

## PLANNING A MULTIMEDIA AND PROBLEM-BASED INFORMATION TECHNOLOGY LEARNING ENVIRONMENT

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### **ABSTRACT**

*The Biomedical Multimedia Unit and the Information Technology (IT) Delivery Group are responsible for the delivery and management of the computer based learning materials that will be a core part of a new medical course being developed within the Faculty of Medicine, Dentistry and Health Sciences at The University of Melbourne. The new curriculum, which will start in 1999, has been transformed from a traditional discipline oriented approach into an integrated body systems program. In the integrated program learning will be supported by clinical cases or a 'problem of the week' (POW). The Faculty IT Unit (FITU) will be involved in the delivery of the problem based learning (PBL) component of the new medical curriculum and will also be instrumental in the delivery of resources to aid students in their self directed learning (SDL). These resources include web sites, image databases, and computer aided learning (CAL) modules. Currently the Faculty is in the process of developing seventeen multimedia education projects and aims to increase this number in coming years. The delivery of self directed learning resources and the problems of the week need to be World Wide Web (WWW) deliverable using intranets and the Internet*

*To assist in implementing the new curriculum a computer laboratory has been built, capable of seating up to one hundred students using fifty workstations. Network connections for student laptops are also available within the laboratory. 1999 will also see the introduction of twentyfive tutorial rooms equipped with one main computer and network connections for up to eleven student laptops to access the Internet and University/Faculty intranet. Learning framework software has been purchased to provide staff and students with email, electronic discussion groups, networkable programs, databases of images and access to the WWW.*

*The aim of this paper is to give details of the management and continuing development of the new (IT) learning environment. It will consider:*

- (i) the previous IT learning environment;*
- (ii) the requirements of the groups involved with using, developing and managing the new IT learning environment;*
- (iii) the constraints placed upon the new IT learning environment from the previous IT learning environment with reference to the various groups, previous infrastructure and the new curriculum;*

- (iv) *the new IT learning environment; and*
- (v) *future requirements and directions such as remote-campus delivery of learning materials for students, lecturers and for continuing professional education.*

## **KEY WORDS**

Information technology, problem based learning, self directed learning, medicine, internet, intranet, multimedia, learning environment.

## **1. PRE-1997 INFORMATION TECHNOLOGY LEARNING ENVIRONMENT**

Before 1997 the use of Information Technology for teaching and learning within the Faculty of Medicine, Dentistry and Health Sciences at The University of Melbourne was conducted in a traditional style of university teaching and learning characterised by a focus on teacher-centred learning incorporating lectures, tutorials and highly structured laboratory sessions. This type of approach is also consistent with didactic teaching and learning where teachers present information to a passive audience. The School of Medicine in particular adopted a discipline-based approach to medical education by which students covered the necessary material in areas such as Physiology, Anatomy or Pharmacology with little integration between these content areas.

In this traditional environment, multimedia (MM) technologies such as slides, overhead projections, videos and computer-based presentations using programs such as PowerPoint were gradually introduced. In 1991 some laboratory classes began to make extensive use of computer-based data acquisition and analysis systems and included computer simulations using HyperCard, some straightforward DOS and Macintosh programs and text databases. There was little organised or structured use of the Internet, email or newsgroups. Many academic staff and students obtained IT skills and expertise through personal interest. Others, through fear of computers or lack of opportunity had low skill levels. By 1996 much of the hardware and programs used were five or more years old with disparate software, older (slower) CPUs, small amounts of memory and small, low resolution screens.

Currently, the School of Medicine in the Faculty is undergoing a pedagogical shift to a problem-based and self-directed learning approach. An aim of the new approach is to provide integration between disciplines and to establish a relevant framework to support student learning. Integration will occur both horizontally between disciplines and also vertically between principles of biomedical science and clinical practice. A framework for student learning will be provided in the form of clinical 'problems of the week' (POW). Students will be required to investigate the problem over the course of the week using resources such as lectures, practical sessions, computer aided learning modules, library references, text books, image databases and world wide web pages.

The IT learning environment is integral to the delivery of the new medical curriculum. The initial 'triggers' for the problems of the week will be presented to students via computer in problem based learning (PBL) tutorial rooms. Students will be able to investigate relevant aspects of the problem through the use of computer based resources. Students will access these resources through a Learning Framework software package. This software should enable secure delivery, organisation, authoring and evaluation of educational content. It should also allow communication between the various groups involved in the new curriculum. As mentioned above, resources will include information on lectures, practical sessions, textbooks and library references; students will also be able to access computer aided learning modules, image databases, and WWW pages. In addition, the learning framework will provide staff and students with access to email and electronic discussion groups.

