

The development of an electronic distance learning course in health informatics

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Abstract

Since 1997 the authors have been involved in the development of a distance learning course in health informatics. The course is delivered via CD-ROM and the Internet. During this process we have learned valuable lessons about computer-assisted collaboration and co-operative work. In particular we have developed methods of using the software tools available for communication and education. We believe that electronic distance learning offers a realistic means of providing education in health informatics and other fields to students whom for reasons of geography or work commitments would not be able to participate in a conventional course.

Introduction

Health or Medical Informatics (HMI) has been defined as comprising "...the theoretical and practical aspects of information processing and communication, based on knowledge and experience derived from processes in medicine and health care"(van Bommel and Musan 1997). We are firmly of the belief that HMI is more than information science for health workers. We sympathise with the view that "Computers are to health informatics, what stethoscopes are to cardiology"(Coiera 1997), however, computers are an essential part of any teaching about health informatics. Any course in HMI has to incorporate elements of a traditionally taught by a number of disciplines among them; medicine, nursing, information science, library science and project management.

As a relatively young discipline, practitioners and educators in the field are more likely to have been trained in another field and migrated into HMI. At present there are efforts to produce a prescription for curriculum by the International Medical Informatics Association, much as the ACM has done with computer science, but this process is still continuing.(IMIA 1998)

By the same coin, the requirement for teaching in HMI is very large and increasing. Because of the nature of the career structure in many clinical disciplines, changes to an undergraduate curriculum will take many years to filter through to the majority of clinicians. People working in the clinical environment often find it difficult to take time off work for continuing education and the audience for this sort of course is geographically dispersed around country, so only a part-time distance learning course is suitable for their needs.

Aims and deliverables

The aim of the project was to produce a distance learning course that fulfilled the following objectives:

- It should provide the information needed for the students to acquire a suitable level knowledge (both practical and theoretical in) health informatics.
- This information should be presented in an attractive and easy-to-use form.
- Students and staff should be able to communicate in a timely and effective manner.

The educational model

A conventional distance learning course, as taught at Otago University comprises a large folder including written materials, reprints of academic publications (readings) and a weekly audioconference lecture/seminar. Students are assessed either by questions administered at these audioconferences or by an invigilated examination at the end of the course. The audioconferences are based around central rooms and telephone links to those students who cannot travel to these centres.

Our educational model for the course in Health Informatics emphasises application of learner's knowledge, independent study, collaborative work and communication. This is designed to lead to so-called 'active knowledge' (Koppi, Lublin et al. 1997) rather than rote-learning. To achieve these ends, we decided to use electronic methods of course delivery and communication. It was hoped that these methods would have additional benefits in terms of reducing the isolation of learners, improved organisation and learning from using the technology.

In order to fulfil these aims, we needed to construct systems to provide course materials such as illustrated text, animations and videos and systems for synchronous and asynchronous communication for support and collaboration.

For educational reasons we chose to use Microsoft Office products to support the teaching process. In particular we used Access '97 as the introductory database tool. This decision led us to insist on students using the Windows 9X/NT operating system family

Course Delivery

Design considerations

The major decision is whether to deliver the material via the Internet or CD-ROM

Table 1 shows some of the characteristics of the two methods, compared to paper textbooks.

Media	Cost/unit	Cost of Development	Ease of revision	Convenience of use
CD-ROM	Low	High	Low	Medium
Text book	Medium	Low	Low	High
WWW Pages	Low	Medium	High	Medium

Table 1: Delivery systems

However there were a number of factors that encouraged us to use the CD-ROM delivery method:

- Because the students were working from home, bandwidth considerations made delivery of multimedia components almost impossible via the web.
- At the time of writing, authoring packages for CD production are both more mature and easier to use than their www counterparts. Many of the features of HTML, such as hypertext, and page navigation are easy to implement in the CD-Authoring packages.
- Because CD-ROM based packages are run entirely on the student machine, they can be tightly coupled to the operating system and software packages on the local machine.
- The decision to insist on windows OS, avoided the need for multi-platform development and testing.

