The Development of a Departmental and Web based Teaching Syllabus for Radiological Anatomy

Gerald Lip

A dissertation submitted to the University of Dublin, in partial fulfilment of the requirements for the degree of Masters of Science in Health Informatics.

2005

Declaration

I declare that the work described in this dissertation is, except where otherwise stated, entirely my own work, and has not been submitted as an exercise for a degree to any other university.

Signed: _____

Gerald Lip

10 September 2005

Permission to Lend and/or Copy

I agree that the Trinity College Library may
lend or copy this dissertation upon request.

Signed: _____

Gerald Lip

10 September 2005

Acknowledgments

I would like to express my sincere appreciation to the following:

Dr Mary Keogan, for her support, advice and faith in this project

The Trinity Association and Trust; without their financial support this project would not have succeeded.

Ms Nina Bresnihan for agreeing to mentor me for this Masters

Mr Tommy Walsh, Department of Photography Tallaght Hospital for his help in supplying images.

Mr William Cox, Department of Radiology, St James Hospital for his initial help in providing films and getting the project started.

The staff and members of the Department of Anatomy, Trinity College Dublin for their support and advice in implementing the syllabus.

Ms Amy Murray of CAPSL and Ms Catherine Bruen of WebCT for invaluable help and advice.

My family for being there.

Summary

The role of radiology in clinical practice has grown exponentially over the years with each new discovery of further imaging techniques such as MRI and PET imaging. Undergraduate teaching of radiology however has often been ad-hoc or an add-on to other parts of the undergraduate programme, often as part of the anatomy module. This has often led to complaints from clinical teaching staff about student unfamiliarity with X-rays and a subsequent lack of confidence on the students' part. With the increasing complexity of curricula along with demands on student time coupled with a smaller number of qualified staff, university departments have had to come up with new methods of delivery of educational material.

Despite a 20% decrease in actual teaching hours for students, the Department of Anatomy in Trinity College Dublin resolved for the academic year of 2004-2005 to increase the teaching of radiology in the syllabus and also to deliver it in house via small group tutorials with film and computer-based teaching. Trinity students were also using a new resource called WebCT, a commercial authorware website developed by the University of British Columbia which housed lecture notes and teaching materials.

This thesis sets out to document the design and production of an online web page to deliver radiological anatomy teaching within the Department and on the Internet to students of the Faculty of Health Sciences. The web page aims to cover all the topics taught in the academic year for the second and third year medical students along with

first year speech and therapy, physiotherapy, occupational therapy and dentistry students utilising the relevant radiological material with teaching notes. The progression of this process is described beginning with defining a radiological anatomy syllabus, storyboarding and developing the website, user questionnaires, surveys and image acquisition to finally implementing and evaluating the finished product.

The website, built with Dreamweaver MX and delivered using the WebCT module is freely accessible by all students and utilises text, graphics, videos and animation. Student usage can be tracked online and the website is also used in house currently in small group sessions to teach radiological anatomy as part of a formal practical session. Radiographs have already been used in formal student exams and independent surveys have revealed a high level of student satisfaction with the radiological anatomy syllabus.

TABLE OF CONTENTS

List of Appendices

Table of Figures

Table of Tables

Abbreviations

MRI	Magnetic Resonance Imaging
PET	Positron Emission Tomography
CT	Computed Tomography
CAI	Computer Aided Instruction
TCL	Traditional Classroom Learning
CSS	Cascading Style Sheets
DICOM	Digital Images Common
PACS	Picture Archiving System
HTML	Hypertext Markup Language
ISS	Information Systems Services
CAPSL	Centre for Academic Practice and Learning, Trinity College Dublin
CLT	Centre for Learning Technology, Trinity College Dublin
IEEE	Institute of Electrical and Electronics Engineers, Inc
AICC	Aviation Industry CBT (Computer-Based Training) Committee
ARIADNE	Foundation for the European Knowledge Pool
SCORM	Sharable Content Object Reference Model

Chapter One: Introduction

1.1 Background

The teaching of anatomy has a long and illustrious history. It is often the first point of contact for a medical student with the clinical environment and often the cadavers used for dissection in anatomy are referred to as their first patient. In the past few years, teachers in many anatomy schools around the world have been facing similar challenges. The detailed content of the anatomy course has been reduced with more emphasis on clinically relevant anatomy. Anatomy as a pure discipline is disappearing and few new anatomists are being trained (Older 2004).

Radiology is a growing specialty and has become an essential part of medical decision making. However, many students receive little or no formal training in radiology and often graduate from preclinical to hospital-based clinical rotations without the necessary skills at deciphering radiographs.

With the actual teaching hours per student in Trinity College for 2004-2005 being reduced by about 20% and a move towards student-centred problem based learning, emphasis has shifted away from didactic based lectures towards making the student more responsible for their own learning. What is needed is a course that delivers anatomic content that is relevant, gives students enough knowledge for their background information in their clinical futures, is efficiently delivered despite a shortened course, increasingly packed curriculum and decreasing numbers of academic staff.

Radiological anatomy as a concept has been around since the 1960s and has been recognised to give an advantage to students in their future careers (Ekelund 2000). Very few anatomy departments have dedicated radiological anatomy staff. More likely, an informal arrangement with the radiology departments of their respective teaching hospitals exists and assistance is provided in the form of loans of images or stand alone lectures (Mitchell 2002).

The use of technology in teaching anatomy has also been explored in many schools and most schools have some form of computer-aided learning. All students have access to computers in college and much of the curriculum has been shifted online for easier access by students.

Case and problem-based learning are being introduced in many medical schools' curricula (Mitchell 2002). Teaching is consistent with the theory of group learning with reinforcement and repetition of information being part of the discussion process and enhancing the educational learning process. With any of these cases, imaging is often central and indeed clinically relevant. Often the radiological imaging demonstrates the anatomic principles of the clinical cases most clearly.

In consultation with planning for this thesis, the Department of Anatomy in Trinity wanted to take a two pronged approach in introducing radiological anatomy to the syllabus. The first approach was for radiological anatomy teaching within the Department

to be taught at each practical session in small groups using film and digital media to demonstrate the anatomy of the dissection practical that day. The teachers would be trained doctors who would be able to bring clinical relevance and accuracy to the radiological cases and stimulate discussion with the students. The second approach addressed repetition and reconfirmation of the information by making the images discussed accessible on the Internet under password protection for the students to access from computers in the Department, in college or at home at any time to revise the practical sessions of the day.

1.2 Objectives of the dissertation

To document the design and production of an Internet website to teach the radiological anatomy syllabus

This website would incorporate relevant X-rays, CT's, MRI's, PET scans and relevant photographs and videos. One section of the site would be enhanced to show the full potential of the site including videos of surgery, animation of embryology and of course the relevant radiology. It is envisaged that the site will continue to be maintained and indeed expanded by the Department as a continual resource for students to use during their undergraduate career as the radiographs are relevant up to and past the clinical attachment years.

To formalise a radiological anatomy syllabus

There is no formal teaching of radiology at all to medical students in most Irish and English universities. We aim to produce a basic and clinically relevant radiology syllabus

corresponding closely to the anatomy practicals and introduce radiology via the anatomy course to preclinical students giving them a formal grounding for their clinical futures. The author believes that this familiarity will help promote student enthusiasm and confidence in approaching the hospital rotations.

To review the published literature on radiological anatomy teaching

Radiological anatomy is still a relatively new term and the review of processes adopted elsewhere will provide an insight and guide to the approach to take in developing this project.

To evaluate student response

Three surveys have been sent to all students in the Faculty of Health Sciences and the author hopes to identify the success of the project and what further improvements are needed.

1.3 Guide to dissertation

Chapter two is a review of the evolution and state of teaching of radiological anatomy worldwide and reviews current trends and approaches in teaching. It looks at the level of involvement by radiology departments and how much of the course is given over to radiology. It looks at approaches especially in the United States to teaching radiological anatomy and their success and techniques of delivery.

Chapter three reviews literature on computer aided learning and discusses the online teaching platform used by Trinity College called WebCT and does a literature review of efficacy of that teaching system as well.

Chapter four describes the planning process in designing the website for the radiological anatomy course. It details the necessary steps required in building the site and the rationale behind the student questionnaire. It discusses the methodology and findings of the questionnaire and reviews the setting up of the anatomy teaching centres and gathering of resources for it. It also details the planning involved for the website and shows the user experience via a site map.

Chapter five describes the implementation phase as images are acquired and retouched whilst videos, graphics and animations are produced for the website. An overview and walk thru the website is also discussed

Chapter six describes the continuing evaluation for surveys 1 and 2. Survey 1 was taken before the launch of the website but after the introduction of the new syllabus and survey 2 addressed student response to the radiological anatomy course and the website as well. Internet usage which can be tracked using the WebCT programme is also discussed and analysis of results the radiological anatomy exam question in the Easter exams is also described.

Chapter seven provides an analysis of the main findings of the dissertation, describes the benefits of the approach used and discusses future directions for the radiological anatomy project.

Chapter Two: Literature review – Using Radiology to Teach Anatomy

2.1 Introduction

Ever since the first X-rays were produced of the human body, their obvious use in the teaching of anatomy was also apparent. Evidence of this has appeared in the medical literature since the 1960's mostly in Australia and the United States of America (Reidy J 1978, Chambers 1973). It has also existed in piecemeal unstructured forms in most schools in the United Kingdom and Ireland.

Since the 1960's the role of radiology in clinical and teaching practice has increased exponentially with each new imaging modality. This has been accompanied by a similar progression in computer technology and methods of teaching radiological anatomy. New technologies developed over the decades include computed tomography in the 1980s, magnetic resonance imaging in the 1990's up till positron emission tomography combined with CT today. More powerful MRI scanners and newer multislice detector CT's are producing finer images than ever seen before. This, in combination with more powerful computers, allows for 3 dimensional reconstructions of images allowing visualisation of internal organs and vessels of the body with unprecedented clarity. Digital imaging is increasingly more important in the practice of medicine (Novelline et al 2001) and our target of introducing this myriad of imaging techniques to the preclinical medical students aims to help students become comfortable with these alternative forms of imaging and their technical aspects during the acquisition of anatomic knowledge.

2.2 Academic teaching in crisis

The British Medical Journal launched a campaign in 2004 to try to resuscitate academic medicine (Abbasi 2004). One survey in the Independent (2003) newspaper revealed that more students (69%) sent a social text message to their friends during a lecture than asked a question (49%). Similarly the teaching of anatomy is undergoing a downward spiral as reviewed by Older (2004). In that article he pointed that the current teaching trend in medical schools worldwide is to introduce problem based learning to replace structured didactic teaching. In doing this, teaching slots and financial budgets for the traditional foundation courses like anatomy are being downgraded. In this mix of increasing pressure on an expanding syllabus and decreasing time in which to teach it, staff morale and teaching inevitably suffers. Anatomy schools in particular with their specialised preservative equipment and high administrative costs are an attractive target for downsizing. Indeed other advocates like McLachlan (2002) argue that anatomy should be taught without cadavers. Multiple centres especially in the Middle East have approached using alternatives to cadaveric dissection through the use of radiology, plastic based models and problem-based learning.

Most academic anatomy departments have good relationships with the radiology departments of their teaching hospitals but receive only limited help in the form of voluntary teaching or donations of films or digital images. In all the medical schools of the UK and Ireland only Peninsula medical school has a full time radiological anatomist (Mitchell 2002). The curriculum, content and level of radiological anatomy taught is highly variable and is crying out for a degree of standardisation.

2.3 Computer-Based Teaching of Anatomy

The lead in teaching radiological anatomy via computer-based learning and web-based learning has been pioneered mainly in the United States. A recent discussion paper by Shaffer (2004) on teaching anatomy in the digital world asserts that with increasing developments in computer capability, greater availability of computers on university campuses along with the advent of high bandwidth data transmission and selective data delivery, more realistic and educationally valuable experiences can be delivered.

With 'virtual' methods for teaching anatomy radiological images can be manipulated on computers in a variety of ways. For example, engineering software can be used to map and show an organ like the heart, in 3 dimensions, allowing the user to rotate it in all planes and viewing all blood vessels. Anatomical models can be developed with this technology allowing for these to be searched, manipulated and explored by students. DICOM viewers are freely available now and it has been shown (De Barros 2001) that formal teaching of interpretation of coronal and sagittal views on CT's does result in better performance of students in the later clinical years.

Possible future technology could include Haptic or tactile technology giving feedback and simulating living tissue. Another option is virtual reality anatomy in a similar vein to virtual surgery now being pioneered in the Royal College of Surgeons Ireland via the "SCHOOL for Surgeons" - (Surgical Conferencing with enHanced Opportunities for Online Learning

2.4 Current Approaches in the Teaching of Radiological Anatomy

In the United States, the method of teaching radiological anatomy has evolved in response to academic thinking and student feedback using a theory called blended learning (Shaffer 2004). This theory postulates that optimal educational benefit is obtained from using a variety of different teaching approaches including lectures, small group learning, individual study and computer assisted learning. Cases in point are the various Radlab modules developed by Harvard Medical School. These cover a range of topics starting with a brief introductory lecture to a large group followed by small group web based instruction with rotating lab instructors. Some of these modules include self study cases prior to the practical sessions with follow up cases and optional review sessions.

In the UK, teaching methods range from showing a few X-rays donated at the end of a practical to fully integrated radiological anatomy syllabus as described by Mitchell (2002). One medical school in the UK, Peninsula medical school, which is teaching anatomy without cadavers is heavily reliant on using medical imaging examples and the use of virtual reality imaging (McLachlan et al 2004). In McLachlan's article, Peninsula, defends it use of imaging without cadavers with examples from studies by Rosse (1995) and Zirkel (1997) as part of their evidence base for setting up the course.

Erkononen (1999) in a review to an Introduction to Clinical Medicine course for 2nd year medical students found that lecturers content included diagnostic images with up to 7% of lecture time devoted to radiology yet there is very little formal interaction between radiologists and nonradiologists in teaching.

The current recommendation is that radiological anatomy teaching should be introduced earlier in the course, preferably during years 3-5 of a 6 year course (Ekelund et al 2000). Evidence has been shown that early teaching in cross sectional anatomy results in a positive effect on subsequent interpretation of computed tomographic scans (de Barros N 2001). The importance of the role of computing has been highlighted and many Web sites and teaching files are available, although some of these are too advanced for medical students (Maleck M 2001, Collins J 1999).

Creative use of technology will likely be essential for teaching anatomy in the current and future medical educational environment, when time is short and faculty are in short supply (Reidenberg 2002, Kim S 2003, Walker D 2002). However computers alone are not sufficient for optimal student engagement (Chew F 2002). Most medical schools are moving towards a variety of theories of learning with the most popular at the moment being the transtheoretical or blended learning model which integrates didactic lectures, small group teaching and web based modules allowing for optimum knowledge acquisition. (Barbian J 2002).

Currently, medical schools worldwide are in a transitional period with regards to their curricula. Many are moving from the traditional lecture based style didactic teaching towards a stronger emphasis on problem based learning and small group teaching. The Internet is becoming an important tool for the distribution of information to medical students and medical schools should also look into educating students on how to apply evidence based evaluation and skills to sift through the available information.

Chapter Three: Literature Review – Computer-Aided Instruction

3.1 Introduction

This chapter discusses the use of CAI in health care education and profiles the WebCT online education system being used to instruct students in the Faculty of Health Sciences, Trinity College Dublin. I will also review a small section on CAI in comparison to traditional classroom learning (TCL) .As the main aim of this thesis is to devise an online radiological syllabus, the comprehensive literature review focuses on methods of CAI, the processes in developing a teaching module and a summary of the planning stage.

3.2 Computer Aided Instruction

The literature identifies the use of computers in education as far back as the 1950'-s (Kulik et al 1980). The creation of the World Wide Web made possible the introduction of user friendly web-based software for teaching (Matthies et al, 2000, Ward et al 2001).

Questions that educators should consider in developing computer and web-based teaching modules include the types of materials to view (Turchin 1999), whether online teaching can be as effective as traditional classroom teaching (Handler et al 1995) and how to measure the effectiveness and quality of the products. Most studies reviewed by the author tend to use subjective studies on student satisfaction (McLean 2000). Others have tried to use tools to track the pattern of website use and try to link them to examination performance (Rizzolo et al 2002). This reflects a more sophisticated form of teaching that has evolved from the original CD-ROM based drill and practice programs (Gleydura et al

1995). CAI programmes as mentioned above can now include tracking technology in the background. On the web front – multimedia technology defined as the delivery of sound, text and images on one platform provides an invaluable tool for teaching. One aspect in particular which students are enthusiastic about is online quizzes (Turchin 1999)

In the field of health sciences many major textbooks have been digitised to provide didactic teaching. CAI packages such as those by Lowry and Johnson (1999) were used at Leeds University to provide background teaching to the health sciences course. Rouss (1999) further describes a CAI package to teach students about congenital heart disease and Franck and Langenkamp (2000) comment on using CAI for in-service training, teaching clinical decision making skills and non clinical skills. The personal digital assistant also heralded an era of mobile CAI with drug formularies such as Epocrates Rx (www.epocrates.com) easily at hand. Additionally amateur programmers have built simple CAI modules such as protocols in advanced cardiac life support, medical calculations and decision making tools with programmes such as the Griffin 5 minute clinical consult. Teleteaching is also making inroads with one example from Timms in Germany (2000) detailing a web cast combined anatomy and surgery teaching session to students in another location.