## **2. GROUPS INVOLVED WITH THE NEW LEARNING ENVIRONMENT AND THEIR REQUIREMENTS**

This paper will primarily concern itself with the new IT learning environment and the four groups concerned with its structure: students, course organisers (lecturers and tutors), program developers, and managers and administrators.

### **2.1 STUDENTS**

The students are the driving force for how the new IT learning environment is to be structured. Given the emphasis on PBL and SDL, the IT learning environment needs to provide students with efficient and reliable access to educational resources that support this approach. Students not only need to access fact-based information but to research and solve problems to which answers are not always clear cut. They need to be able to consider a variety of solutions to a problem and to decide which may be the best choice or choices for the problem they are dealing with. The IT learning environment should create a forum where students are involved with their learning. Finally the IT learning environment needs to facilitate communication between students and between academic staff and students.

### **2.2 COURSE ORGANISERS**

Traditionally, lecturers and tutors have been the main organisers of the material that students learn, deciding which are the most appropriate and up-to-date skills. The academic staff have considered not only what is suitable content but also the most appropriate method of presentation and the pace at which it should be assimilated. In the new curriculum many parts of the course will still be presented as lectures or as practical sessions but in addition, computer based MM modules will be provided via the intranet or Internet. Academic staff will need to participate in the production of MM modules and will be actively involved in determining the academic relevance and accuracy of web-based resources. Also, they will be encouraged to select suitable commercial, shareware or freeware programs so as to reduce the burden of 'in-house' production. This will involve evaluation of the educational effectiveness and appropriateness of resources to the course and also considering management issues such as printing costs, screen resolution and speed issues relating to computer and program execution.

### **2.3 DEVELOPERS**

In the case of in-house produced modules the developers may also be course organisers. Generally they will seek the assistance from instructional designers, multimedia programmers, graphic artists, and educational specialists provided by multimedia development units consisting. Commercial providers and various other bodies producing educational programs will need to know what hardware and software are required to run their programs. Issues such as computer type (Macintosh, PCs, workstations), operating system (OS), the amount of RAM, the amount of hard disk drive memory and capacity for video (screen resolution, colour and size of monitor) will all be important here.

### **2.4 MANAGERS AND ADMINISTRATORS**

Managers and administrators are involved with ensuring that the hardware, software and infrastructure work together to meet the requirements of the other groups dealing with the learning environment. These individuals advise on what hardware and software to purchase and how to install it. The maintenance of this equipment (upgrading components, synchronising the various aspects of the system and trialing the equipment) is also the responsibility of managers and administrators as are arrangements for security for hardware, software and students, staff and others.

### **3. OTHER CONSTRAINTS ON THE NEW IT LEARNING ENVIRONMENT**

It can be seen, therefore, that four groups will primarily be associated with the IT learning environment. These groups have diverse characteristics and often come into contact with the IT learning environment for different reasons. Given these eclectic associations with the IT learning environment a number of factors need to be considered when designing and setting up a new IT learning environment. Some of these factors are detailed below.

#### **3.1 IT SKILLS OF GROUPS**

Not all groups will be fully familiar or comfortable with the technology being used in the Faculty. The attitude of the various groups towards computer usage needs to be assessed to enable a suitable level of programs to be developed. There is a need to look at what previous IT knowledge and skills exist and what further training is required. Students will be required to have a certain level of IT skills before they start the course in 1999. Issues such as accessibility options and special requirements for particular groups of people should also be given some consideration.

#### **3.2 TESTING AND EVALUATING**

The evaluation of both the IT learning environment itself and the skills and knowledge students' gain from accessing the new IT learning environment need to be considered. Issues such as the effectiveness and efficiency of CAL tutorials, ease of student use, frequency of contact with discussion groups, and accessibility of academic staff should be considered. A general program of evaluation needs to be developed and implemented to monitor the impact of the IT learning environment on students learning experiences and outcomes.

#### **3.3 COSTS**

The costs of establishing an IT learning environment need to be established. The stability of such funding needs to be determined along with the commitment of funding bodies involved. The maintenance of the IT learning environment will require ongoing financial support. Issues such as initial set up costs, costs of upgrades (hardware and software), maintenance of IT infrastructure and other recurring costs (such as staff training) will need to be considered and budgeted for. The source and timing of funding is also an issue – will funding be up front or staggered over several months or years?

