer software delivered on CD-ROM. As well, both users’ and developers’ expectations seem to be rising even faster than the available hardware upgrades with the result that the newest versions of commercial games and other CD-ROM based materials demand fast drives (double or quad speed) in very well endowed computer systems. CD-ROM based movies, when they arrive in the next few months, will require even faster hardware.

Software tools have improved significantly since my 1994 paper and there is a wide range of software tools available to cater for the needs of the absolute novice developer as well as the serious educator and multimedia professional. Prices, however, have generally not fallen for the more sophisticated tools and user expectations increasingly require even basic presentations to use sophisticated features, such as 3-D buttons and animation, found only on the more expensive tools.

Sophisticated tools also require the most sophisticated, and expensive, computers for development of the multimedia productions. Current versions of development tools such as Canvas, Adobe Premiere, and Macromedia Director are optimised for Power PCs and even the top of the line Macintosh Power PC requires special hardware add-ins to capture more than a quarter screen video image at TV standard 25 frames per second.

Post production costs also remain high. While US developers have access to CD-ROM recorders in the US$2200 price range (including software), can purchase blank gold CDs for about US$10, and

can have a one time ‘gold’ CD recorded for approximately US$20, Australian developers are not so lucky. Sony’s $US2200 CD-R drive costs $5050 (AUD), blank CDs cost at least $22 (AUD), and current magazine ads still quote costs of $140 (AUD) for a one time gold recording. Costs for mastering and duplicating CDs in bulk may have come down somewhat from 1994 prices but still remain a barrier to the small organisation trying to develop low cost multimedia materials.

At first glance then, the conclusions from that 1994 paper (Zelmer and Pace, 1994) seem to have been sustained—low cost multimedia remains a myth.

Unfortunately, while instructional designers still question whether 16 bit sound, full screen motion, and millions of colours are important for learning, the ‘infotainment’ industry has dictated that courseware without these attributes will be seen by the consumer, student and staff member alike, as inferior. This commercialisation and raising of user expectations may also condemn to oblivion both the desktop-based individual author approach and local development of anything other than very basic multimedia materials.

4. Interactive Multimedia for Diabetes Education

The author is currently involved in developing an interactive multimedia package for diabetes education. As the CAUT application indicated:

> This project seeks to reduce the tedium of teaching repetitive materials with a self-paced learning and evaluation tool for introductory-level university students, health workers, diabetics (there are hundreds newly diagnosed each year in Australia) and their families who require considerable information to effectively manage a diabetic condition. A user-tested multimedia teaching program on compact disk (CD) will provide students in pre-professional health programs with a tool for their own learning and for patient education; multiple entry points enable the lecturer and student tailor the program to meet individual needs.

Aimed initially at first year health science students, the package will include resource materials integrated with scenario-based problems requiring a real-life solution. Interaction will be ensured by requiring the user to answer appropriate questions about the care required and to perform a variety of tasks ranging from planning a meal (dietary management) to determining the appropriate method and dosage for insulin use. As the prototype screen design (figure 1) illustrates, screens can contain a mix of text and illustrative materials, a video segment in this instance.