After a period of evaluation we decided to use Macromedia Authorware as the development environment for the CD-ROM. A major influence was the experience we had with Macromedia Director for animation construction, and the compatibility between the two products. Interestingly, we began using Authorware version 4, which can produce Macintosh or Windows packages, but this has been superseded by version 5, which produces windows or web packages.

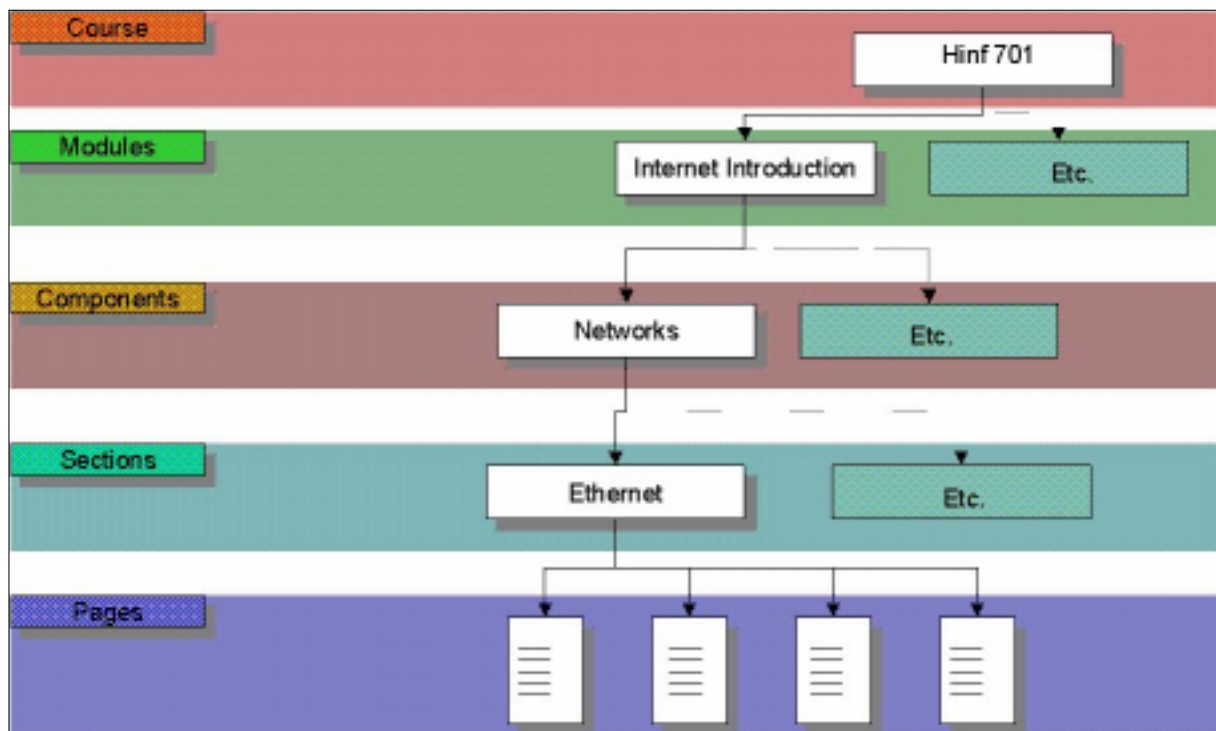


Figure1: The structure of the course

Construction of the CD-ROM

Each paper in our course comprises ten modules (figure 1). Each staff member (the authors of this paper are the staff of this course) is responsible for the material in each module, although contributions and review from other staff members also takes place. In order to retain a common structure between the modules, all the modules are combined and finally formatted by the paper editor. The process of producing written and graphical materials is shown in figure 2.