CAI provides an avenue for individualised learning that helps supplement current training methods (Rouse 1999) positively enhancing the acquisition of skills. The learner is able to set their own pace with the accessibility and convenience of CAI. This does require a degree of self imposed learner discipline in order to complete programmes. Rouse (2000)

reports that CAI is particularly useful in reinforcing factual material and problem solving skills and helps students particularly when faced with more difficult subjects as they become an active participant in deciding their own learning progress. Sternberger (2001) observes that students gain cognitive skills along with quicker understanding of new concepts using CAI packages.

CAI uptake has gradually improved in tandem with technological development. For example, 10 years ago we were only starting to use email technology but today it is everywhere with many students using mobile internet devices.

All students in Trinity College Dublin have an email address and there are high levels of computer ownership among the students in the Trinity College Faculty of Health Sciences as shown in a survey discussed later in this thesis. Thus, problems with CAI in the past (Thede 1994) where students were reluctant to take up CAI due to a lack of computer skills are not the barrier they used to be due to increased familiarity and better comfort levels of the user with technology. Another factor pointed out by Wainwright (1994) was staff resistance to technological changes but again that approach seems to be fading away with increasing computerisation in the workplace, universities and at home.

3.3 The WebCT Teaching Modules

E-learning itself has been moving away from proprietary to open standards and the IEEE has a major role in devising standards for e-learning material. A common standard would allow content to be moved and shared between platforms. The Advanced Distance Learning (ADL) initiative in the US in 1997 resulted in collaboration between professionals such as the IEEE, AICC and ARIADNE to develop the Sharable Content Object Reference Model (SCORM). SCORM provides a collection of specifications with a comprehensive standard of capabilities to be used in the e-learning environment to enable interoperability, accessibility and reusability of web based e-learning content.

WebCT was developed by the Department of Computer Science at the University of British Columbia in 1999. It is a software package used as an authoring tool to create an online learning environment. It adheres to the SCORM principles of content being reusable, accessible, interoperable and durable (RAID).

By using WebCT as our authoring tool I was able to sidestep a lot of development and design issues that would have delayed implementation of the project. The software provided the necessary functions for design and delivery of online education and students in Trinity were already using WebCT for other course modules hence familiarity and training was not a problem.

The WebCT package provides the capability for synchronous and asynchronous discussions, email, file sharing, student grading, student access to course content, tracking of students' work, and external linking to references as well as being multimedia capable (Frederickson 1999, Nada 2000). The framework allows for easy uploading of images, MS PowerPoint and MS Word files and also functions as a hosting site for web pages. The designer control panel allows access to student records and usage patterns allowing for quantitative measurement of students usage of the website.

3.4 Conclusion

It can be concluded from a review of the literature that more and more packages are being developed to teach medical students radiological anatomy. The current favoured teaching model is the blended learning model of education where students have a mix of didactic large group lectures, small group teaching, computer-aided and web-based programs for teaching and individual self learning. The WebCT program on review is an excellent authoring tool providing the framework of a design that is compliant with international standards and provides a medium for delivery that is learnt and mastered quickly.

Chapter Four: The Planning Stage

4.1 Introduction

This chapter will look at the steps involved in the planning and development of the departmental and web-based syllabus for radiological anatomy. Particular steps described include the process involved in web design, user identification, requirements elicitation along with various interface designs. It was decided early on to do an initial student questionnaire on computer usage patterns and comfort with technology. One of the main aims of the questionnaire was to determine if students had reached the 'tipping point' in terms of acceptance of computer-aided learning. This was via questions ranking their comfort with technology, whether they had accessed the WebCT program already and levels of computer ownership.

The ten-question questionnaire was aimed at students in the Faculty of Health Sciences and given during a one-week period. The methodology and findings are covered in this section. This will be followed by a discussion of the findings and an account on resource gathering and technology assessment.

4.2 Aims and Objectives of Questionnaire

During the beginning of the academic term for 2004-2005 (Michaelmas) a questionnaire (Appendix A) was administered to all students in the Faculty of Health Sciences who would be the target group of users for the Radiological Anatomy syllabus. The aim of the questionnaire was chiefly to:

- Identify levels of computer ownership among students
- Assess on a ranking scale students' confidence in using computers and using the Internet
- Check how many students have already accessed the WebCT module which also hosts lectures from other courses
- To check Web use of students and to see if they have accessed other medical websites.
- A free text section to see what suggestions students have that would aid in development of the website.

An account of the process involved in administering the questionnaire and an analysis of the results follows.

4.3 Methodology and Administration of Questionnaire 1

A quantitative approach was taken to acquire the relevant information from users. A self administered questionnaire was distributed to all students attending lectures in the Anatomy Department over a one week period in October. All classes receive one lecture a week hence there was no doubling up and a short announcement was made at the beginning of each lecture and the questionnaires were then distributed. The papers were anonymous and were considered more effective than the personal interview approach in order to generate this amount of data. This generally is the most common and versatile method of collecting data and is used extensively to carry out need assessment (Cormack 2000). This approach would be more advantageous as well as with anonymity; candid

responses in an unpressured situation should deliver respondent's true opinions. (Polit 1999)

Permission for distributing the questionnaire was given by the Head of the Department of Anatomy after vetting. The questions were also validated by the Head of Department in the Anatomy department and a consultant radiologist in St James Hospital. The questionnaires were then distributed personally by the author and the results collected after each lecture and collated by the author as well.

4.4 Results of the Questionnaire

A total of 259 surveys were completed and returned. This was out of a total of 350 students attending lectures that week giving a response rate of 74% showing good student interest in giving feedback for implementation of the project. The results of the survey are grouped under the following headings:

- Computer ownership levels
- Student confidence in using computers
- Assessment of usage of the WebCT project and usage of the Internet to access medical material online
- Some excerpts from the freetext section

Appendix B contains full details of the results of the questionnaires

4.4.1 Computer Ownership Levels

As more and more CAI is being used to teach students. There will be a time in the near future when all students will be bringing laptops to lectures and accessing web based materials to aid in their learning experience. More and more teaching materials are being posted online and students are increasingly being moved towards an ethos of self directed learning. As such computer ownership is an important factor in advancing CAI.
Of all respondents, 204 (78.8%) owned a laptop, desktop or both. Broken down, 103 (39.8%) owned laptops 53 of each were wireless enabled.

4.4.2 Student Confidence in Using Computers

Students were given a scale from 1 to 10 ranking 1 as having no IT knowledge and 10 as considering themselves as being IT savvy. The mean ranking received from 259 students was 6.3 with a median of 6. 15 gave themselves a 10 out of 10 ranking and most respondents 65 ranked themselves with a 7 out of 10 ranking symbolising good confidence with technology.

4.4.3 Assesment of Usage of the WebCT Project and Usage of the Internet to Access Medical Material Online

With regard to the WebCT online site 253 of the students (97.7%) reported that they had accessed the website mainly to access and download lecture notes and past examination papers. Analysis of their access was estimated by asking the average amount of time they accessed the sites and the number of times a week they accessed it. This was reflected by

most students accessing the site once a week and spending an average of 38 minutes online. 145 (56%) of students also reported that they had tried to access medical educational material online.

4.4.4 Freetext Analysis

Responses from students in the freetext section included the following suggestions:

- Multiple choice questions
- Quizzes
- Additional notes
- Sample answers

4.5 Discussion of Findings

The current generation of students have grown up using computers and are very familiar with them. This makes it easier to introduce teaching materials for CAI and e-learning. Anatomy as discussed in the literature review is a highly visual subject requiring imagination and 2D and 3D mental visualisation. This is aided in practicals by dissection. We would aim with CAI to assist this form of learning using movies, X-rays and graphical teaching material.

The students showed a high level of computer ownership (78.8%) in addition to also being able to access computers at various sites around the campus. The students are generally comfortable and able to use computers reflected by the 202 (78%) of students ranking their IT skills from 5-10 or above average in terms of ability.

The WebCT program, which can also be accessed via both the college intranet and off campus by students via the Internet is a good easily accessible program. Students enter their college id and password to enter the site and click on their topic of choice. 249 (97.7%) of students had already accessed WebCT before implementation of the radiological anatomy website. These students accessed the site at least once a week and spent an average of 38 minutes browsing and studying from it. This bodes well for student usage of the radiological anatomy website in future which will be hosted on the same WebCT portal that all students will log into.

With the addition of future materials as per student suggestions in the form of multiple choice questions, quizzes and multimedia in the form of animation, movies and images, the WebCT site will be enhanced and provide a definitive one stop shop for students to access in their self directed learning. Ideally they should access the site pre and post practical to review the lessons of the day. Another factor is broadband penetration in Ireland is still low at 5% (McDonald I, 2004) compared with the UK at 30% but this number is steadily increasing and this should help facilitate students with self guided learning and provide a valuable adjunct to current college based practicals and lectures.

4.6 Authorware Selection

The selection of authorware was simplified somewhat by the use of the Department of the WebCT module which is a form of authorware for CAI. The framework is relatively simple to learn and provides a reproducible, standardised, familiar format for delivery of

e-learning material to medical students. However one area that it was lacking in is additional flexibility in displaying larger movie and image files and a decision was made to create web pages which could be hosted in WebCT and allow students access to this using WebCT as a portal.

Dreamweaver MX was chosen to create the website because the author had previous experience in web page design and was familiar in using Dreamweaver and it²s sister programs Fireworks MX for graphics' manipulation and Flash MX for developing small movies and animations.

Dreamweaver allowed for the creation of hotspots – a key component for teaching X-ray interpretation as will be discussed in later chapters, Dreamweaver can also easily use cascading style sheets (CSS) to be compliant with the Trinity College guidelines. Again this presents students with websites that would be instantly recognisable and similar to all websites hosted on college computers. Many tools can be used with Dreamweaver and include visual images, animation, sound and video.

4.7 Resource Requirements

To ensure that the course could be delivered effectively online and within the Anatomy department a full list of hardware and software necessary to develop the tutorial into a functional CAI resource was drawn up.

Computers

Using the theory of blended learning from the literature review, the teaching practicals were reorganised with a large group didactic lecture at the start of the practical followed by small group doctor led teaching. Computers would be needed at these small group teaching sessions to teach radiological anatomy effectively. A further computer ideally separate from the four teaching computers would be needed to develop and create teaching material for the lectures. The DICOM CDs showing CT²s and MRI²s can best be shown on computers.

X-rays and Digital Media

A bank of images would need to be built up consisting of film X-rays and digital images of the same and of CT²s and MRI²s covering all parts of the bodies covered in the anatomy practicals.

Software

Copies of Dreamweaver MX, Fireworks MX and Flash MX needed to be purchased to design the website.

Extra equipment

Network cable connections. Blank CDs for copying additional X-ray images and shelving units for the computers were additional pieces of equipment that needed to be considered.

Applications were made to the Trinity College Association and Trust for a grant to pay for computers to be placed in the Department of Anatomy for teaching and web developments. That grant was approved and five computers were bought with the grant. Additional network points needed to be installed and this was supported by financial support from the Faculty of Health Sciences. The software was also purchased with this support and the author was given additional instruction and training on Dreamweaver and WebCT by the Centre for Learning Technology in Trinity College Dublin.

Radiological images in the form of multiple film X-rays and CDs with DICOM images on all parts of the body were donated by the radiology departments of St James Hospital and Tallaght Hospital along with advice on the clinical aspects of teaching these images from consultant radiologists in both hospitals. These hospitals are the teaching hospitals associated with the Faculty of Health Sciences in Trinity College Dublin.

The desktops purchased were network ready Dell Optiplex GX280 models running a Pentium 4 2.8GHz processor with 512MB RAM and a 64MB Video card with DVD/CD rewritable drive and 17" TFT monitors which more than fulfilled any of the technology requirements of the software.

4.8 Planning The Website – User Maps

Thorough planning is required as an integral part of development of any software program or website. This section deals with what the user experience will be and how

they are expected to navigate through the site. I will illustrate this further with a user map as well.

During this planning and design period, the author spent some time in the early stages of the design process determining and documenting a preliminary draft of the content and sequence of the relevant radiological anatomy sequences and practicals to be included on the website.

An organisation chart and storyboards were developed to define the structure and sequence of content for each part of the website and allocate resources and images to each part of the module.

The organisation chart and storyboards were structured using the existing teaching practical sessions as a base and creating layers based on the images and teaching materials to be included. By using the organisation chart, branching instructions and navigation requirements between pages on the website could be defined. The requirements and expectations for the design of the web pages themselves were confirmed during these periods and a planned screen design began to take shape. The web page design followed principles recommended by Powell (2000) who recommended That one of the keys to success was maintaining a consistent look throughout an interactive program.

The author followed this closely by using one cascading style sheet (CSS) or base design throughout all the web pages and placing the text and images in the same way on all the web pages. The stylesheets ensured uniformity in all the pages with proper cross linking navigation between the many pages on the site. The stylesheets ensured that when clicked the links would all change a different colour or when clicked an image would appear. This uniformity quickly allows the student to become comfortable and familiar on the new pages and navigate through them with confidence.

A user map below illustrates what the author expects of how users will interact with the web page and to highlight the intended functionality of the web page.

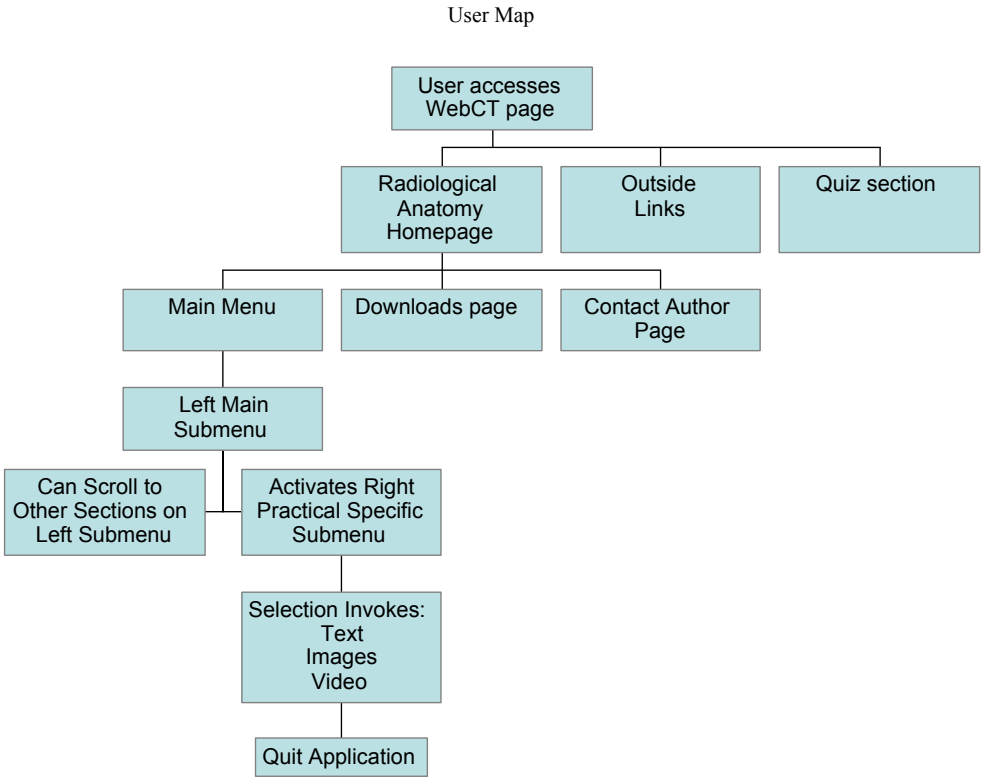


Fig 4.1 User map for navigating through the radiological anatomy website

Initially, the student should log in to WebCT and select the radiological anatomy option. At this point the student will then have a choice of three options, the main radiological anatomy site, external radiological anatomy links or enter a quiz and self testing section. A text section on the right gives a general introduction and highlights objectives of the website. The student should then select the radiological anatomy homepage, which brings them to a main menu where they can select from a range of web pages arranged according to their anatomy practicals. The left hand side menu which is present at all times covers a section of the body like the thorax or the abdomen. Each main heading on the left hand side of the page when selected will bring up a secondary menu on the right hand side of the web page showing a list of practicals relevant to that section of the body, for instance, the bowels or the heart. The student then views the relevant text and radiological anatomy images and can now navigate using the menus located on the left or right hand side. A menu also resides at the top of the pages, which are present at all times. One tab leads the students to a downloads page of numbered radiological images. Other tabs link to the main menu and a contact details page. Once completing the practical the student can quit at anytime.