One of the major ongoing costs of any IT organisation is the salary and training of qualified support staff. A PC support technician salary varies between \$25,000 to \$40,000 while an IT administrators salary starts at around \$40,000. There are also the costs of supplying staff with a suitable computer (\$3,000 to \$10,000 for a workstation; \$5,000 to \$15,000 for a server/workstation); assorted software to trial and use; manuals; office and furniture; tools; training; telephones (mobile or otherwise) and so on.

#### **3.4 PHYSICAL**

The IT learning environment aims to create flexible learning spaces so students can access the material they need from a variety of locations (computer laboratory, PBL tutorial rooms and home access). With regard to the computer laboratory and the PBL tutorial rooms decisions need to be made regarding where to place equipment, taking into account issues such as student and staff access, the delivery system, procedures for installation, network administration, ergonomics, adequate lighting and electromagnetic interference, security and accessibility.

#### **3.5 MANAGEMENT**

Software tracking will need to be arranged in order to ensure that only legal software is being used and that computers are not being used for illegal or frivolous purposes. A system of software security is required to ensure that software is not illegally copied or used. In addition measures need to be undertaken to ensure the physical security of the IT learning environment.

For example, computers should be stamped with identifying marks and monitors, keyboards and mice should be secured with cables or other physical locks. Motion sensors, swipe cards, optical cables or other security procedures should be installed to maintain the security of the IT learning environment. Documented instructions including emergency procedures should also be established and the various groups appraised of those procedures applicable to them. Timetabling of the laboratory for unsupervised student access and class bookings need to be clearly specified.

### **3.6 MAINTENANCE**

Maintenance schedules need to set up and maintenance will need to be carried out at regular intervals. Warranties should be checked – one to two day turn around and three to five years replacement of faulty equipment should be standard. Reliable suppliers who will provide effective and efficient backup services need to be established. Procedural maintenance will involve software and hardware maintenance and upgrades, as well as cleaning of screens, mice, and keyboards, including areas around the workstations. Virus checks of software will need to be performed regularly.

## **4. THE NEW IT LEARNING ENVIRONMENT**

### **4.1 PRESENTATION**

The majority of the IT components of the new curriculum will be delivered through Web pages over the Internet and University intranet to enable students to access course work from any available computer with a suitable network connection to the University. Study materials will be developed to be platform independent as far as possible. However, some pre-existing programs that will be used as SDL resources will not be web deliverable. Such software will be made available on computers in the computer laboratory, in the PBL tutorial rooms and possibly through removable media such as zip disks or CD ROMS.

The computer hardware and software will need to meet minimum specifications to enable the running of multimedia modules, a suitable browser (Netscape Communicator or Microsoft Internet Explorer), plug-ins (Shockwave) an emailer (Telnet or Eudora Pro), discussion and newsgroups, virus checkers and suitable security software. The LF software will also coordinate email, discussion groups, security and presentation of content. Students may elect to use the Faculty's computer resources or purchase a suitable laptop, which can then be connected to the University's network.

### **4.2 LEARNING FRAMEWORK SOFTWARE**

The main functions of the Learning Framework (LF) are to:

- deliver educational content;
- allow electronic messaging amongst students and teachers;
- provide electronic discussion groups or forums;
- allow student self assessment;
- provide an authoring process for content creation; and
- allow the system to be administered (security).

The LF will be based upon WWW technology and will be platform and network independent. This will enable the LF to support the varied hardware and software characteristics of our clients. The Faculty decided to purchase an established LF package rather than develop one itself. This decision was based upon the perceived cost-effectiveness advantages of purchasing consolidated, trialed and tested software as opposed to the having to fully develop our own package.

The following criteria were used to evaluate a number of candidate LF packages:

- Functionality – a set of 86 functional requirements specific to the Faculty were developed against which each package could be evaluated;
- Cost – both implementation and maintenance costs were considered;
- Product maturity – the history and proposed development path of each package;
- Supplier support – the service and support offered by the supplier;
- Risk – the overall risk associated with each package and supplier.

Based upon these criteria the Faculty has selected TopClass by WBT Systems, <http://www.wbt systems.com>, as its LF.

### **4.3 COMPUTER LABORATORIES AND TUTORIAL ROOMS**

A new computer laboratory of over fifty computers has been set up to cater for up to one hundred students. The lab also has connections for up to fifty laptops. It is envisaged that students will often work as a group (either two or four students) when researching and completing CAL modules to encourage communication and the elaboration of concepts encountered. The laboratory has been structured with an open design to encourage discussion between students. The PBL tutorial rooms have been designed to act as a ‘home’ room for a small group of students and to allow them another point of access for their SDL. These rooms will contain one computer and connections for up to eleven laptops. The PBL tutorial rooms have been designed and will be equipped with a small set of learning resources, such as medical dictionaries and other medical accessories. The rooms have three configurations: as a PBL room with a central table to seat ten students plus one tutor; as a SDL room with ten computer ports and the table split and placed along the walls; and as a clinical skills training room.