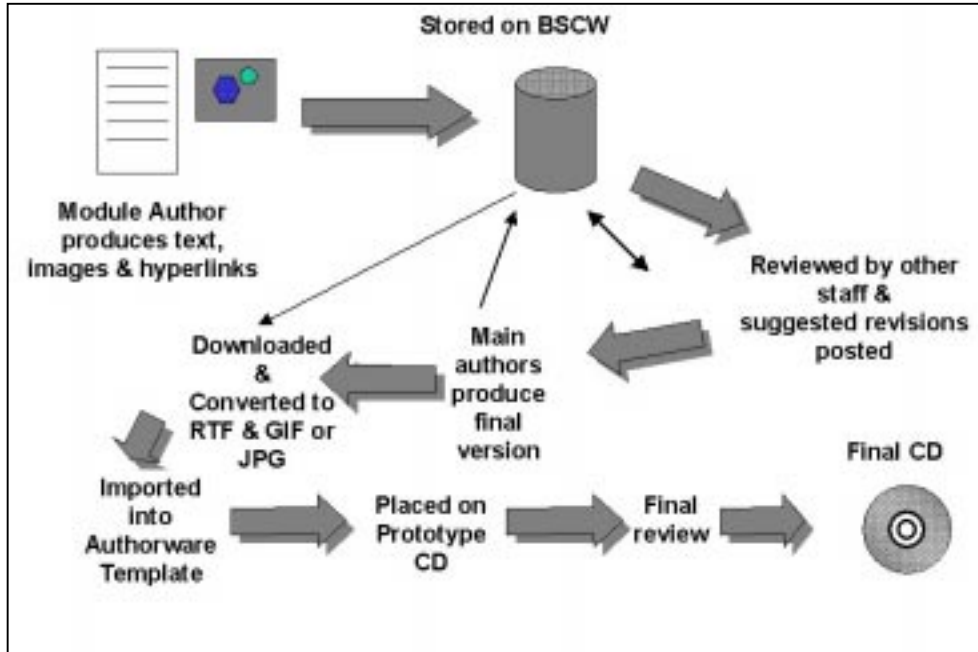


Figure 2: The production process

Each module comprised between 30-60 pages of material (each page contains up to 400 words). Each module has an associated web page and a competency test at the end of the module. The layout of the page is shown in figure 3. A local log file is created which records the date and time each page is visited.

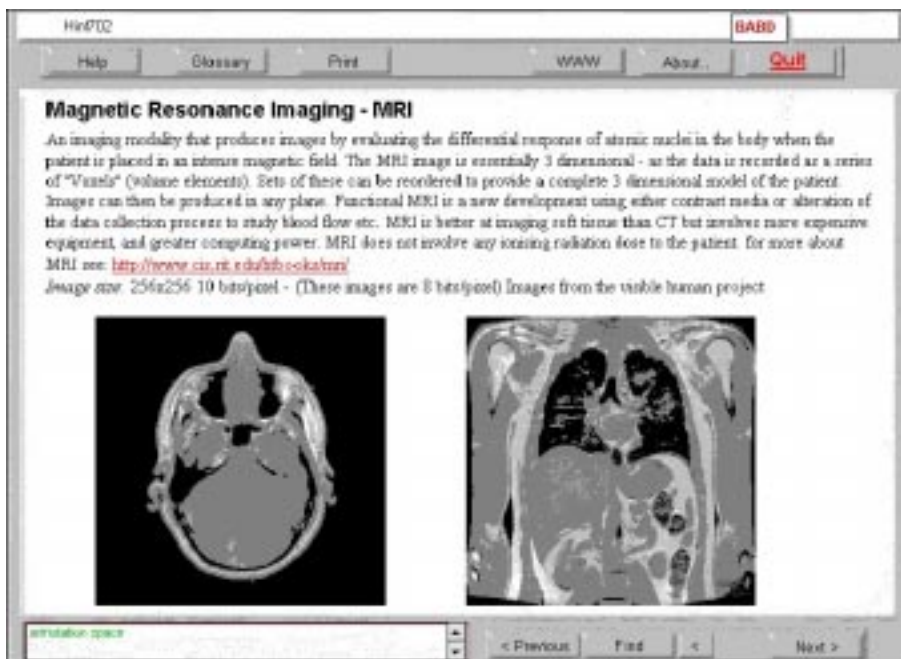


Figure3: The page layout

Navigation around the course is split into two parts; at the bottom right-hand corner there are buttons for paging back and for through the module. There are also "browser like" forward and back buttons that navigate through a list of pages that have been visited. Also in this group is a "find" button, which performs a full-text search on the whole CD, and allows navigation to the occurrence of the string being searched for. Navigation to the start of each module is via the labels at the top of the screen. Other features of the CD include hyperlinks

to WebPages and help files and a "learning journal" -a list of pages visited and yet to visit, based around the log file. Each page has an annotation box that can hold comments about the material on the page added by the user. The annotations are especially useful for the review process as they are held as a set of text files that can be archived and e-mailed to the editor.