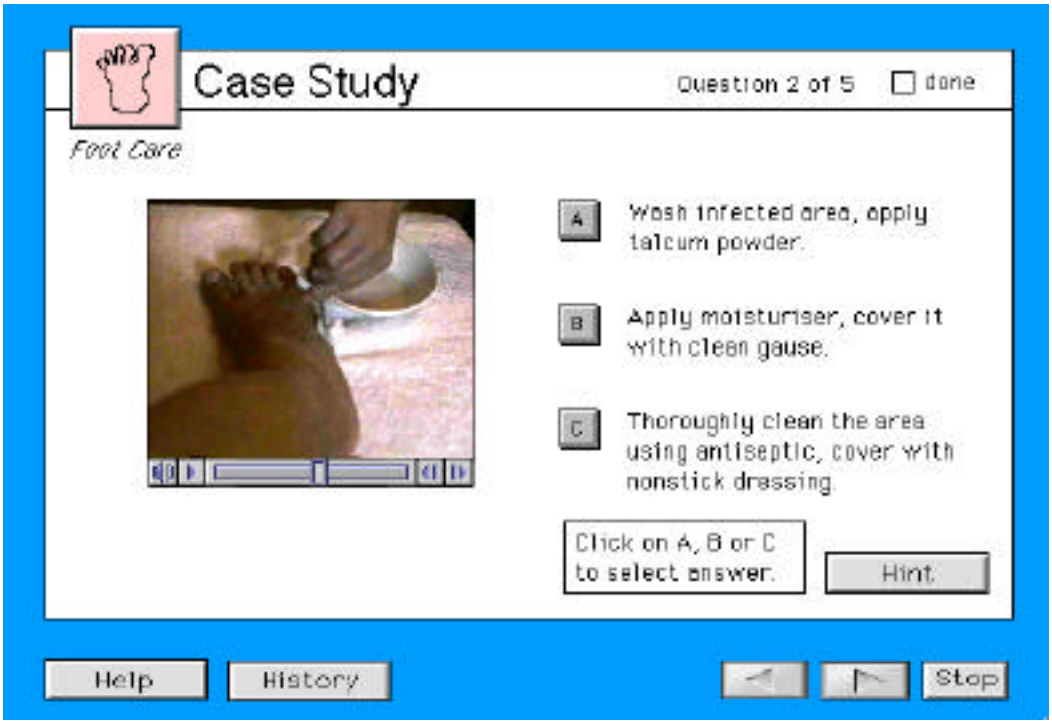

Figure 1: Prototype Screen Design

The user's attempts to respond to the problems presented will be recorded in a 'care plan' which can be printed out by the user and / or made available to a supervising lecturer. While we have received funding for some costs (teaching relief for the author, materials and supplies including limited university videotaping and graphic artist, CD-ROM production, etc.) the level of funding from the CAUT grant insures that the project is relatively low-cost and much of the development is being done by a postgraduate student as part of her Masters degree project.

When we started designing this project early in 1994 we aimed our development at current and foreseeable technologies. Improvements in both the hardware and software tools looked able to provide a much more acceptable product, using a lower cost development work station, than was possible in 1993-94. As well, users were increasingly acquiring multimedia capable computers with CD-ROM drives, making distribution of computer-based educational products more realistic.

Given the quality and variety of development tools—software for image capture (audio, video and graphic / animation) and manipulation as well as courseware management (HyperCard, Authorware, Premiere, and Director), hardware such as the VideoSpigot cards for video capture and the Apple QuickTake camera for digital imaging—we elected to develop on the Macintosh platform. Our limited budget then constrained us to distribution of the first version for the same platform although development did proceed with the ultimate intention of also converting to the Intel platform.

While preliminary design work was done on both Macintosh and Intel platforms, most of the development has been done on a Macintosh LC III (roughly $2200) with a VideoSpigot card (roughly $900) capable of capturing a roughly one-sixth screen image as in figure 1 at 15 frames per second. An additional advantage of the LC computer is that it is roughly equivalent to the minimum delivery platform we can expect for our package. This is the basic package used by the programmer cum developer. [All prices in this and the following paragraph are educational.]

Macromedia Director (roughly $1175) was chosen for the development software because of the need to include a wide variety of image types and a desire to provide as professional an interface as

possible. Courseware authoring tools such as Authorware and CT were rejected because their underlying hierarchical structure did not fit the interactive hypermedia style required for the package. It is now (late 1995) possible to purchase a number of lower cost presentations tools but, as with presentation software for business use (PowerPoint, for example), they are also much more limited in scope and utility.