### **4.4 IT SKILLS**

Incoming Medical students will learn Basic IT skills during Orientation Week as part of their Medical Informatics course. This will include training in ergonomics, the basic operation of the laboratory computers (booting, logging on, mouse, menus, windows, navigating, running programs, browser basics and email). Also the students will be guided through the principles of PBL, SDL and Internet researching. Over the succeeding weeks further IT skills will be built up through course work. As the course progresses greater emphasis will be placed on the skills required for PBL, SDL and Internet research. However, the major emphasis will always be on the skills and knowledge needed as a Medical practitioner with IT skills being presented as having an increasingly important supporting role.

### **4.5 HARDWARE AND SOFTWARE IN THE COMPUTER LABORATORIES AND TUTORIAL ROOMS**

It is envisioned that the hardware and software in the computer laboratories and the tutorial rooms will continue to be reassessed and updated accordingly every one to five years in order to maintain up-to-date resources.

Presently, a basic lab machine consists of an:

- Apple G3 266 MHz Power PC;
- 32 to 64 MB RAM (64 MB highly recommended);
- 4 GB HDD;
- internal 2 to 6 MB video card;
- 17" monitors capable of over 1024 x 768 resolutions and thousands of colours;
- UTP fast ethernet 10/100 Mbps.

The current software set up has:

- OS 8.1 operating system;
- Hypercard;
- Netscape Communicator 4.05 and Microsoft Internet Explorer 4;
- latest Virex Virus checker;
- Virtual PC 2.1 (Pentium/Windows 95 emulator – shares the RAM with the Mac so need at a very basic minimum of 32MB for the Mac, 64MB for reasonable functioning);
- a variety of educational software consisting of various in-house produced MM modules, commercial products and freeware or shareware programs;
- NSCA Telnet; and
- Depending on demand Office 98 may be installed at a later date.

NOTE: Software versions change on a almost a monthly basis due to bug fixes and upgrades.

A fast ethernet network has been set up. Cabling has been completed consisting of Category 5 UTP connected to a University wide fibre optic backbone via fast ethernet switches and hubs. Several Digital servers have been purchased (PII 300 MHz dual processor capable, 256 MB RAM, two 9 GB HDD) running Microsoft Windows NT 4 Server, Netscape Enterprise Server 3.5 Microsoft Internet Information Server 3, backup Server and network software and various other house keeping programs. An Apple Mac 7600 PowerPC server runs the computer security for the computer labs. It runs Apple Network Administration Toolkit 2.0 (ANAT), Retrospect Remote 4 for backup of staff and acts as backup file repository for Web pages and teaching software.

## **5. FUTURE REQUIREMENTS AND DIRECTIONS**

In setting up the infrastructure to support the new medical curriculum the Faculty of Medicine, Dentistry and Health Sciences has tried to provide for future growth. With the fast pace of change of all IT related activities it is difficult to plan for activities more than a year or two ahead. The goal is to reassess the requirements for hardware and software over a one to five year timeframe. Any superseded computer hardware and software can be used in other areas of the Faculty or sold to other departments within the University, students or staff or to other educational organisations. Continued development of MM software modules will increase the minimum specifications for hardware and software. The University is presently converting its network backbone to be able to support Asynchronous Transfer Method (ATM). This provides for a large bandwidth capacity and will open the way for 'Video on demand' which will allow procedures, operations and tele-conferencing to be recorded and subsequently demonstrated to students. 'Video on demand' requires high bandwidth connections and fast computers with specialised video cards.

Off-campus access for training and continued professional development is also being considered. The network in place off-campus will determine if we will provide course content from a server at the University campus or whether we will need to set up an off-site server, which will need to be kept concurrent with the on-campus Faculty servers.

Through Internet searches and by gathering local resources an extensive local database of objects will be established which will be readily available to students. This will include programs, medical images and sounds, web sites and pages, relevant video clips, templates, help files and simulation data files such as DNA molecules, chemicals and spreadsheets.

A means of student and staff being able to connect their laptops into the University intranet while on campus has been set up by the University IT Services group and will be used by the Medical students to access the Faculty intranet.

Availability of funding, evolving IT trends and formal evaluation of the new curriculum and the enthusiasm of the groups involved with the IT learning environment will determine the extent to which the ideas and suggestions contained within this paper will be realised.

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