Multimedia

We have used relatively little "true" multimedia in this course. This is because of not only cost and time constraints but also for pedagogical reasons. Poorly produced or ill thought-out multimedia courseware is far less valuable in teaching terms than the equivalent time spent on conventional text and graphics. We decided to use multimedia presentations -videos with soundtracks and silent animations, only where we felt a definite educational advantage was being gained. This resulted in around 1 hour of video and 10 animations being produced. This was the single most costly part of the course, over \$10,000 (US) was spent in production costs alone, and this material occupies over 500MB of space on the CDROM. Two software tools were used, MSCAM from Microsoft and Director 6 from Macromedia.

MSCAM

This is essentially a screen and commentary capture program for Windows applications. It is supplied free with MS - Office and produces video files in the AVI format. Because the sound quality of the originally recorded files was very low we were forced to follow a multistage process involving a professional sound recording studio, and adding the commentaries using Adobe Premier to produce the final result. This process takes quite a long time, but it was still a great deal quicker than producing animations from scratch. The videos are played on the student's machine directly from the CDROM using windows media player. The sound quality makes a great deal of difference to the overall perceived quality of the video, so we thought this effort was worth it. Shorter videos were much easier to produce, and comprehend than longer ones. We imposed a flexible maximum of about 1-minute for the videos, and limited screen resolution to 640x400 and 16 colours. The videos demonstrated such things as 'Installing Wizards', 'Use of FTP', 'Entering equations in excel' etc. A total of 50 videos were produced for the first paper.

Director

Director 6 (Macromedia) was used for animation production. This was decided because the multimedia research group of the information science department uses it, and we have a number of staff experienced in it's use. It also integrates well with Authorware. The major problems we encountered using director were concerned with integrating it into the CD environment. Around 10 animations and an interactive crossword were produced using director.

Communication

This is a vital part of any educational endeavour. We can identify two types of communication, synchronous and asynchronous. In practice, we use synchronous tools less often than asynchronous ones because they require fixed meeting times, which is difficult for this sort of course.

In this course the staff themselves are dispersed around New Zealand and we found staff collaboration a valuable testing medium for these tools.

Asynchronous tools

We used a number of these tools, and evaluated even more. Although there are a number of systems on the market designed for "asynchronous network learning", (ANL), we agree with Downes (Downes 1998) that being locked into a proprietary solution can cause problems in such a fast moving environment. In addition, because one of the things our students learn about is computed mediated communication, we believe that it is right to expose them to different methods. We will describe these methods in terms of increasing complexity/features.

The simplest tool of this type is email, which was familiar to most of the students before the course started. Organising the mass of emails sent and received is the biggest challenge - one staff member sent over 800 emails in the first semester, to support and teach 23 students. Filtering of emails is very valuable, as well as using mailing lists, for example when students submitted competency tests we asked them to include the phrase "[COMP]" in the subject line. The university runs email as a central service, we used Netscape communicator 4.x as our mail reader and encouraged the students to use the same.

Newsgroups are slightly more sophisticated tools than email. In particular they introduce the concept of threads - lists of linked messages. They also represent publishing to the group rather than individuals, which is important in the context of our educational model where we wanted the students to hear each other's views, and in some cases answer each other's questions. We ran a newsgroup server - Netscape Collabra, on an NT Server.

Errata for the CD, some additional links and instructions for problem solving were posted onto the course Website. Although there is still a dearth of "WYSIWYG" editors for HTML, the relatively simple nature of these pages meant they could be produced quickly using conversion within Microsoft Word, and final formatting using Netscape composer. With this combination the average page only took a few minutes to publish, and by staying with a simple functional design, it did not need the sort of design and HTML skills associated with pages designed for the general public.