This basic package is, of course, not adequate in itself for developing anything more than a demonstration application. We also used the following hardware and software tools for particular aspects of the development:

- HyperCard for prototyping;
- Apple's QuickTake digital camera (currently the model 150) for still pictures and a QuickCam digital camera from Connectix for draft video images;
- access (at semi-commercial rates) to the University's sound and TV studios for final audio and video production (providing videotape for digitising with the VideoSpigot card);
- Nikon CoolScan 35mm slide / negative scanner for higher quality colour images;
- Apple grey scale flatbed scanner for technical illustrations and sketches provided by the project's graphic artist;
- Wacom digitising tablet and pen (almost never used) for drawing directly into the computer to create line illustrations;
- Premiere, Canvas, and PhotoShop software for image manipulation;
- Word 5.0 word processor for documentation, Eudora and Mosaic for network access for communications and research purposes;
- several printers (inkjet and laser) for monochrome and colour printing;
- various public domain utilities for manipulating files, developing animations, etc.;
- external CD-ROM drive for accessing software tools, extra hard drives, including a 1.2 gigabyte drive, for assembling files and testing the resulting multimedia product;
- external DAT tape drive for backing up files; and
- two additional computers used primarily by the author, one a PowerBook 170, the other a Centris 650 with internal CD-ROM drive, for development work, connecting to the scanner(s), etc.

As becomes obvious fairly quickly, the roughly $5100 cost of the basic multimedia development machine and software is quickly overshadowed by the added costs of the tools required to produce the media elements. A truly low cost project could perhaps restrict itself to a hand scanner (roughly $500) for digitising both photographs and illustrations, a medium capacity hard drive (roughly $800), and more basic software (perhaps $1500 for both a Director alternative and alternative graphic manipulation software) but the results would be even more amateurish than normal for a university production.

On the other hand, our production team has remained resolutely low cost. We have a large team of content specialists (Australia wide and including representatives from the Australian Diabetes Educators Association) which reviewed the materials on request plus a support crew from the

University to provide technical assistance upon request. Other than that, the development team consisted of the author and another academic as project co-directors (both very part time with one functioning as instructional designer, the other as general content specialist), a postgraduate student as programmer cum developer (also part time), approximately 10 weeks of time from a diabetes specialist, a few weeks from a graphic artist, and other part time assistance with typing, scanning, image manipulation, etc. Likewise, we do not have large monitors or multiple monitors to display multiple images or program and output at the same time, and we have not had any significant amount of clerical (for obtaining copyright clearance, retyping reference materials, etc.), programming, or other support.

Dedicated staff are critical to the success of any multimedia project and our team has worked willingly to overcome our resource deficiencies. From the author's viewpoint, the most useful addition to the development team would not be additional clerical staff, programmers, instructional designers, courseware developers, or even content specialists. The most useful addition would be additional artistic support / skills. Only a few decades ago most scientists and engineers, as well as many arts graduates, would have had respectable photographic, drawing, illustrating, or painting skills. Multimedia development teams would be enriched tremendously if all members had a few of those same skills today. Failing that, the project budget must be developed to enable the support to be hired. Unfortunately, the skills required may not even be available in a regional centre such as Rockhampton.

Several years ago Dr Paul Campbell, of Edge Technologies in Brisbane, indicated that his boutique-style multimedia development company had purchased over $100,000 worth of software tools alone for evaluation and use. His developers used the most up-to-date and powerful development hardware, at least another $100,000 worth of expenditure, since staff time is a major expense and slower, less capable machines slow down the development work. That was and remains a minimum standard for a commercial production house; the facilities employed for the diabetes education project are probably the minimum possible for a decent university-style development. Even then, as all of the project participants will likely agree, both the LC and the Centris are inadequate for sustained development using today's software tools. Unfortunately, the costs of replication or, in our case upgrading, are beyond current budget allocations, particularly when almost all granting agencies refuse to fund capital facilities.

5. Shifting Goalposts

The diabetes education project was conceived in 1993, the grant application was written early in 1994, and funding was received for the calendar year 1995. Under the terms of our CAUT grant we will have delivered a finished product late 1995 or very early 1996. Among other considerations, this does not provide much allowance for the slippages which always occur in a computer-based development project—Microsoft isn't the only organisation noted for late delivery of product.