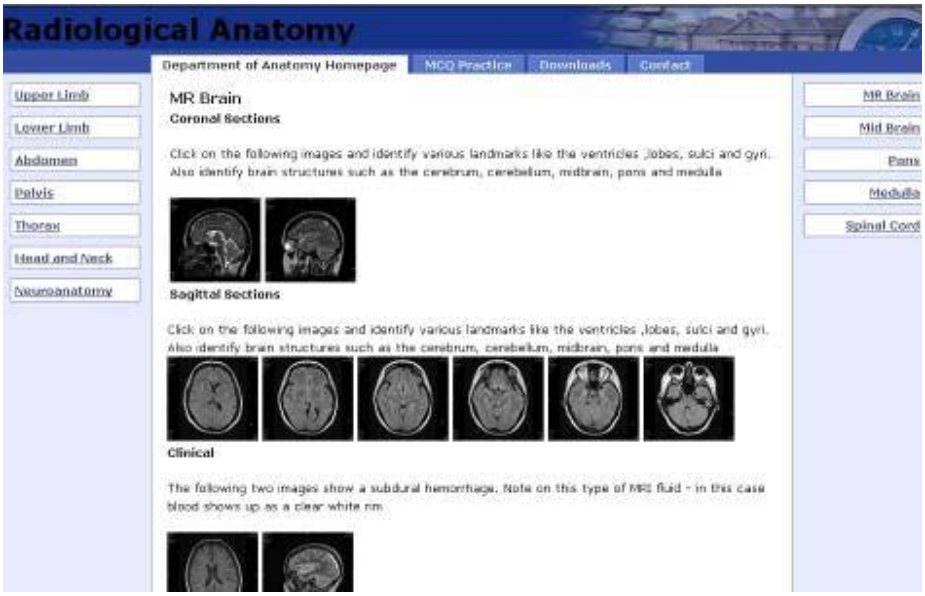


Fig 4.2 CSS template for the radiological anatomy homepage

These storyboards also provided a framework for discussion with the other anatomy demonstrators who would also be tutors in radiological anatomy and allowed for feedback on the actual design and necessary changes prior to full implementation of the website.

Chapter Five: Implementation Phase

5.1 Introduction

This chapter focuses on the process involved in converting the design and storyboards to a fully functional product to be used daily in teaching students in the Faculty of Health Sciences. A detailed account will follow; listing the process of acquisition of X-rays, consultation in designing the syllabus, methods of image manipulation, use of Dreamweaver and hotspot technology to test students, integration of the system with WebCT and the final setup of the clinical teaching centres.

This chapter will also provide the reader, with an overview of the main content of the website and will show some of the navigation through the pages. User acceptance testing and feedback will also be covered later in the chapter.

5.2 Image Acquisition

Contact was made with the Department of Radiology in St James Hospital and access was granted to the reporting rooms and the radiology registrars' museum. In the reporting rooms, the author selected X-rays showing relevant images of normal and abnormal anatomy, which would be an asset and contribute to the course.

The author also sifted through all the X-rays in the radiology registrar museum selecting the best clinical cases from their collection of X-rays, CT[2]s and MRI[2]s showing a variety of cases ranging from bony X-rays to angiograms detailing the arteries of the body. This

was done over a period of a month in October of 2004. Films selected were then brought to the developing room where five copies of each X-ray were made. Four for teaching in each clinical anatomy teaching corner and one set as a spare. The aim was to teach the students with film and digital media as PACS implementation is still ongoing in many hospitals and chances are that these students will still be using film media upon graduation hence the decision to familiarise them with both mediums.

The author also travelled to the radiology department in Tallaght Hospital in January 2005 and was given permission by the radiology department there to collect digital images. Tallaght was chosen because they are currently the only hospital in the country will a fully working picture archiving system (PACS). Hence all images produced by the Department of Radiology are digital in format. Again the author was given access to the reporting rooms and spent a week in the Department picking normal CT²s and MRI²s and clinically relevant cases. The list of the digital images was then transcribed by the Department onto compact discs in proprietary format with a built in DICOM viewer from the Siemens PACS system. A series of five teaching discs covering the thorax, abdomen, peripheral limbs, pelvis and finally, head and neck were created with unique clinical and normal anatomy cases (Figure 5.1).

Figure 5.1 Trinity Radiological Anatomy Teaching CDs

5.3 Syllabus Preparation

In consultation with the Department of Radiology in St James Hospital, the practical lists for the previous year were broken down and in each practical, targets for identification on relevant X-rays were noted and teaching objectives clarified. (Appendix C). This syllabus was stress tested over the year and was subject to a continuing process of refinement. The syllabus was also vetted by the consultant radiologists' in St James Hospital and the senior lecturers in the Department of Anatomy in Trinity College Dublin.

5.4 Image Manipulation, Multi-layering and 'Hotspots'

Fireworks MX was the graphics program used to manipulate images for the website. For the process of creating hotspots a base radiological anatomy image was used. This first image Fig 5.2 has areas of anatomical interest, which are then numbered. These numbered areas are then selected on the image and are the highlighted with selection boxes as shown in Fig 5.3. The hotspot mechanism works by simple substitution of words with these selected boxes as shown in Fig 5.4.

By using these hotspot linked images, students are provoked into self testing and self learning by first guessing the names of the areas and then running their mouse over the numbers to reveal the names of the area in question.

The images were in film format and were put up on X-ray viewing boxes. They were then captured digitally with a Canon Ixus camera to a resolution of 4 million mega pixels. The images were then all cropped to a standard size of 500x600 pixels using Fireworks MX. The automatic balancing wizard was used to optimise and sharpen all images. The images then had text boxes overlaid and the numbers inserted as shown in Figure 6.2. All digital images were also cropped and resized appropriately and where applicable black labels were used to cover patients' names on the X-rays in order to ensure patient confidentiality.

Figure 5.2 Finished image – note the numbers indicating specific areas in the midbrain

Figure 5.3 demonstrates the hotspot mechanism, the green square areas show the special areas that are important to identify in the brain. When the mouse runs over these green squares, the words that are in the second layer as shown in Figure 5.4 will swap with the green areas and show the underlying words revealing the answer to the questioning students mind.

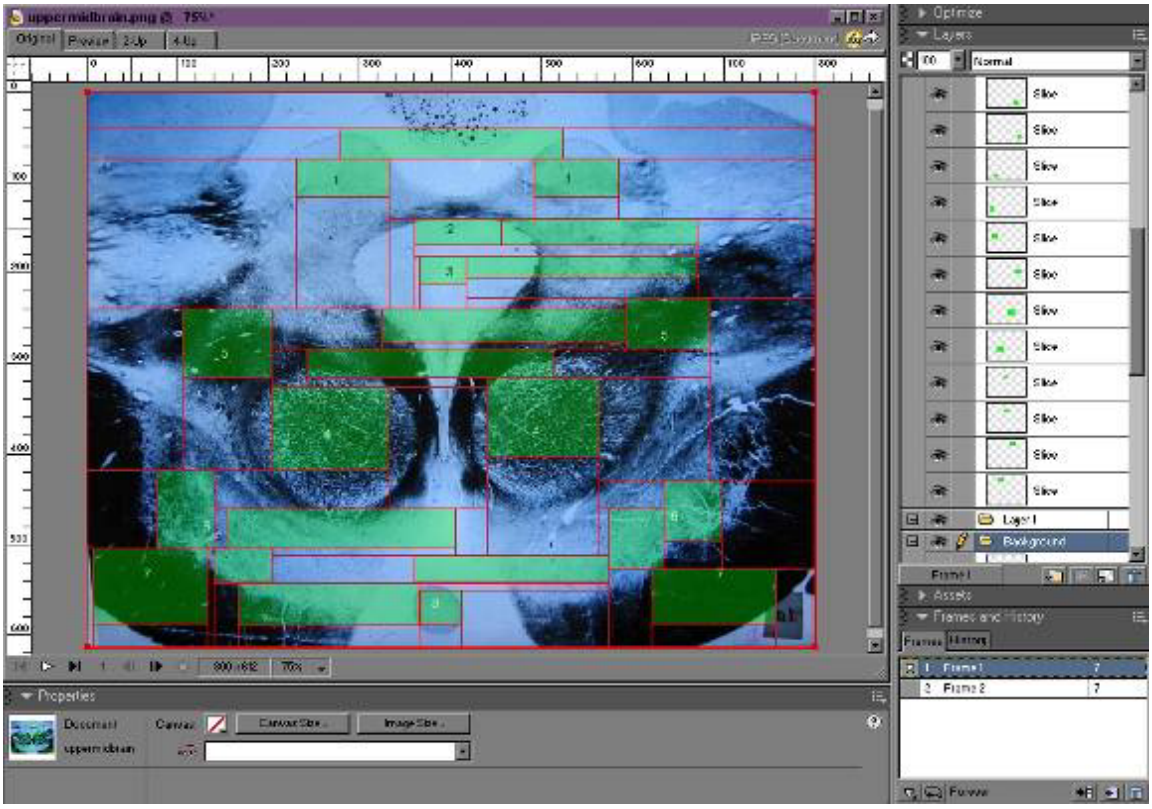


Figure 5.3 Image at Frame 1 – The green boxes represent highlighted areas corresponding to the numbers

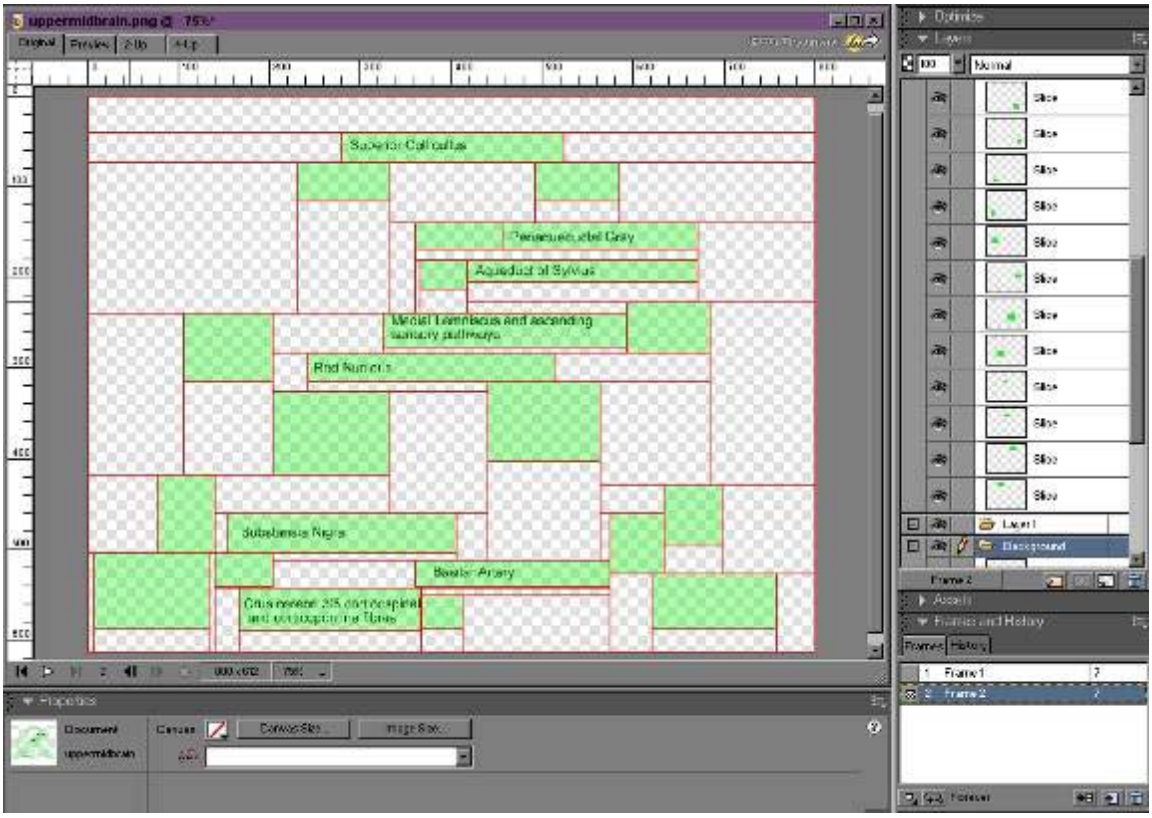


Figure 5.4 Image at Frame 2 – Text blocks within the green blocks which appear when the mouse rolls over hotspots delineated by green boxes in Fig 5.3

This approach was taken with all images that were 'Hot-spotted', about 25 in total in 6 different topics to show a different variety to all the students in the Faculty of Health Sciences. This ensured that a standardised approach is taken throughout the website. The text was verified and confirmed by checking with various textbooks such as Wilkinson's Neuroanatomy (1992), Netter's Atlas of Anatomy (2003), Wier's Atlas of Radiological Anatomy (2003) and in consultation with fellow lecturers and the dissection syllabus. There were short description notes in each section adapted from the dissection manuals but the main aim was to minimise text and maximise image use thus improving

the visual input and learning efficiency of content. Bullet lists and various text features like Boldface and italics were used to draw attention to points of important information.

5.5 Other Multimedia Content

Additional content for the website that was planned included embryology, flash animations, videos and pathology images. It was discussed and decided by the author and his faculty adviser at the outset that it would be too ambitious to achieve this in every section of the website so it was decided to focus on one section, the gallbladder section which would show a Flash MX animation of the embryology and development of the gallbladder, a video of a laparoscopic cholecystectomy or gallbladder removal via keyhole surgery and pathological images of the gallbladder post resections. Additional X-rays such as contrast X-ray endoscopic retrograde cholangiograms and magnetic resonance cholangiograms were also co-opted into this section. Labelled drawings with hotspot links were also included. The images were manipulated in the fashion described in 5.4 above. The videos were taken from a previous multimedia project developed by the author (Lip 2001). From that project the video was already optimised in with MPEG-2 compression in the QuickTime format. These files were easily co-opted into the existing framework of the website. These are shown below in Figures 5.5, 5.6 and 5.7

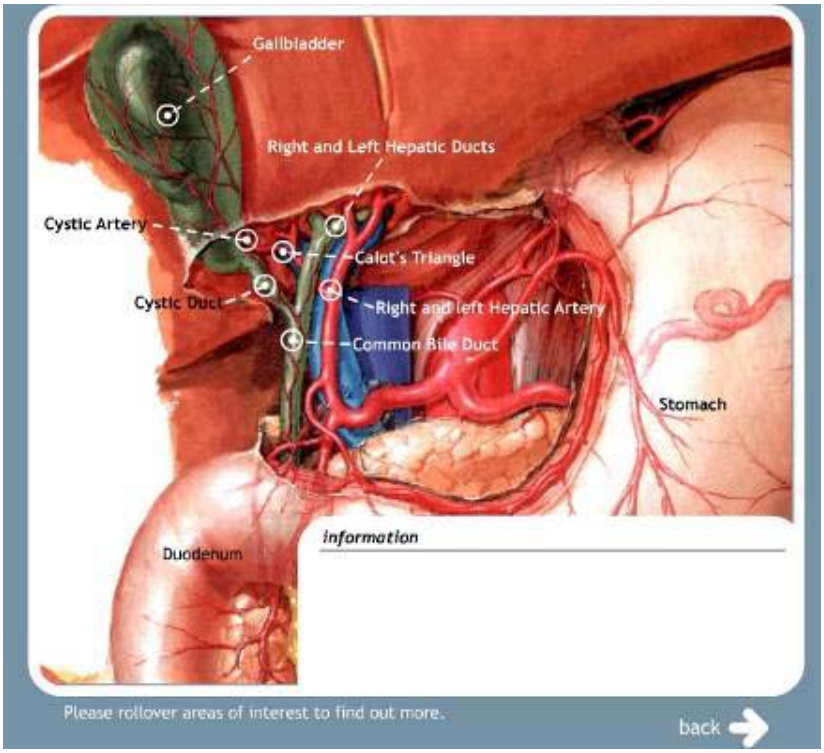


Figure 5.5 Annotated diagram of gallbladder

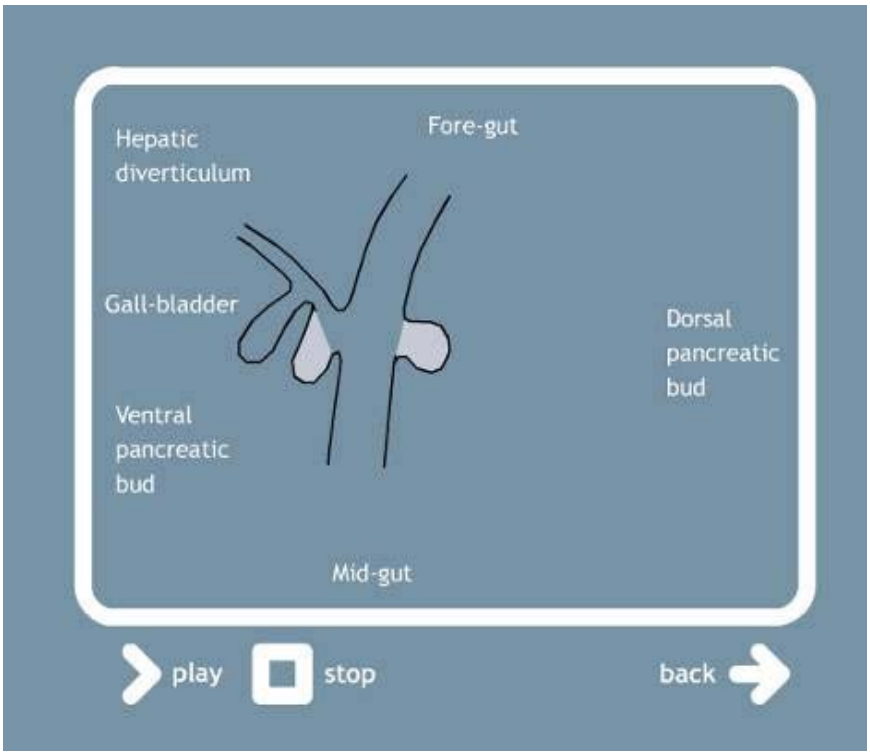


Figure 5.6 Embryology Flash animation

Figure 5.5 is a diagram of the region where the gallbladder is inside the body and running the mouse over parts of the text creates a rollover where text appears in the text box on the bottom right explaining about the figure in question. Text again was added with consultation from the Department of Anatomy. Figure 5.6 was created in Flash 5.0 and demonstrates the embryology or formation of the gallbladder in the foetus.