BSCW (Basic System for Co-operative Work) (Bentley, Appelt et al. 1997)(figure 4) is a fully fledged web conferencing tool. It is accessed via a webpage off the home page and each student and staff member has a username and password. BSCW includes a complete security model, so that each student has a personal folder where they can post assignments that the staff can access, public "discussion group" folders, one for each module, that each student and staff member can post to and read and staff-only areas. Threaded discussions are well supported

One particularly important part of the course is the group project. This involves the writing of a report and production of web pages and PowerPoint presentations about a topic in health informatics. Each project group comprises around five students and one tutor. BSCW supports the use of MIME types and versioning, so that a central repository of the current version of each component can be kept. To support this, each project group is assigned their own workspace.

An additional feature is that BSCW can be set up to send an HTML email to members of the workspace, detailing what has occurred in that workspace in the last 24 hours. Hyperlinks from this email take the user directly to the folder or file mentioned. This particular feature has convinced a number of students that it was superior to sending multiple emails. We run our BSCW installation (downloadable from www.gmd.de) on our webserver running Windows NT 4 and Microsoft Internet Information Server 4.



Figure 4: A BSCW discussion group

Synchronous Communication

Although telephone-based audioconferencing tools have been available for some time they are relatively expensive to use. Text-based applications for communication via the Internet such as IRC and ICQ have been available for some time. Recently Internet based tools for audio conferencing have been developed. A number of these tools have extended capabilities such as video or application sharing.

Considerations for choice of application include ease of use, hardware compatibility and bandwidth usage. Because students are based at home, many with 28K connections, video is not really practical. We have used multipoint systems that allow the project groups to communicate with each other. The combination of NetMeeting and the Onlive server has been adopted because it has a simple interface, the bandwidth requirements can be lowered by decreasing sound quality or even using text chat and it is generally compatible with windows compliant software. Up to 25 simultaneous users can be connected via the H.323 compliant server, but the practical limit is around 5 people.

The greatest challenges with the synchronous communication have been the social and practical aspects of running these meetings. The rules we have developed for successful conferencing are shown in table 2.

For meetings to be successful, ideally participants should have met physically. This establishes confidence and reduces misunderstandings.

Advance preparation for meetings is required; this includes agenda to be circulated via email prior to the event. Ideally, this should be in a place that is accessible to all participants, for additions to the agenda.

One person responsible for being there first and remaining throughout the meeting (subject to technological drop out)

The meeting requires a Chair and a secretary to record Minutes. It may be more efficient for the Minutes to be recorded by the Chairperson. This is because, unlike face to face meetings the input is all auditory and the Chairperson can easily make notes at the time.

The Chairperson is strictly involved in keeping the meeting on track and ensuring that everybody is able to contribute. This medium encourages significant drift from the topic.

The Chairperson may well do most of the talking. When comments or votes are required, silence is considered to be agreement. The Chairperson should invite comment on a regular basis, and participants should not be hesitant about being heard, even if the conversation has moved on. Due to technology, this is a common occurrence. If there is an alternative view the Chairperson should immediately invite further comment seeking consensus. If there is uncertainty about whether someone has finished speaking, a system of indicating end of comment should be used.

Once discussion is complete the Chairperson should briefly summarise.

Minutes are circulated as soon as possible after the meeting to make sure they are correct.

Table 2: Rules for Synchronous meetings

Outcomes and Current Status

The first students began the course in July 1998, although initially we had been planning to offer the course from January of that year. Essentially this represents a one semester delay in the introduction of the course. This time overrun was due to a number of reasons including:

- Late decisions on software selection.
- Increase in required features.
- Late staff appointments (the developer and only full-time staff member was only appointed in September 1997).
- Staff team changes.

Project planning was hampered by the novelty of the project, so that time estimates were at least 50% too low.

Despite these problems a course has been produced and the experience gained in the first paper has been applied to the development of the next two which have already been produced. The course will eventually comprise seven papers. Each paper lasts for 1 semester (15 weeks),

the first two papers 701 and 702 are compulsory, and the others can be chosen from a list of 5. The compulsory papers are: 701- Essential information management skills for health professionals and 702 - Principles of health informatics. Two papers are then chosen from the following: 703- Health information systems, 704 - Evidence Based Medicine, 705 - Computer -aided learning in healthcare, 706 - Health data management and 707 - Research.