The lead time for the project was also significant. Most of the hardware and software tools were being assembled (or at least ordered) in 1993 or early 1994. While some critical software products, such as Director, have been upgraded since, our current development platform is almost three years out of date. This would not have been a problem if we were working in a less volatile environment. Multimedia development projects and CD-ROM based products have been appearing like the sparks from a wildfire. Quality standards and public expectations, initially minimal, have been increasing at the same rate. Costs, and development times (often measured in years), have remained fairly constant.

The goalposts have also shifted sideways with increasing access to, and use of, the Internet, especially facilities such as the World Wide Web. While video and graphical elements require more sophisticated tools, text-based Web pages can be created with a text editor, eliminating the need for

any development tools. Web pages are then immediately available to a world-wide audience without the need for working through a publisher, censor, or other restraint. If ‘the medium is the message’, the message is that developers of conventional multimedia need to look hard at their projects and products. Developers of low-cost materials probably do not have a choice, they need to switch.

What then of our diabetes education project?

Certainly if we were developing this project in late 1995 publication on the net, whether via the Web or using other tools, would be a viable option. The net still does not reach into many health clinics or homes but could be generally accessible to first year health science students, the primary audience. Universities would need to make an increased commitment to providing undergraduate students with state-of-the-art computer facilities but some faculties have already made moves in this direction. Interestingly, the only general computing laboratory for student use which is equipped with multimedia capable computers is provided by the Faculty of Health Science. Alternately, students could be provided with SLIP accounts for access from home using their own computers and modems. This might be feasible now that the prices for faster modems have dropped below $500 and many students have their own computers at home.

From a production point of view costs would undoubtedly be significantly lower *at this time*, partly because user expectations for Web documents remain fairly low. While quality expectations may rise rapidly as institutions establish standards for work on the Web, users have been conditioned by the plethora of unexciting text materials and the delays and low resolution of network video to expect fairly low quality materials. The speed and bandwidth of the delivery system, often a low capacity network connection or a relatively low speed modem, combines with the storage constraints of the delivery system (network server) to restrict the amount and type of non-text material. Long audio, video or animation sequences simply take too much disk and execution space as well as being time consuming to transmit. Since anyone with a text editor can create Web pages adequate for the currently expected quality levels the result is a very low cost multimedia system with great potential.

The reality of any multimedia project is that it must meet the needs of its intended users at an acceptable cost. Realistically, this cost has at least two components, the development costs and the presentations costs. In the 1960s multimedia presentations were used as keynote sessions for annual conferences and other large groups because the level of equipment and other support required made then uneconomic to present to smaller groups. Banks and other institutions requiring high quality presentations built special conference rooms with rear projection facilities to bring multimedia presentations to smaller groups, but only at a very high cost. In the decades following we have seen various attempts to bring the cost of multimedia presentations down to an acceptable level for small group, classroom, and individual use. Commercial products such as the Australian Aboriginal Encyclopaedia and Encarta achieve their low cost to the consumer by government subsidies or volume sales; multimedia computer games likewise require volume sales to be competitive. Topic or course focused educational products, however, cannot expect a volume market. All require the user to pay for the presentation platform, usually an individually owned multimedia capable computer. Web publishing, whether text-based or multimedia, simply adds the requirement for the user to have a high speed modem and network access.

Projects such as our diabetes education interactive package, using conventional computer-based multimedia techniques and tools and delivered on CD-ROM, are probably only possible when produced as a ‘labour of love’ or when funded by outside agencies as the audience is too small for volume production. The attraction of the World Wide Web is that it provides the opportunity for every user to become their own publisher of multimedia materials and the potential market is the world. It remains to be seen whether the quality trade-off kills off this new media or whether the Web does become the truly low cost multimedia system of the late 1990s.

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7. Acknowledgements

The author wishes to acknowledge the debt owed to his postgraduate students, both in assisting with the multimedia projects leading to this paper and in the discussions about their studies and writings which have helped mould the author's approach to multimedia use in education.

The assistance of those project funding agencies named in this paper and others, such as the Department of Mathematics and Computing and Faculty of Health Science professorial research support funds which provide continuing support, is also gratefully acknowledged.