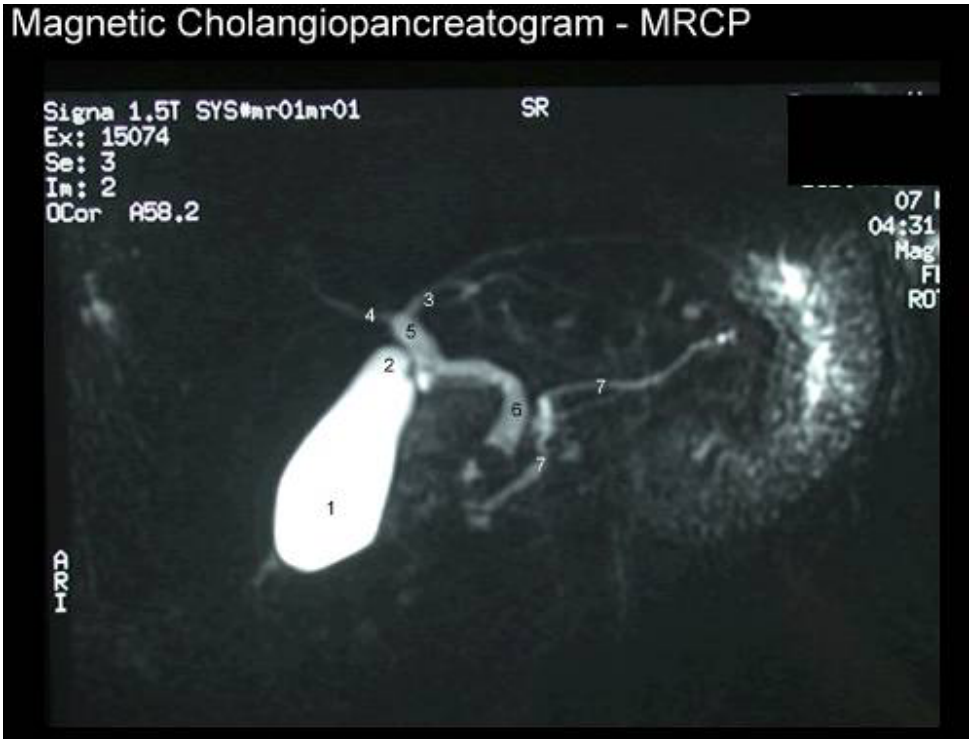


Figure 5.7 Magnetic Resonance Cholangiopancreatogram

Figure 5.7 is a magnetic resonance image of the gallbladder and related ducts. Again these where 'hot-spotted' continuing the theme of standardisation and reinforcement of student information by showing them the same information from different X-rays, diagrams and points of view.

5.6 Integrating with WebCT

As described in earlier chapters, the author decided to go ahead and use the WebCT online teaching system to deliver the Radiological Anatomy website. The WebCT programme is also the designated portal of choice as advised by Trinity College via the Centre for Academic Practise and Learning. WebCT facilitated the author with certain issues like arranging for password identification of students, designing tracking systems for students, designing online quiz programs and storage size issues. The author was also able to avail of college user support from the WebCT staff. Using the upload page (Figure 6.8), the WebDAV files could link directly to development files and transfer images and HTML pages reflected on the website. The program used to develop the web page hosted on WebCT was Dreamweaver MX and it²s development is detailed below.

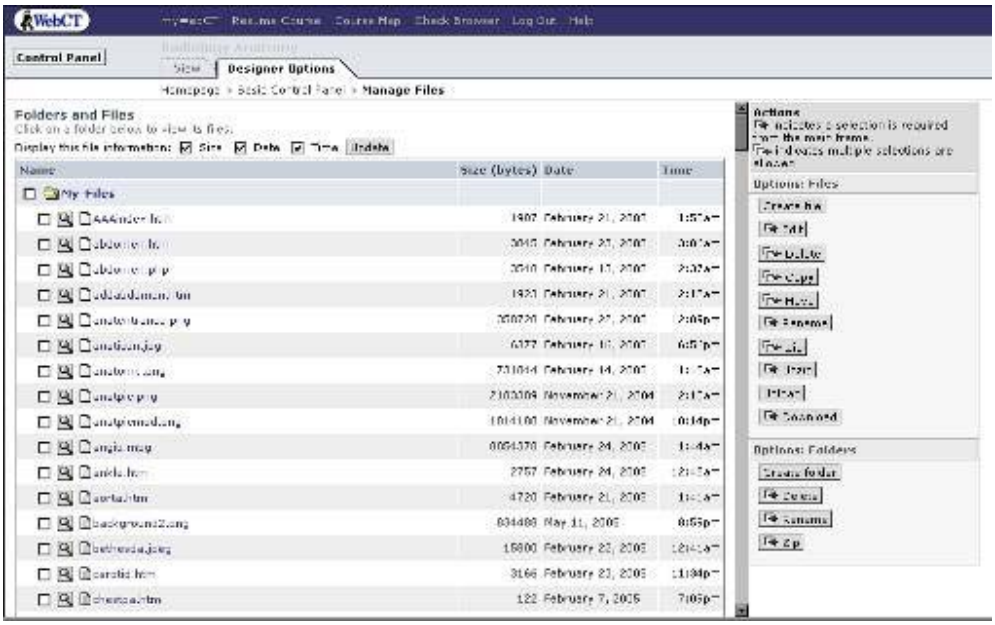


Figure 5.8 Upload page for WebCT

Once the WebCT staff had cleared the author, he was given a developer's username and password. Images, documents and web page materials could easily be transferred via the upload page shown in Fig 5.8 where the author would log on to WebCT shown in Figure 5.9 via the Internet and transfer previously prepared and enhanced material and transfer it directly into the online storage server for WebCT maintained and specific to Trinity College Dublin.

Figure 5.9 Login page for WebCT

5.7 Developing the Web Page and Navigation

With the web hosting site decided, the author set about designing the WebCT component pages and the Radiological Anatomy homepage as well. There were radiological anatomy sites that were much more detailed on the Internet but the aim of developing the radiological anatomy page specifically for Trinity students was to continue to deliver a consistent course with standardisation of materials at an accessible level. Some of the images were specific to the department's private collection of teaching X-rays. The main

introduction page shown in Fig 5.10 was designed to be clutter free and focus the patients to three main sites addressing all their needs for radiological anatomy as detailed in the first survey (Appendix A & B).

The three sections were as follows;

The Radiological Anatomy Homepage

The main site and teaching resource housing all the X-rays and text used for teaching radiological anatomy. Development and layout further elaborated below.

Recomended Radiology Online

Links selected by the author of excellent web based sites for students who wanted to enhance and develop their knowledge further in the field of radiological anatomy. By selecting the sites and evaluating them first, the author hoped to save students time and direct them to appropriate resources online.

Quiz Wizard

Survey results indicated that students requested more quizzes and self testing and this section was built using the WebCT built in quiz editor to build some multiple choice questions with previous examples taken from departmental files.

Figure 5.10 Radiological Anatomy Homepage Index Screen

The radiological anatomy homepage as shown below was developed using Dreamweaver MX. This is a standard web authoring program. The layout for the pages were taken from cascading style sheets (CSS) available on the Information systems services homepage. Development of the web page had to follow college guidelines on disability access and standardisation hence using the CSS again simplified the web development process as all the headers, formatting and colours were already standardised in an index folder and the main job of the author was to put content on rather than worry about formatting of a line or piece of text.

The main page aimed to develop a readily accessible style with 3 menus one on top, one to the left and one to the right. The top folder was tabbed to allow easy access back to the index page, the multiple choice questions page, a downloads page (detailed further) and a contact details page.

The left sided menu was oriented to the main topics covered in each term whereas the right menu dealt with the individual practical sessions of each main topic.

Figure 5.11 Radiological anatomy Website Index Screen

Figure 5.12 below is an example of one section. In this case, the main topic chosen on the left was the neuroanatomy topic. The practical chosen on the right was on the brain. As seen below, there is a text description and small icons showing the available X-ray images. On clicking the icon, a new window appears showing the X-ray in question. Most of the X-rays have been hot-spotted and allow the students to test themselves. Demonstrators also use this site according to the radiological anatomy syllabus at each practical to teach during the practical sessions.

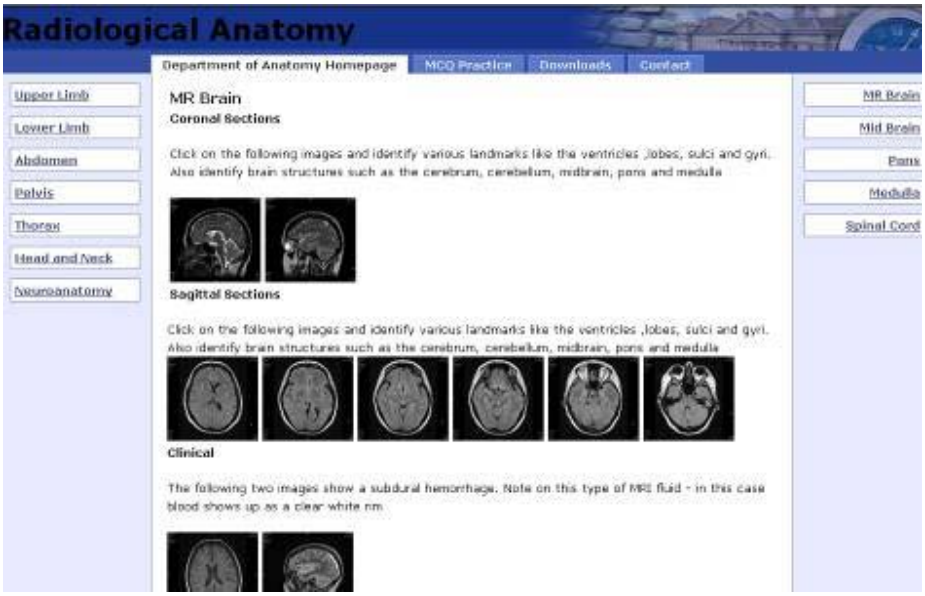


Figure 5.12 MR Brain page

The download page is shown in Figure 5.13 was developed in Dreamweaver MX using a menu function called create web photo album which quickly grabbed all images required, ordered them, wrote the necessary code and created icon links as well. The images shown below were optimised and labelled in Fireworks MX.

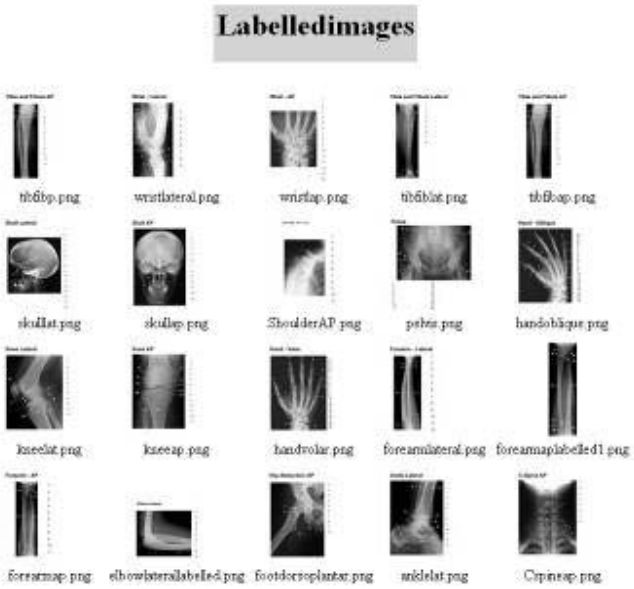


Figure 5.13 Download page for self testing

5.8 Setting up the Clinical Teaching Centres

Figure 5.14 Clinical Teaching Corner

The process of teaching radiological anatomy in-house would have been impossible to do without a grant provided by the Trinity Trust and Association who funded the purchase of the four computers that would form the centrepiece for teaching small groups via a digital web based interface.

The user specification of the computers required that they have DVD-ROM drives, run at least 256MB RAM and have a Pentium 2.4Ghz processor and a hard drive of at least 20GB. This was the minimum specification so that the computers would not only be able to show digital images but could also run the self loading DICOM based CD's containing

CT[2]s and MRI[2]s and were also able to play anatomy dissection DVD[2]s. The computers were also equipped with an Ethernet card so that the computers could access the college network and hence the WebCT based Radiological Anatomy Teaching Modules.

There were four corners set up and students would be brought into these corners at the third hour of each practical where a program of teaching of surface and radiological anatomy would be implemented followed by viewing of a revision dissection DVD of the dissection of the day. Teaching, for the radiological anatomy sessions would be via the computer for digital based media and also on the light viewing box for film based media giving the students a well rounded education in both media as levels of technological implementation of digital based radiology varies widely around the country and ideally students should be well versed in the interpretation and manipulation of images in both mediums. A familiarity with using the imaging and DICOM systems also confers an advantage to students in the later clinical years as it reduces the steep learning curve encountered as student doctors enter the teaching hospitals.

Groups would range in size from 5-15 based on the size of the class and teaching would be done by the anatomy demonstrators or lecturers who were all qualified doctors with clinical experience. The tutors themselves had already reviewed the material beforehand and also had access to the syllabus and films. The students would be taught via the syllabus a basic interpretation of the radiology images, some clinical applications and a standardised systematic clinical method of presenting their findings. For example in a chest X-ray, the students would be taught to apply a systematic interpretation of the X-

ray and to present their case accordingly working from outside in and identifying anomalies along the way. Clinical lessons on lung punctures from trauma would follow and in the surface anatomy follow up students would be aught how to assess and identify lung markings. Using the DICOM CD-'s students would also be able to manipulate images highlighting bone or air windows to gain a greater understanding of sagital and 3 dimensional anatomy.

Figure 5.15 Radiological Anatomy teaching session

5.9 Testing

As the timing of the preparation of the radiological anatomy syllabus was closely linked to the start of term there was little time for a full series of small group testing and

evaluation and instead the author used his three fellow demonstrators in anatomy as test students and to provide feedback on usability and their impressions.

Feedback from their testing included advice on access issues and usage including redesigning the hotspot pages to magnify the images, using more sections of images, decreasing the difficulty level of some of the images and advice on presentation of content.

Having used and tested the website themselves, the demonstrators were also more familiar with the material and this helped them with preparing their lesson plans for teaching small groups as they had already done it in the 'student' role themselves. The site was also seen and evaluated and proofed by my educational advisors in the departments of anatomy in Trinity College Dublin and radiology in St James Hospital before being cleared for teaching and access by students.

Chapter Six: Evaluation Phase

6.1 Introduction

Chapter five has described the setting up of the website and teaching syllabus which was implemented in successive stages. The radiological anatomy syllabus was defined and enough film images collected for teaching in small groups to begin with the start of the academic (Michaelmas) term in October 2004. This was delivered to all students in the Faculty of Health Sciences numbering about 440 in total. The web development and procurement of computers and digital media occurred during this period from October to December of 2004. As planned, the online and web based component went 'live' at the end of March during the second academic (Hilary) term 2004-2005. Survey 1 assessed student opinions of the new formal approach to teaching radiology and was administered in the first week of January 2005. Survey 2 was run in the 3rd week of April 2005 after the students had been using and been taught with the WebCT program for a period of five weeks up to and including the end of term exam period in which the students knew that a radiological anatomy question would be asked.