Around 45 students are currently enrolled on the course; we have had a drop out rate of 15%, and a failure rate of 5%. Student evaluation of the course has been extremely positive, more so than for many conventional courses. We are hoping to make the courses available to a wider audience, both as a diploma and as a series of short courses. In addition, the course forms the basis for some undergraduate teaching at the Wellington school of medicine. We hope to be able to offer a course in the same area but with a different focus for information science professionals who are interested in working in this field. Finally, expertise gained from this process is being offered to other departments in the University, and collaboration with other universities is being actively pursued.

In terms of cost, the project has required the services of one whole time equivalent clinical senior lecturer and two teaching fellow/ assistant lecturer staff. Travel and equipment costs have been relatively high, but the course runs effectively with the use of two medium sized Intel-based servers. As with many university projects it is difficult to separate start-up from recurring costs. However if the course were funded only at the "distance student" rate of around \$2000 US per student, it would not be sustainable in its present form.

Conclusions

Any case study should the reader to decide if the method described is potentially useful to them. In terms of the deliverable outcomes this project has been successful in that it achieved what it set out to do, in that a course exists and is being taught in electronic form. As a learning experience for the writers the development process has been very educational, and there are a number of general and specific conclusions we draw from this experience.

- Specifically we have discovered:
- An electronic course can be produced for a reasonable cost
- Students enjoy this type of course and learn well with it.
- Tools in this field are maturing rapidly, but still hold out the prospect of greater functionality in a short time-scale.
- Evaluating tools and reviewing the product is a time-consuming task but vital to success.
- We see no reason why this method - or rather set of methods -could not be applied in different domains, and at different levels.
- This work is hard, but rewarding.

These lead on to some more general conclusions, which will be no surprise to those who study project organisation:

- A team approach is especially valuable, and the team is more than the sum of its members.
- A common goal, especially an exciting one is a good driver.
- Project planning and estimation are difficult, especially for a novel project, but vital to success.

There are a lot of similarities between our work and that reported by Hirumi and Bermudez- (Hirumi 1996) most especially the realisation that this is a learning experience for the teachers as well as the students. We also agree that more interaction is needed than can be provided by a model that has the educator producing material and the student reading it.

Although this type of course is sometimes seen as a threat to conventional teaching it can instead be seen as an opportunity to extend teaching in a number of ways:

- Specialist courses can be offered to students that would not be viable otherwise
- Students with work or family commitments can be accommodated.
- Geographically isolated students can take part.
- Most of all, if lifelong learning is to be a reality then these methods offer a practical way to do it. The academic community should not feel threatened; rather they should see this as an exciting and fruitful way of extending their horizons.

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Appendix 1

The following table outlines the characteristics of some of the synchronous tools we evaluated:

Tool	Type	Number of participants	Cost	Degree of use	Comments
<i>Voxchat (Voxware)</i>	Audio and text chat, half duplex.	Up to 5	Free for up to 5 participants	Used by all staff and students initially	Problems running under Windows 98. Solid and reliable but no longer supported.
<i>Internet Conference Professional (Vocaltec)</i>	Audio and text Chat, whiteboard.	No limit but need 4K per audio connection to server.	Around \$40 US per seat plus \$unknown for server	Widely used, initially, forestalled by licensing problems	Good product let down by a complicated model.
<i>Conference Room (WebMaster)</i>	Text Chat	Up to 200	\$100US	Backup system	A simple web-based text chat system.
<i>NetMeeting (Microsoft) & OnLive server</i>	Text and Audio Chat, Whiteboard, Application Sharing	5 free, up to 25 with licensed server	\$2,500 US for 25 seat server educational use. Client free.	Used by all groups in later part of the course	The OnLive server allows multipoint audio via a web interface and H.323 server. A good, reliable product
<i>ICQ (Miribalis)</i>	Text chat	No limit	Free	Used by one group	A very nice text chat application

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