An independent college body – the Centre for Academic Practice and Student Learning (CAPSL), administered the surveys using internationally recognised standardised questions with some tailored questions for the Department as well. The surveys were run in conjunction with the Department of Anatomy's Quality of Teaching survey. The full survey results are in Appendix D and E. The appended tables relevant to the radiological anatomy course are discussed below.

Internet usage patterns from the launch of the website on March 27 were able to track the first three weeks of the growth of usage of the website and a basic analysis of student usage using WebCT's tools are shown and discussed as well. This period covers the usage levels from the launch of the website till the student exams in April 2005.

The exam question for radiological anatomy is discussed in 6.7, This question only applies to the second year medical students and was part of their exams at the end of Hilary term in April 2005.

6.2 Results and Analysis of Survey 1

Survey 1 was administered on December 7th 2004 by CAPSL, medical students in the 2nd and 3rd medical years were asked a series of 19 questions on their opinion on the syllabus and teaching in the Department of Anatomy and their reaction to teaching methods and materials. A total of 107 students in the 2nd year medical class and 79 students in the 3rd year medical class were surveyed on 11th of January 2005. The survey covered the performance of the anatomy department in general, student reaction to the changes in syllabus and introduction of new material such as the radiological anatomy module. It was felt that too much student time would be lost on doing multiple surveys hence only a few of the questions in the survey are directly relevant to the thesis. The full survey results are attached in Appendix D. Relevant questions are detailed in table format below.

6.2.1 Guide to Reviewing Tables

Several questions were asked of the students in the second and third medical years by the two CAPSL surveys. The students were asked questions which depending on the question, they could answer by picking one of five or six choices. These choices were then given a colour each and are represented on the y-axis. The length of the bars (or the x-axis) corresponds to the number of students by percentage who chose that answer. For instance in question 5 below, 65% of 2nd year medical students shown by the long horizontal red bar agreed with the statement that the language used in the teaching module was appropriate and free of jargon and abbreviation.

Question 5. The language used in the instructional material (notes) is appropriate, user sensitive and free of jargon and abbreviation

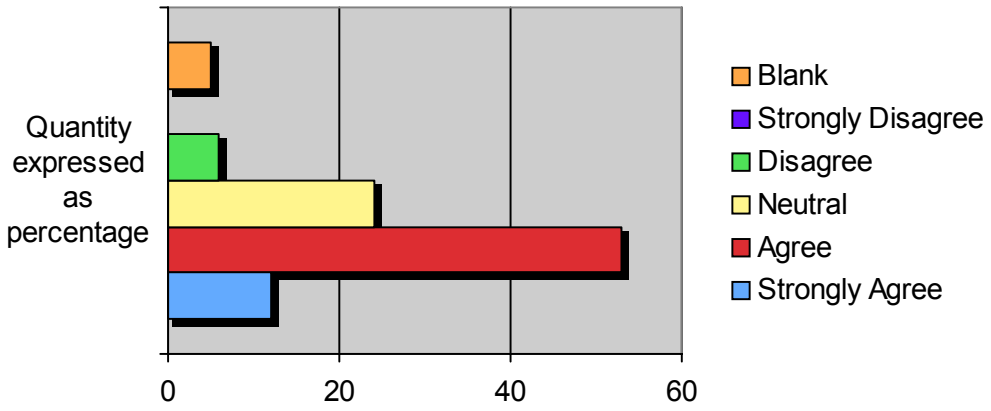


Table 6.1 Answers to Survey 1 Question 5 2nd Medical Year

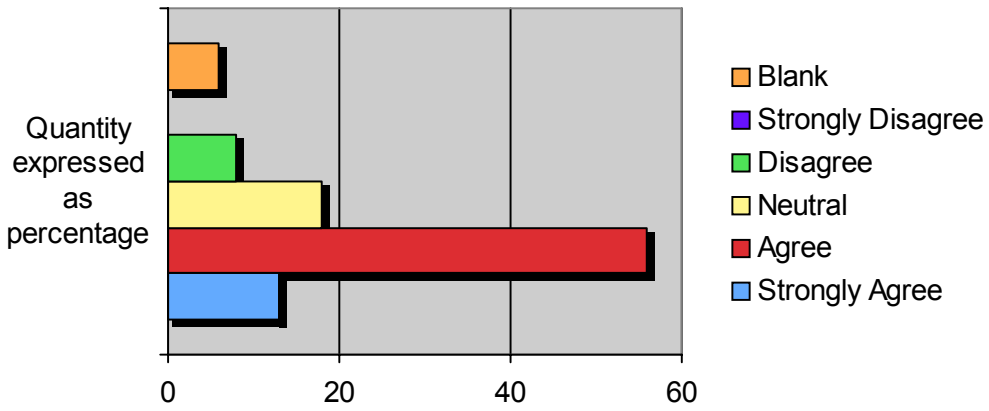


Table 6.2 Answers to Survey 1 Question 5 3rd Medical Year

This question was to assess user contentment with the language used to teach in the website and as a test of usability and whether students understood the point that was being made in each section of the radiological anatomy site. Admittedly this would be hampered by the fact that students would be meeting with many medical terms and names for the first time and which in fact would be like learning a new language. An effort was made to keep the use of text to a minimum. The highly graphical nature of the site should make this easier as confirmed by 65% of second year and 69% of third year students who agreed or strongly agreed that the language used was accessible.

Question 7. The navigation and direction through the instructional material is intuitive

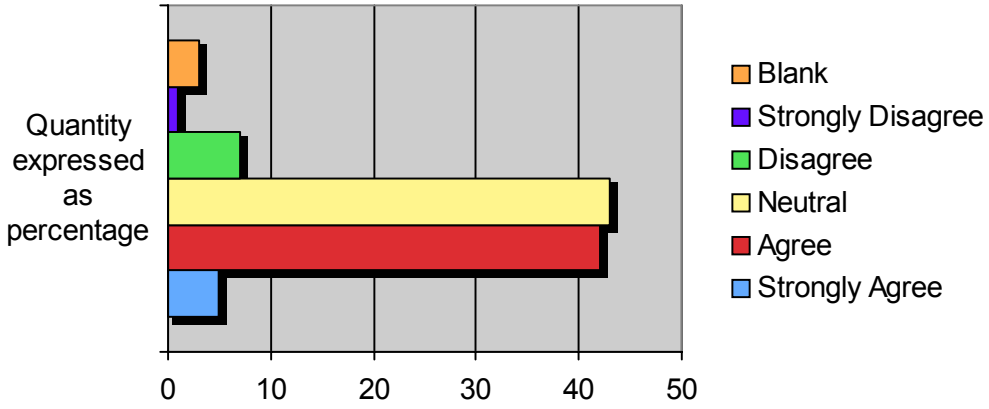


Table 6.3 Answers to Survey 1 Question 7 2nd Medical Year

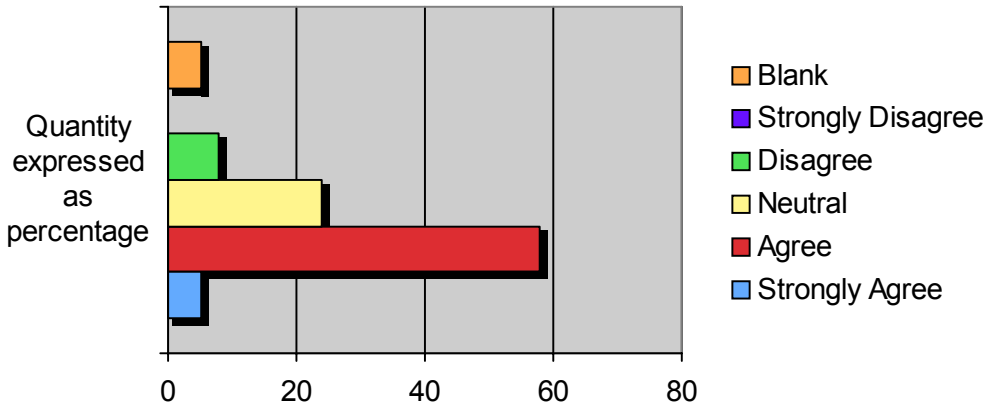


Table 6.4 Answers to Survey 1 Question 7 3rd Medical Year

Using CAI guidelines as discussed in Chapter Two, a standardised evaluated CSS was used from the college ISS service. These style sheets were in effect pre-written code designed to comply with international guidelines on usability and access to all with Level 2 web accessibility (ref www.tcd.ie/webdesign/index.php). The site format would also be familiar to students and encountered on other college websites.

The site was organised according to the students' practical schedule and would correspond directly to the relevant practical of the day. 47% and 63% of second and third year medical students agreed with this with 43% and 24% respectively staying neutral. The better response from the third medical year to the survey was followed up by asking a selection of third year medical students their reasons. The general opinion was that in the year 2003-2004, the syllabus was in transition and several practicals and lectures had to be re-arranged or cancelled and teaching staffs were unsure of priorities for teaching. The impression of the students for the year 2004-2005 was that the syllabus was more organised.

Question 10. The various parts of this course were linked

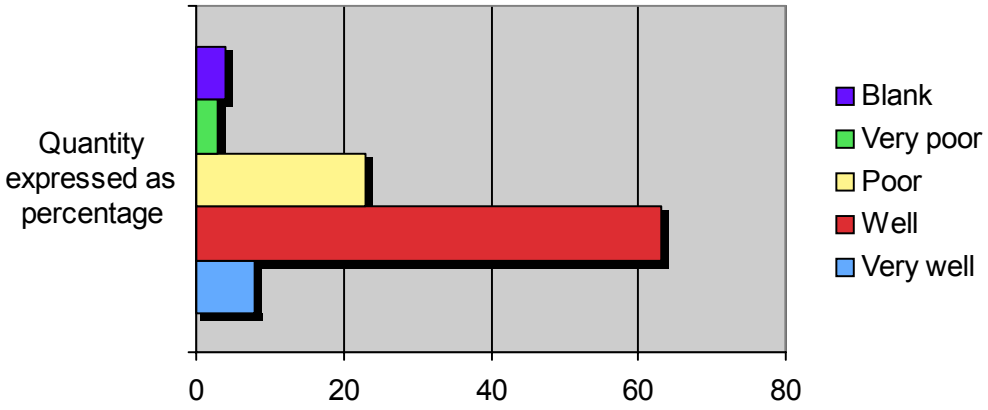


Table 6.5 Answers to Survey 1 Question 10 2nd Medical Year

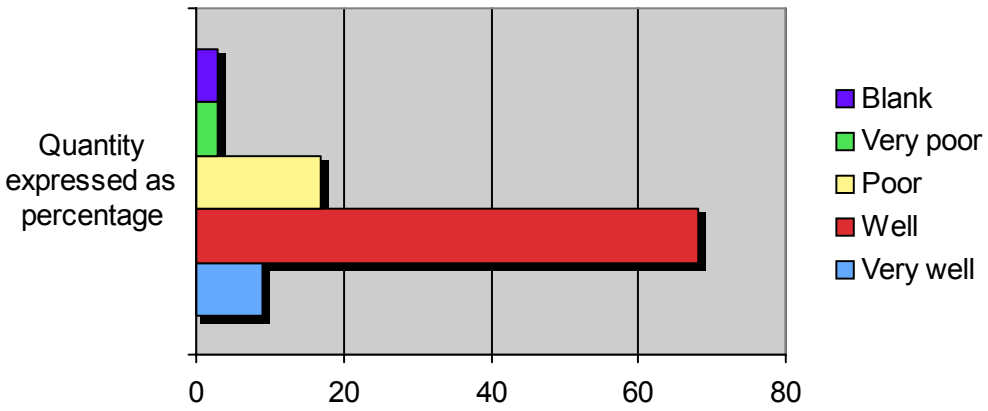


Table 6.6 Answers to Survey 1 Question 10 3rd Medical Year

Question 11 The course seemed:

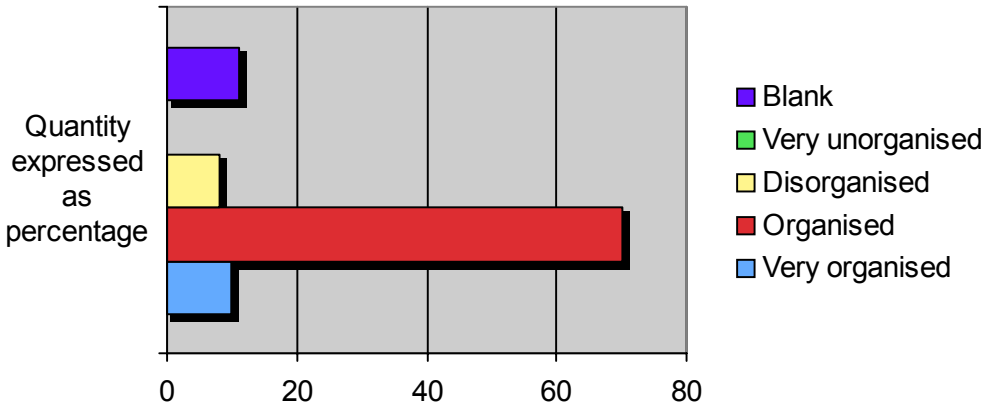


Table 6.7 Answers to Survey 1 Question 11 2nd Medical Year

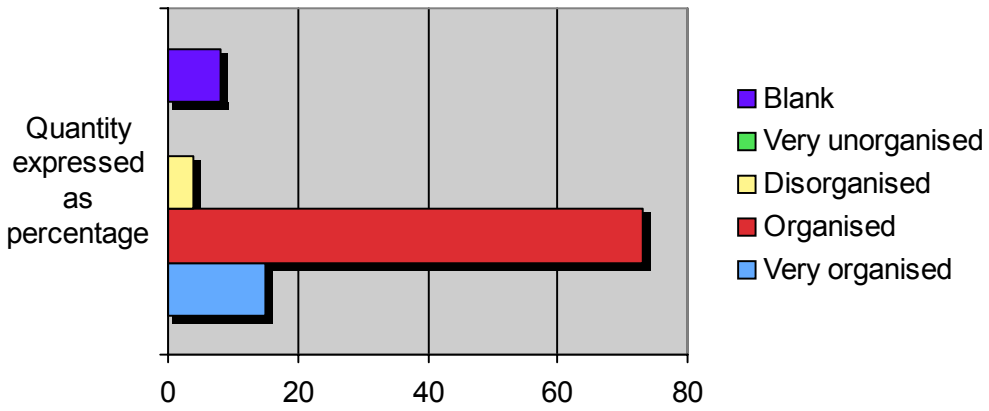


Table 6.8 Answers to Survey 1 Question 11 3rd Medical Year

The aim of the two questions above was to address how seamless the fit was of all the disparate sections of the course – from the practicals and lectures to the new web based initiatives. A lot of these changes were being trialled this year especially with the reduction in lecture hours and the addition of radiological anatomy to the practical sessions. On the whole the student response was quite positive. With 77% of second year students and 71% of third year students of the opinion that the courses were linked well or very well while 80% and 88% of second and third year medical students respectively found the course well or very well organised. In designing the website the main aim of the author was to make it complement existing teaching material. The author linked the practicals to the existing practical schedule and the lectures are on the same WebCT menu that they access the radiological anatomy website from.

Question 14 Overall I would rate my level of satisfaction with this course as:

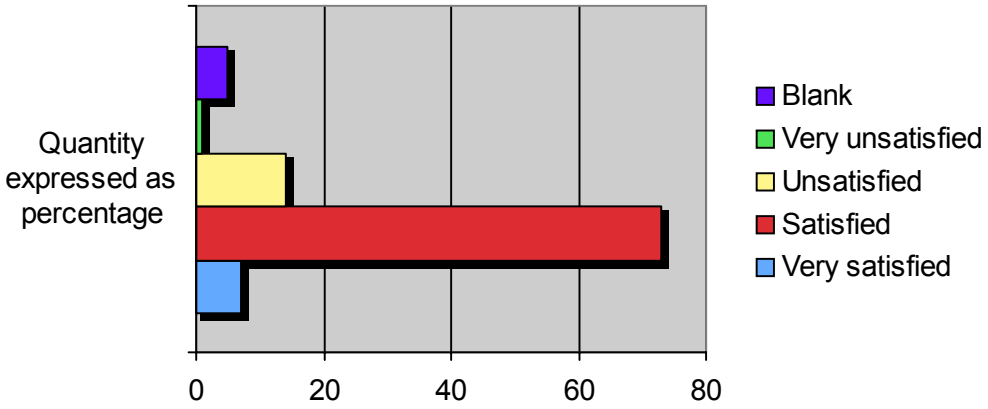


Table 6.9 Answers to Survey 1 Question 14 2nd Medical Year

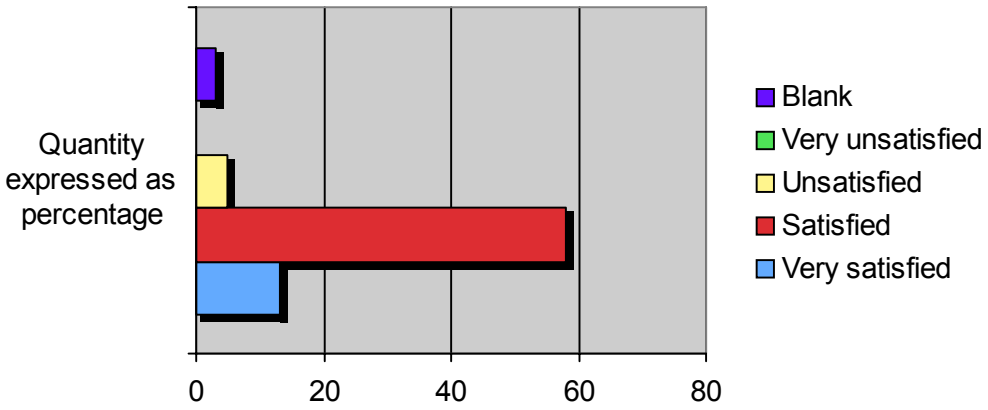


Table 6.10 Answers to Survey 1 Question 14 3rd Medical Year

Students were then asked for their opinion and satisfaction with the new anatomy course. Again an encouraging response with 80% and 89% satisfaction ratings from the second and third year medical students respectively which is due to a good communication policy with the students and substantiated by constant feedback via the class representatives.

6.3 Results and Analysis of Survey 2

Survey 2 was conducted on the 19 April with a cohort of 109 second year medical students. Again this survey was administered by CAPSL and a selection of more focused questions on the radiology module were added. At this stage the module had gone 'live' via WebCT to all students in the Faculty of Health Sciences and the students had had access to it for about three weeks from computers around campus, in the department and from their homes. Further analysis of this is covered in Section 6.4.

Questions on usability, language and accessibility had already been covered in Survey 1.

The radiology module questions formed part of the general anatomy department quality audit questions and the full survey is available in Appendix E. An analysis of the radiology module questions follows:

Question 17 The radiology course helped me understand the anatomy under review

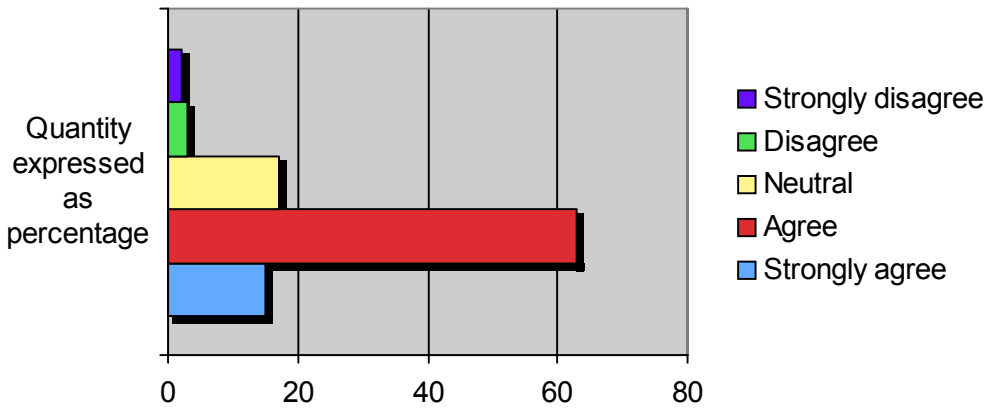


Table 6.11 Answers to Survey 2 Question 17 2nd Medical Year

78% of students found the radiology module helpful in their understanding of the practical. All modules were linked to the practical of the day. For example, if students were studying the gallbladder they were shown various forms of imaging the gallbladder such as contrast studies, X-rays and magnetic resonance images. The aim of this was to build the visual and radiological picture of the organ in question and enhance their understanding of what they were viewing.

Question 18 The radiology module made the anatomy more complex or difficult

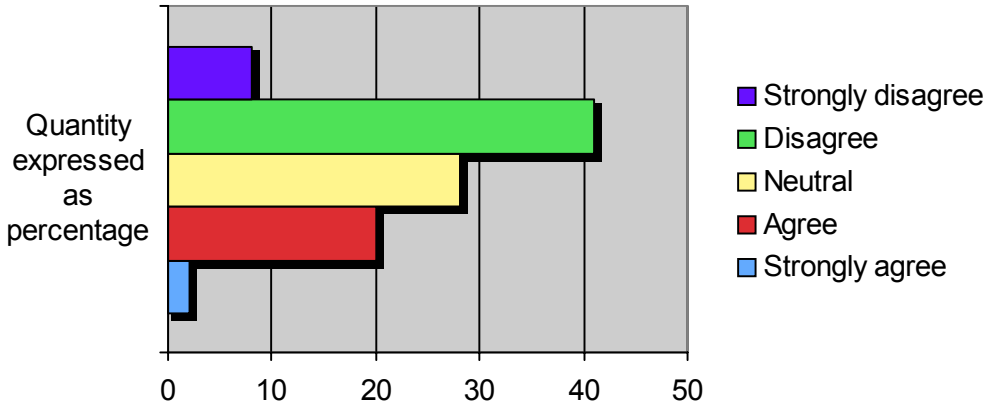


Table 6.12 Answers to Survey 2 Question 18 2nd Medical Year

When asked if they felt that the radiology module made the anatomy more complex 49% disagreed or strongly disagreed whilst 28% were neutral and 22% agreed with the statement. This shows a good balance among the students as radiology can be a difficult subject to comprehend initially and students have to become proficient in 3 dimensional anatomy and also gain confidence in their own personal abilities in interpreting radiographs.

Question 19 The radiology module helped to link anatomy with clinical medicine/surgery.

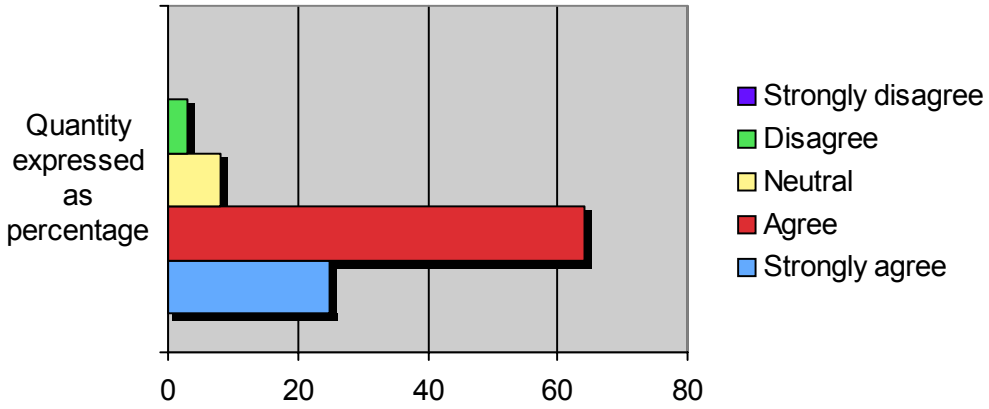


Table 6.13 Answers to Survey 2 Question 19 2nd Medical Year

89% of students agreed or strongly agreed that radiology helped their understanding of medicine and surgery and this was part of the strategy in bringing more relevance to their study of the subject of anatomy. Where relevant, clinical X-rays with abnormal pathology that accentuated the anatomy subject on study were used to bring home the relevance of why they needed a good knowledge of anatomy. For instance, images of fractures and dislocations were shown alongside normal images of joints and students were taught to recognise important features of both.

Question 20 The radiology module encouraged my own study of the subject

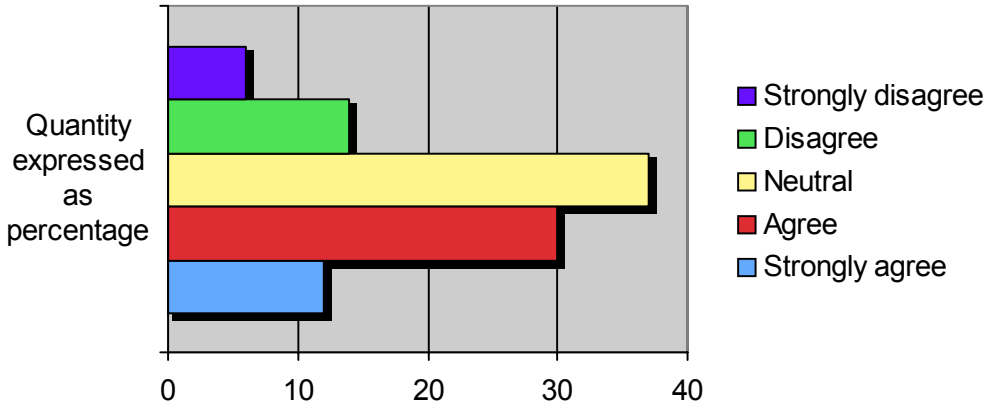


Table 6.14 Answers to Survey 2 Question 20 2nd Medical Year

While 37% of students chose to stay neutral on the subject of being encouraged to do extra studying, 42% indicated that they had continued on to look for more resources and read up on the subject as opposed to 20% which is a good response to a new topic on the syllabus for this year.

6.4 Internet Usage Analysis

The Radiological Anatomy website hosted on WebCT went live on March 11th. Part of WebCT's additional functions are a limited ability to audit student usage of the website and this was done over a four week period from March till April 8th.

Again as the second medical year students were the primary focus of the radiological anatomy site, the author chose to narrow the analysis of usage tracking to their class. Logs from WebCT were compared to the class list with regard to the number of students

accessing the site, the number of times they accessed the site and the time they spent on the site. This information was collated and is analysed here.
Due to confidentiality of student names and identification numbers I cannot include these on the appendices but they can be viewed with permission from the Department of Anatomy and WebCT in college.

On analysis of the 123 students in the second medical year 99 were tracked as accessing the radiological anatomy website at least once and at times ranging 9am to 2am. They accessed the site on average about 8 times in the four weeks of monitoring and spent an average of 13 minutes online at each time. Of the 28 remaining students 11 accessed the website using the computers in the anatomy department which were not linked to the Internet at that time. As this was on the students own time and not part of formal teaching on pages they had been taught from in practicals already this is an encouraging pattern of use of a resource that they can always come back to and refer to during their careers as students and beyond. This also confirms the findings of the questionnaires that students have reached a stage where they are comfortable and confident in using computers for personal learning and computer aided instruction.

6.5 Exam Paper Results and Analysis

As part of the exams for the Hilary term the 2nd year medical students had a short answer practical session comprising 10 stations for anatomical identification. Question 10 was a radiological anatomy topic on the gallbladder – an x-ray which had been formally taught to students during their Hilary term practical session. The question and picture are detailed below:

Question 10	X Ray	Marks
A	Name the structure marked with the BLUE arrow (gallbladder)	(1)
B	Name the Structure marked with the RED arrow (bile duct)	(1)
C	Name the opening into which the endoscope marked with the YELLOW arrow is protruding (hepatopancreatic ampulla)	(1)

Figure 6.1 Radiology question in exam paper for 2nd year medical students Hilary Term

A total of 122 students sat this exam. Their results are summarised below in Table 6.1

Score (across)	0	1	1.5	2	2.5	3
Number of students	37	16	1	16	7	45

From the results above 69 out of 122 or 57% passed this question which was consistent with the general class performance in other questions. The half marks were for partially correct answers in the third question. There is not enough information available to correlate this with student use of the website but that is a possible avenue to assess in the future.

6.6 Conclusions

With the development of any project there must be a process of evaluation and analysis by the users. In this case, the thesis became an actual working proof of concept as it was implemented as it was being developed and used straight away in teaching students in the Faculty of Health Sciences. As it was difficult to maintain analysis and survey all the students in the department a decision was made early on to limit the analysis primarily to the students in the second medical year.

This was on the background of a climate of change in the faculty with a decrease in the number of lecture and practical hours and a refocusing of the syllabus on clinically relevant anatomy and the introduction of the additional radiological anatomy syllabus. This again was a good reason for comparing the 2nd and 3rd medical year students who would have had two different syllabi.

Overall the students had a very positive response to the radiological anatomy syllabus as evidenced by surveys 1 and 2. Students had little difficulty in navigating through the tutorial with the only major issue being that sometimes the picture was too large for their screens but this was attributed to their screen resolution size. The author responded to this by manually resizing each of the pictures in Fireworks MX to roughly fit a 600-800 [ixels by 600-800 pixel frame depending on the size and shape of the original X-ray. Another answer that the author gave the students was to right click on the mouse and open the images in a new window as more up to date browsers are able to automatically resize the images to fit to screen. The images themselves did not take too long to load and students found enough that was interesting to maintain their interest while on the site. They also

made use of the links to other websites and downloads that were available on the web page. There was no problem with running the web page as all college computers are compliant and most modern computers have well above the minimum requirements to open the web pages.

The tutors and demonstrators had no problem with using the radiological anatomy modules for teaching purposes and were happy at the variety of images and the ability to put up digital images and film as well. The CDs also gave an opportunity to teach more advanced cross sectional anatomy via CT'-s and MRI'-s, which students would have not been able to interpret without teaching.

While the focus was on the second medical year students, the neuroanatomy module was also developed in tandem for the third year medical students. These images are proprietary to the department and as only four sets are available at any time – the spread of these images on the website allowed all students to view this equally at any time and was greatly appreciated by them.

The students would have appreciated having a quiz section fully developed but time constraints meant that the focus was on developing the main teaching module first. Students also requested if they could have everything on CD to take away with them but the Department disagreed with this approach on the grounds of the intellectual property rights of their x-ray images and a feeling that students may not turn up for practicals if they had all their notes and images at hand already.

Currently all sections of the website have been completed and as discussed above, students have been using the site regularly and the radiological anatomy syllabus has been integrated with the regular practical syllabus in anticipation of the next teaching term starting in October of 2005.

Chapter Seven: Discussion of Main Findings and Conclusion

7.1 Introduction

This chapter will provide an account of the main findings from the literature review undertaken for this study. An analysis of the creation of the syllabus, website and radiological resources, implementation and evaluation will also be covered. A description of the benefits and limitations of the module and a discussion on feedback, recommendations and future possible directions will also be presented within this chapter.

7.2 Findings from Literature Review

A literature review was done on two issues the first being the introduction of radiological anatomy teaching and the second on the use of computer aided instruction.

From completing the literature review on the forms and methods of radiological anatomy teaching, it is quite clear that with each advance in radiology, new methods of showing the internal organs of the human body are opened up to educators. The key is in packaging and interpreting this information for the purpose of education. The current delivery of radiological anatomy education to undergraduate students has been mostly ad hoc and dependent on the goodwill of radiologists in giving their time for a lecture. However, one didactic lecture would not be able to cover the breadth of material to be covered and a much more formal grounding in radiological anatomy has been shown to have a greater impact on students performance in the clinical years and in their later

hospital practice (de Barros 2001). The logical place for this would be in the anatomy department in tandem with their practical training in visual and surface anatomy. However in the face of decreasing hours for teaching and increasingly packed syllabi educators are looking to cut subjects out of the curriculum rather than add any new topics.

The use of computers and the increasing reliance on students to take more responsibility for their education has resulted in a change in attitudes and styles of learning and teaching. Students are not just placed in the didactic lecture situations anymore but the onus has been placed on them to go out and seek the information and integrate it with their lectures, tutorials, practicals and small group teaching. Lecture notes and indeed the radiological anatomy course have been moved online with students encouraged to review the materials before coming to practicals in order to enhance the quality of the learning experience.

The literature review also demonstrated that CAI provided the optimum learning environment for students in combination with TCL. While the implementation of web based education in Ireland has been relatively slow, avenues that Trinity College has taken such as providing the WebCT environment and CSS downloads with additional support help greatly with the integration of CAI into departmental teaching. The WebCT environment, which was also reviewed, provides in effect a one stop shop or portal where students can go and retrieve their notes, attempt quizzes and review their radiology.

As more educators develop their own CAI programs they must have an awareness of the processes that need to take place during production, to ensure that an effective CAI program is developed. The main aim of the literature reviews was to ensure that the author was aware of the steps and information needed and pertinent to designing the CAI program. This is why the work involves a planning, implementation and evaluation phase.

The survey²s and continuous evaluation were undertaken with the end user in mind. In this case there are two sets of end users the students and the teachers. The literature stresses the importance of continuous communication during the entire process to ensure the needs and functions of both groups are met. This also has the net effect of giving the users ownership of the program and increases usage and acceptance of the end product. It was with this in mind that the author arranged three surveys along with testing on fellow educators to assess what the users' needs were during the production of this radiological anatomy syllabus.

7.3 Evaluation Findings

The main aim of this project was to develop a radiological anatomy syllabus and web based teaching module. Following the literature review the author adopted a systematic planned approach to developing the project. The author took on most roles in managing the project, graphic and web design. The project was split into several phases

A. The Planning phase, this involved a requirements elicitation from the users and educators. This was via discussions with departmental advisors from the Department of Radiology in St James Hospital and the Department of Anatomy. Targets were drawn out and a timeline laid to the launch of the syllabus first then the web page.

B. The Development phase, in which the style of the web page was decided. Contact was made with the Centre for Learning Technology for access to WebCT and applications were made for funding for computers to facilitate CAI within the department in small group tutorials. This was also a period where raw film and digital X-rays were copied, collated, digitised and optimised with the kind assistance of the Departments of Radiology in St James Hospital and Tallaght Hospital. The first web pages were also completed and evaluated and tested in house by fellow demonstrators in the Anatomy department and refinements and adjustments carried out.

C. The Implementation phase, where an initial survey was carried out to ensure that there was adequate acceptance and usage of WebCT and to assess the computer literacy of the students. In a way it also mentally prepared students that a more computer based approach was being taken by the Department. Initially in the first (Michaelmas) term 2004-2005 all teaching was via film boxes and on flatscreen computer monitors which were setup after funding arrived but were not networked yet. The networking and web launch of the site occurred in the second (Hilary) 2004-2005 term and student awareness was raised as the demonstrators

had already been teaching from a static model on the anatomy department computers.

D. The Evaluation phase, this continued during and after the implementation phase in the form of surveys carried out by CAPSL as part of the anatomy departments' internal audit with questions for the radiological anatomy module added in.

It is important to stress that the above was non linear and during the cycle of the process many steps would have been revisited and refined as part of the process of continuous development.

7.4 Benefits

The finished radiological anatomy syllabus and website provide a valuable foundation and a sign of the continuing vertical integration between the preclinical and clinical teaching years in Trinity College Dublin. By using the full breadth of CAI and utilising college resources in the form of WebCT the department has created a valuable interface with the students where they can access all their needs for resources as well as provide a central point for self study and it provides educators with a teaching platform as well.

The collection of videos, graphics, x-rays and animation enhance the learning experience of the user and provides visual and verbal reinforcement. The students are given the basics providing them with a foundation in radiological anatomy, which will help them throughout their clinical years and beyond. With early exposure and familiarity with the

images especially with the focus on normal anatomy students should develop more confidence and experience in reading and interpreting radiological images.

There has been strong input sought throughout from the end users in this project which feedback being incorporated into development of the web based teaching module. As the surveys have shown the module has been generally well received with good usage levels and via objective examination methods has shown good results from the students.

7.5 Limitations

Time as always was a limiting factor and the subject of radiological anatomy encompasses such a large and broad scope that it was difficult to cover every topic to full effect. The students did request more quizzes and tests but it was not possible to develop those as well in the time frame.

Without further analysis and more testing it will not be currently possible to show if the students had any appreciable benefit from the web based module or the new syllabus. There was also a delay in networking the computers due to funding issues which slowed down access to the computers for the students but that was countered by running the site directly off the hard drives of the computers initially.

Recommendations for Future Work

The radiological anatomy teaching module and syllabus will provide the initial framework for a move by the department into placing more resources online for the students for self-guided learning. Most of the sections already include hot spot images and more images could be added from additional radiological resources such as PET-CT scans.

Utilising the same design, the online modules can be expanded to include other forms of clinically relevant anatomy such as dissection videos, surface anatomy and surgical videos demonstrating anatomy encountered during operations.

Further evaluation of the radiological anatomy syllabus should be carried out with the same cohort of students being retested with the same question in two years to assess retention and new learning. Deeper analysis could be done with the WebCT audit figures to see if there is any correlation between students accessing radiological anatomy resources online and their scores in the radiology questions in their exams. The students can be also be followed up once they have reached their clinical rotations and asked by survey if their introduction to radiological anatomy teaching in second year had helped them during their clinical rotations in hospital training.

To ensure continuity, another demonstrator will continue administration of the site after the author has left the Department of Anatomy.

7.6 Conclusion

The use of radiology in clinical practise has grown exponentially over the years and is an essential part of the diagnostic toolkit of the physician. A good firm grounding in the basics of radiological anatomy early on in the basics will provide a solid foundation for the future. Despite cutbacks and increasing pressure on the curriculum, the anatomy department is the most logical place for this teaching to occur. Unfortunately in most academic centres, the syllabus is not well developed and relies mostly on the goodwill of the radiology department of the respective teaching hospital.

Students themselves are becoming more assertive and reliant on new technology. With the advent of web based and multimedia technology, these platforms must be utilised as another tool in delivering quality education to students. These resources should be used for teaching and be readily accessible by students for self guided learning.

The author took the opportunity to develop this syllabus and web based module in order to formalise the teaching of radiological anatomy. A proper process of planning, literature review, design, implementation and continuous evaluation achieved this objective. A measure of success is that this was very well received by the students, and remains in the curriculum despite pressures on time and teaching quantity. It is hoped that students will refer back to this module during their medical career to refresh their skills and knowledge. It is hoped that the cycle of evaluation and updating continues on the syllabus and module and additional resources such as quizzes and further images can be added on.

The author was not a computer programmer but was able to develop this course by using standardised preformatted web pages from the ISS web pages in Trinity College and host it online with WebCT which handled other potential stumbling blocks like passwords and protection of data. The author recommends a thorough and methodical planning process and timeline before any production takes place in identifying requirements and user needs. Educators and users should also be involved and communication maintained throughout the design and implementation process to produce an adequate result.

The experience of bringing in a new teaching modality which will impact on students and help in the moulding of future health professionals has been a rewarding and fulfilling experience which the author would wholeheartedly recommend.

Bibliography

Abbassi K.(2004) Who cares about academic medicine?British Medical Journal 2004;329:751-2

Afaq A, McCall J. (2002) Improving undergraduate education in radiology. Academic Radiology 2002; 9:221-223

Barbian J. Blended works: here's proof! **Online learning** 2002;713-720

Beckman G. (1994) Computer Currents, Navigating Tommorrow's Technology. Redwood City, California : Benjamin/Cummings Publishing Company.

Belfry J. & Winne, P. (1988). A review of the Effectiveness of Computer Aided Instruction in Nursing Education. Computers in Nursing. March/April 6(2):77-85

Bennett R. (1968)The value of radiology in teaching anatomy to medical students. Australasia Radiology. 1968 Feb;12(1):64-8.

Berry HM Jr, Ashman JR. (1977) A new concept in teaching anatomy and radiologic anatomy. Oral Surgery Oral Medicine Oral Pathology. 1977 Jun;43(6):976-8

Bidgood Jr, WD, Horii, SC (1992) "Introduction to the ACR-NEMA DICOM standard." Radiographics 12: 345-355

Broudo M, Walsh C.(2002) MEDICOL: online learning in medicine and dentistry. Academic Medicine. 2002 Sep;77(9):926-7.

Cormack D. (2000) The Research Process in Nursing 4th Edition. Oxford:Blackwell Science

Chambers CH. (1973) Radiological Anatomy. Medical Journal Australia. 1973 Apr 21;1(16):816

Chew FS, Smirniotopoulos JG. (1993)Educational efficacy of computer-assisted instruction with interactive videodisc in radiology. Investigative Radiology. 1993 Nov;28(11):1052-8.

Collins J, Riebe JD, Albanese MA, et al.(1999) Medical students and radiology residents: can they learn as effectively with the same educational materials? Academic Radiology 1999; 6:691-695

De Barros N, Rodrigues CJ, Rodrigues AJ Jr. (2001)The value of teaching sectional anatomy to improve CT scan interpretation. Clinical Anatomy 2001; 14:36-41.

Ekelund L, Elzubeir M. (2002) Diagnostic radiology in an integrated curriculum: evaluation of student appraisal. Academic Radiology 2000 7:965-970

Erkonen W, Albanese MA, 1999 et al Diagnostic image use by nonradiologist lectures in an introductory clinical medicine course. Academic Radiology 1999: 37:476-480

Ernst R, Kawashima A, Tamm E, et al (2000). A high-quality, low-cost,Internet/intranet-based digital imaging database. RSNA Electronic Journal page, RSNA Web site. Available at: http://ej.rsna.org/EJ_0_96/0056-97.fin/ . Accessed September 6, 2000

Ernst, RD, Baumgartner, BR, Tamm, EP et al. (2002) "Development of a teaching file by using a DICOM database." Radiographics 22: 217-221

Feigin D S, James G. Smirniotopoulos and Timothy J. Neher (2002) Retention of Radiographic Anatomy of the Chest by 4th-Year Medical Students Academic Radiology, Volume 9, Issue 1, January 2002, Pages 82-88

Franck, L. & Lagenkamp, M. (2000) Mandatory Education via the Computer: Cost-effective, Convenient, and Creative. Journal For Nurses in Staff Development. 16(4):157-163.

Forrester D. (1971) Teaching anatomy through radiology. A new challenge requiring new techniques. Radiology. 1971 Sep;100(3):561-5

Ganguly PK, Chakravarty M, Latif NA, Osman M, Abu-Hijleh M. (2003) Teaching of anatomy in a problem-based curriculum at the Arabian Gulf University: the new face of the museum. Clinical Anatomy. 2003 May;16(3):256-61.

Garrett RE. (2004) Product review of WebCT Vista. Internet and Higher Education 7 (2004) 165-168.

Gleydura, A.,Michelman, J., a& Wilson, N. (1995) Multimedia Trianinng in Nursing Education. Computers in Nursing. July/August 13(4): 169-175

Goldberg, DJ, DeMarco, KJ, Parikh, T (2000) "Internet-based interactive teaching file for neuroradiology." American Journal of Roentgenology. 175: 1371-1373

Gostin, LO (2001) "National Health Information Privacy: Regulations Under the Health Insurance Portability and Accountability Act." JAMA 285: 3015-3021

Handler TJ, Lynch P, Jaffe CC. (1995). Computer-aided learning validation: a CAI-critical mission. Proceedings Annual Symposium Computer Applications Med Care 164:522-526

Hooper AC. (1980) The teaching of anatomy in Irish medical schools. Irish Medical Journal. 1980 Jan;73(1):17-20.

James DR, Purkayastha S, Athanasiou T, Shafiq O, Paraskevas P, Darzi A. (2004) Anatomy: the future teaching of undergraduates. Hospital Medicine. 2004 Nov;65(11):681-5.

Kaiden R. (2002) A review of WebCT. Internet and Higher Education 5 (2002) 399-404.

Kim S, Brinkley J, Rosse C. (2003) Profile of on-line anatomy information resources: Design and instructional implications. Clinical Anatomy 2003; 16:55-71

Kulik, J.a., Kulik C., & Cohen, P.A. (1980) Effectiveness of computer-based teaching: a meta-analyis of finings. Review of Educational Research. 50:525-544

Lambert, T.,Kirkby, K., & Dunn J. (1997) Clinical education and the computer: A proposed model for computer-aided learning in the medical curriculum. Australian Psychiatry. 5(1):19-21.

Lip G, (2000) Teaching Anatomy Using Multimedia. Trinity Student Medical Journal 2000; 1:18-20

Lowry, M., & Johnson, M. (1999) Computer assisted learning: the potential for teaching and assessing in nursing. Nursing Education Today. 19:521-526

Maleck M, Fischer MR, Kammer B et al. (2001) Do computers teach better? A media comparison study for case based teaching in radiology. Radiographics 2001; 21:1025-1032

Matthies H K, von Jan U, Porth A J, Tatagiba M, Stan AC, Walter GF. (1999) Multimedia-based courseware in the Virtual Learning Centre at the Hannover Medical School. Student Health Technological Information 77:541-545

McDonald I. (2004) Competition is the key to achieving broadband Ireland. The Sunday Times 10 October 2004

Mitchell BS, Williams (2002) Trends in radiological anatomy teaching in the U.K. and Ireland. Journal of European Clinical Radiology. 2002 Dec;57(12):1070-2.

Netter F. (2003) Atlas of Human Anatomy Icon Learning Systems

Older J. (2004) Anatomy: a must for teaching the next generation. Surgeon. 2004 Apr;2(2):79-90.

Polit, D. & Hungler, B. (1999) Nursing Research: Principles and Methids 6th Edition Philadelphia: J. B. Lippincott Company.

Powell, T. (2000) Web Design: The Complete Reference. New York: Osborne/McGraw-Hill

Reidenberg J, Laitman J (2002) The new face of gross anatomy. Anat Rec 2002;269:81-88

Reidy J, Williams J, Dilly N, Fraher J. (1978) The learning of radiological anatomy by medical students. Clinical Radiology. 1978 Sep;29(5):591-2.

Rouse, D. (2000) The Effectiveness of Computer-Assisted Instruction in Teaching Nursing Students about Congenital Heart Disease. Computers in Nursing. November/December 18 (6): 282-287

Rizzolo LJ, Aden M, Stewart WB. (2002) Correlation of Web usage and exam performance in a human anatomy and development course. Clinical Anatomy. 2002 Aug;15(5):351-5.

Shaffer K. (2004) Teaching anatomy in the digital world. New England Journal Medicine. 2004 Sep 23;351(13):1279-81

Shaffer K, Juan E. Small D. (2004) Blended learning in medical education: Use of an integrated approach with web-based small group modules and didactic instruction for teaching radiologic anatomy. Academic Radiology. 2004 Sep;11(9):1059-70.

Siegel, E, Reiner, B (2001) "Electronic teaching files: seven-year experience using a commercial picture archiving and communication system." J Digit Imaging 14: 125S-127S

Tegtmeyer CJ, Keats TE, Pullen EW, Langman J.(1974) The teaching of roentgen anatomy to medical students: a self-instructional approach. Journal Medical Education. 1974 May;49(5):455-6

Tellis, WM, Andriole, KP, Avrin, DE et al. (1998) "Web technology in the integration of a digital teaching file at the diagnostic workstation." J Digit Imaging 11: 117-119

Tran, TH, Roach, NA, OKane, PL et al. (2000) "Creating a digital radiographic teaching file and database using a PC and common software." American Journal Roentgenology 175: 325-327

Turchin A, Lehmann CU (1999). Active Learning Centre: utilization patterns of an interactive educational World Wide Web site. Proc AMIA Symp 25:627-631

Wainwright, P. (1994) Nursing Informatics. Edinburgh: Churchill Livingstone

Walker D, Lee W, Skov N, Berger C, Athey B. (2002) Investigating users requirements : Computer based anatomy learning modules for multi user test beds. J Am Med Inform Assoc 2002; 713-720

Wier J, Abrahams P. (2003) Wier's Atlas of Radiological Anatomy 2003 Mosby

Wilkinson J L. (1993) Neuroanatomy for Medical Students. Butterworth Heinemann

Weinberger, E, Jakobovits, R, Halsted, M (2002) "MyPACS. net: A Web-Based Teaching File Authoring Tool." American Journal Roentgenology 179:579-582

Zaidel, M, Hopper, K, Iyriboz, T (1999) "Interactive Web-based radiology teaching file." Journal Digital Imaging 12: 203-204

Appendix A

Survey for Introduction of Radiological Anatomy Teaching to the Medical School in Trinity College Dublin

The Department of Anatomy is in the process of introducing additional radiology resources as part of the pre-clinical teaching program. We would like to seek your opinion on the best method for teaching these resources. This survey will only take five minutes of your time and will aid us greatly. Please circle your choices below.

1. Would you rather be taught from X-ray films or via digital media? Film/Digital

2. Do you own a computer? Yes/No

3. If yes, is it a laptop or desktop? Laptop/Desktop

4. If laptop, is it wireless enabled? Yes/No

5. Would you rather the teaching material be on a CD or on the college network? CD/ College Network

6. Please rank yourselves from 1 – 10 . 1 being No IT knowledge and 10 being IT savvy
1 2 3 4 5 6 7 8 9 10

7. Have you used WebCT yet ? Yes/No

8. Will you use WebCT if further teaching materials were placed online? Yes/No

9. Indicate in minutes how long you would stay online using WebCT _____

10. Have you tried to access any medical educational material online? Yes/No

11.We would welcome any suggestions you have. Please detail them below.

Appendix B

Results of Questionnaire 1

Number of surveys returned : 259

Attendance at lectures: Approximately 350

Q1. Would you rather be taught from X-ray films or via digital media? Film/Digital

Film	34
Digital	27
Both	198

Q2. Do you own a computer? Yes/No

Yes	204
No	55

Q3. If yes, is it a laptop or desktop? Laptop/Desktop

Laptop	90
Desktop	103
Both	11

4. If laptop, is it wireless enabled? Yes/No

Yes 53

5. Would you rather the teaching material be on a CD or on the college network?
CD/ College Network

CD	86
College Network	47
Both	126

6. Please rank yourselves from 1 – 10 . 1 being No IT knowledge and 10 being IT savvy
1 2 3 4 5 6 7 8 9 10

1	2	3	4	5	6	7	8	9	10
0	9	26	37	46	73	47	15	3	3

Q7. Have you used WebCT yet ? Yes/No

Yes 253
No 6

Q8. Will you use WebCT if further teaching materials were placed online? Yes/No

Yes 255
No 4

Q9. Indicate in minutes how long you would stay online using WebCT

Minutes	0	1-20	20-40	40-60	60-80	80-100	100-120
Number of students	23	55	86	47	22	15	11

Q10. Have you tried to access any medical educational material online? Yes/No

Yes 145

Q11.We would welcome any suggestions you have. Please detail them below.

Responses from students in the freetext section included the following suggestions:

- Multiple choice questions
- Quizzes
- Additional notes
- Sample answers

Appendix C

The Radiological Anatomy Syllabus (Trinity College Dublin written for 2004-2005)

This syllabus was written with the advice and help of Dr Mary Keogan, Consultant Radiologist, Department of Radiology, St James Hospital, Dublin.

It is divided according to the practical dissection schedule and gives guidelines to lecturers and students on available resources in the Department and aims for each practical.

There are 5 sets of folders of film X-rays divided into the main headings below, similarly digital images are located on the website and on the 5 sets of DICOM CD-'s provided in the Department. Four sets belong to the demonstrators and one set is kept with the department technicians for loan to students.

During the surface anatomy and radiological anatomy part of the practical the demonstrators can make use of the film and digital media as well as printed sheets of numbered images which the students can fill out before or after the session. Students should bring in parts of the skeleton and hold it up against the x-rays to aid in identification.

Clinical films showing abnormal pathology are also archived but the primary aim is to show and teach normal anatomy initially.

Important details for identification listed below

Upper Limb

Practical 1 Shoulder
2nd Medical Year Michaelmas

Film: X-ray shoulder

Shoulder AP

1 Clavicle	2 Acromoclavicular joint	3 Acromion
4 Greater tubercle	5 Head of humerus	6 Lesser tubercle humerus
7 Surgical neck	8 Anatomical neck	9 Coracoid process
10 Glenoid fossa	11 Lateral border scapula	

Practical 2 Elbow
2nd Medical Year Michaelmas

Film: X-ray elbow

Elbow joint AP

1 Olecranon fossa	2 Medial epicondyle	3 Lateral epicondyle
4 Capitulum	5 Olecranon	6 Trochlea
7 Coronoid process ulna	8 Proximal radioulnar joint	9 Head of radius
10 Neck of radius	11 Tuberosity of radius	12 Ulna
13 Lateral supracondylar ridge	14 Medial supracondylar ridge	

Elbow joint lateral

1 Olecranon	2 Trochlea	3 Supracondylar ridge
4 Coronoid process ulna	5 Trochlear notch	6 Head of radius
7 Neck of radius	8 Tuberosity of radius	9 Ulna

Practical 3 Wrist
2nd Medical Year Michaelmas

Film X-ray wrist, forearm, hand

Forearm AP

1 Scaphoid	2 Lunate	3 Styloid process ulna
4 Head of ulna	5 Radius	6 Styloid process of radius
7 Ulna	8 Tuberosity of radius	9 Neck of radius
10 Head of radius	11 Proximal radioulnar joint	

Forearm Lateral

1 Scaphoid	2 Lunate	3 Styloid process ulna
4 Head of ulna	5 Radius	6 Distal end of radius
7 Ulna	8 Tuberosity of radius	9 Neck of radius
10 Head of radius	11 Trochlea	12 Olecranon

Wrist PA

1 Metacrpals 1-V	2 Trapezium	3 Trapezoid
4 Capitate	5 Head of capitate	6 Hamate
7 Hook of hamate	8 Scaphoid	9 Lunate
10 Triquetrum	11Pisiform	12 Styloid process of radius
13 Head of ulna	14 Styloid process of ulna	15 Radiocarpal joint
16 Distal radioulnar joint		

Hand Oblique

A. Thumb B. Index C. Middle finger D. Ring finger E. Little finger
1,4. Distal phalanx, 2. Middle phalanx, 3,5. Proximal phalanx
6. Sesamoid bones 7. Distal interphalangeal joint (DIP)

8. Proximal interphalangeal joint (PIP)		9. Metacarpophalangeal joint (V.)
10. Carpometacarpal joints	11. Trapezium	12. Trapezoid
13. Capitate	14. Hamate	15. Scaphoid
16. Lunate	17. Triquetrum	19. Radius
20. Ulna		

Hand - Carpal Tunnel

1. Pisiform	2. Triquetrum	3. Hook of hamate
4. Capitate	5. Scaphoid	6. Trapezium
7. Uina	8. Radius	

Wrist Lateral

1. 1st metacarpal	2. Metacarpals II-V	3. Trapezium
4. Tubercle of scaphoid	5. Lunate	6. Triquetrum
7. Radiocarpal joint	8. Distal end of radius	9. Distal end of ulna

Lower Limb

Practical 4 Hip

2nd Medical Year Michaelmas

Film: X-ray Hip

Hip AP

1 Ilium	2 Superior pubic rami	3 Inferior pubic rami
4 Obturator foramen	5 Pubic symphysis	6 Pubic tubercle
7 Lesser trochanter	8 Neck of femur	9 Greater trochanter
10 Head of femur	11 Acetabular fossa	12 Anterior inferior iliac spine
13 Anterior superior iliac spine	14 Fovea	

Practical 5 Knee

2nd Medical Year Michaelmas

Film: X-ray knee, CT knee

Patella - distal proximal

1. Patella	2. Medial part of patella	3. Lateral part of patella
4-5. Patellofemoral joint	6. Lateral femoral condyle	7. Medial femoral condyle

Knee Joint AP

1. Femur	2. Patella	3. Medial epicondyle of femur
4. Lateral epicondyle of femur	5. Medial condyle of femur	
6. Lateral condyle of femur	7. Intercondylar eminence	8. Intercondylar notch
9. Knee joint	10. Lateral condyle of tibia	11. Medial condyle of tibia
12. Tibia	13. Fibula	

Knee lateral

1. Femur	2. Lateral condyle of femur	3. Medial condyle of femur
4. Fibula	5. Patella	6. Base of patella
7. Apex of patella	8. Intercondylar eminence	9. Apex of fibula
10. Fibula	11. Tibia	12. Tibial tuberosity

Lower limb AP

1. Femur	2. Medial condyle of femur	3. Lateral condyle of femur
4. Knee joint	5. Intercondylar eminence	6. Lateral condyle of tibia
7. Head of fibula	8. Fibula	9. Tibia
10. Medial condyle of tibia		11. Neck of fibula

Lower limb lateral

1. Femur	2. Knee joint	3. Intercondylar eminence
4. Tibial tuberosity	5. Fibula	6. Tibia
7. Ankle joint	8. Talus	9. Calcaneus

Practical 6 Ankle and Foot

2nd Medical Year Michaelmas

Film: X-ray ankle, foot

Ankle Joint AP

1. Fibula	2. Tibia	3. Distal tibiofibular joint
4. Malleolar fossa	5. Lateral malleolus	6. Ankle joint
7. Medial malleolus	8. Talus	

Ankle Joint Lateral

1. Fibula	2. Tibia	3. Ankle joint
4. Promontory of tibia	5. Trochlear surface of talus	6. Talus
7. Cuboid	8. Calcaneus	9. Sustentaculum tali
10. Tarsal tunnel	11. Navicular	12. Cuneiforms
13. Posterior tubercle of talus		

Foot - Dorso-plantar

A-E: Toes 1-5. (A: Great toe)
I-V. Metatarsals
1,3: Distal phalax
4: Middle phalax
2,5: Proximal phalax

6. Interphalangeal joints	7. Metatarsophalangeal joints	8. Sesamoids
9. Head of metatarsal	10. Shaft (body) of metatarsal	
11. Base of metatarsal	12. Cuneiforms	13. Navicular
14. Cuboid	15. Talus	

Foot – Oblique

1 Identify toes and phalanges	1-5, proximal, middle and distal	
2 Interphalangeal joints	3 Metatarsophalangeal joints	4 Sesamoids
5 Head of metatarsal	6 Shaft of metatarsal	7 Base of metatarsal
8 Cuneiforms	9 Navicular	10 Cuboid
11 Talus	12 Calcaneus	13 Tibia
14 Fibula	15 Tarsometatarsal joints	16 Transverse midtarsal joint

Thorax

Practical 1 Thorax
2nd Medical Year Hilary

Film: CT Thorax, Chest X-ray

Aims – Identify

1 Arch of aorta	2 Left ventricular border	3 Clavicle
4 First rib	5 Inferior vena cava	6 Left atrium
7 Left cardiophrenic angle	8 Left costophrenic angle	9 Left dome of diaphragm
10 Position of heart valves	11Right atrial border	12Right dome of diaphragm
13 Spine of scapula	14 Sternum	15Superior vena cava
16 Trachea		

Practical 2 Thoracic vertebrae, ribs and sternum; intercostals spaces
2nd Medical Year Hilary

Film: CT Thoracic vertebrae

Aims – Identify

1 Aorta	2 Vertebral body	3 Costotransverse joint
4 Epidural space	5 Head of rib	6 Intervertebral disc
7 Lamina	8 Articular facets	9 Spinous process
10 Pedicle	11 Tubercle of rib	

Practical 3 The superior and anterior mediastina and the heart
2nd Medical Year Hilary

Film: CT Thorax, Coronary Angiogram

Aims – Identify

1 Aorta	2 Apex of left ventricle	3 Atrioventricular nodal artery
4 Circumflex artery	5 Conus artery	6 Left anterior interventricular artery
7 Left coronary artery	8 Right coronary artery	9 Posterior interventricular artery
10 Sino atrial nodal artery	11 Right marginal arteries	

Practical 4 The lungs and posterior mediastinum
2nd Medical Year Hilary

Film: Chest X-ray, CT Thorax
Aims – Identify as above

Abdomen

Practical 5 The anterior abdominal wall, the inguinal canal, the testis
2nd Medical Year Hilary

Film: Nil applicable

Practical 6 The peritoneal cavity, stomach and spleen, small and large intestine
2nd Medical Year Hilary

Film: CT abdomen, barium studies of large and small intestine, clinical cases accentuating anatomy ie large bowel obstruction; sigmoid and caecal, small bowel obstruction secondary to femoral hernia.

Aims – Identify on CT abdomen

1 Liver	2 Stomach	3 Azygous vein
4 Vertebral body	5 Spinal cord	6 Aorta
7 Oesophagus	8 Crus of diaphragm	9 Spleen
10 Pancreas	11 Inferior vena cava	12 Large bowel
13 Small bowel	14 Internal oblique muscle	15 External oblique muscle
16 Superior mesenteric artery	17 Renal arteries	18 Duodenum
19 Left kidney	20 Right kidney	

Aims – Identify on Barium study

1 Caecum	2 Ascending colon	3 Hepatic flexure
4 Transverse colon	5 Splenic flexure	6 Descending colon
7 Sigmoid colon	8 Rectum	

Practical 7 The liver, biliary tree and gall bladder. The pancreas; The portal venous system
2nd Medical Year Hilary

Film: CT liver, ERCP, MRCP, CT abdomen

Aims – Identify on ERCP an MRCP

1 Gallbladder	2 Common bile duct	3 Left hepatic duct
4 Right hepatic duct	5 Duodenum	6 Endoscope (ERCP)
7 Pancreatic duct	8 Spleen (MRCP)	9 Cystic duct

Practical 8 The retroperitoneum: kidneys and suprarenal glands
2nd Medical Year Hilary

Film: IVP, CT abdomen

Aims – Identify

1 Minor calyx	2 Major calyx	3 Renal pelvis
4 Renal artery	5 Ureter	6 Bladder
7 Common sites of ureteric stone obstruction		

Practical 9 The retroperitoneum; muscles, aorta and IVC; lumber plexus
2nd Medical Year Hilary

Film: AAA CT's, CT and MR abdomen

Aims – Identify

1 Aorta	2 Left common iliac artery	3 Right common iliac artery
4 Left renal artery	5 Right renal artery	6 Left internal iliac artery
7 Left external iliac artery	8 Right internal iliac artery	9 Right external iliac artery
10 Inferior vena cava	11Erector spinae	12Quadratus lumborum
13 Psoas major		

Pelvis

Practical 1 Osteology and joints of the pelvis
2nd Medical Year Trinity

Film: X-rays pelvis, CT and MR of pelvis

Aims – Identify

1 Lateral part of sacrum	2 Gas in colon	3 Ilium
4 Sacroiliac joint	5 Ischial spine	6 Superior pubic rami
7 Inferior pubic rami	8 Obturator foramen	9 Intertrochanteric crest
10 Pubic symphysis	11 Pubic tubercle	12 Lesser trochanter
13 Neck of femur	14 Greater trochanter	15 Head of femur
17 Acetabular fossa	18 Anterior inferior iliac spine	19 Anterior superior iliac spine
20 Posterior inferior iliac spine		21Posterior superior iliac spine
22 Iliac crest		

Practical 2 Pelvic blood vessels and nerves
2nd Medical Year Trinity

Film: Femoral angiogram

Aims – Identify

1 Common femoral artery	2 Profunda femoris	3 Popliteal artery
4 Anterior tibial artery	5 Posterior tibial artery	6 Common peroneal artery

Practical 3 Uterus, broad ligament and ovaries
2nd Medical Year Trinity

Film: Salpingogram

Aims – Identify

1 Uterus	2 Left Ovary	3 Right Ovary
4 Broad ligament	5 Fimbrae	

Practical 4 The rectum and the bladder
2nd Medical Year Trinity

Film: X-rays plain film of abdomen, CT pelvis, IVP

Aims – Identify
As per above

<u>Head and Neck</u>

Practical 1 The cervical vertebrae and the skull
Third Medical Year Michaelmas

Film: X-rays C-spine AP, transverse and lateral, Skull AP and lateral, MRI C spine coronal and sagittal T2 weighted

C-spine AP

1 Anterior arch of atlas	2 Posterior arch of atlas	3 Vertebral body
4 Spinous process	5 Dens	6 Uncinate process
7 Air filled trachea	8 Transverse process	8 1st rib
9 Clavicle		

C-spine lateral

1 Anterior arch of atlas	2 Dens of axis	3 Posterior arch of atlas
4 Soft palate	5 Transverse process	6 Intervertebral disc

7 Inferior articular process 8 Superior articular facets 9 Spinous process

Practical 2 The face and scalp and the posterior triangle
Third Medical Year Michaelmas

Film: X-rays facial bones, Skull AP and lateral

Skull lateral

1 Frontal sinus	2 Ethmoidal sinus	3 Sphenoidal sinus
4 Maxillary sinus	5 Anterior clinoid process	6 Hypophyseal fossa
7 Posterior clinoid process	8 Petrous temporal bone	9 Nasopharynx
10 Angle of mandible	11 Anterior arch of atlas	12 Dens of axis

Skull AP

1 Frontal sinus	2 Crista galli	3 Cribiform plate
4 Lesser wing of sphenoid	5 Superior orbital fissure	6 Temporal bone
7 Maxilary sinus	8 Ramus of mandible	9 Angle of mandible

Practical 3 The anterior triangle and the ear
Third Medical Year Michaelmas

Film: CT Petrous bones

Aims – Identify

1 Auditory tube	2 Brainstem	3 Carotid canal
4 Cerebelum	5 Clivus	6 Cochlea
7 Ethmoidal air cells	8 Foramen ovale	9 Greater wing of sphenoid
10 Hypoglossal canal	11 Incus	12 Internal acoustic meatus
13 Jugular foramen	14 Mastoid air cells	15 Sphenoidal sinus
16 Stapes	17 Temporomandibular joint	18 Superior orbital fissure

Practical 4 The cranial cavity
Third Medical Year Michaelmas

Film: CT skull

Aims – Identify

1 Auditory tube	2 Brainstem	3 Carotid canal
4 Cerebelum	5 Clivus	6 Cochlea
7 Ethmoidal air cells	8 Foramen ovale	9 Greater wing of sphenoid
10 Hypoglossal canal	11 Incus	12 Internal acoustic meatus
13 Jugular foramen	14 Mastoid air cells	15 Sphenoidal sinus
16 Stapes	17 Temporomandibular joint	18 Superior orbital fissure

Practical 5 The orbit, lacrimal apparatus and eyeball
Third Medical Year Michaelmas

Film: X-ray facial bones, Skull AP and lateral

As per above

Practical 6 Parotid Gland, muscles of mastication, mandibular nerve
Third Medical Year Michaelmas

Film: - contrast x-ray needed

Practical 7 Nasal cavity and air sinuses, maxillary nerve, suprahyoid region
Third Medical Year Michaelmas

Film: X-ray facial bones, nasal bones x-ray. CT skull and CT sinuses

As per above

Practical 8 Oral cavity and tongue, palate and pharynx
Third Medical Year Michaelmas

Film: X-ray - sialogram

- swallowing fluoroscopy video needed

Aims – Identify

1 Tongue 2 Submandibular duct 3 Submandibular gland

Practical 9 Larynx and thyroid gland
Third Medical Year Michaelmas

Film: - thyroid scan x-ray and nuclear medicine scan needed

Neuroanatomy

Practical 1 External topography of the brain (1)
Third Medical Year Hilary

Film: MR Brain

Aims – Identify
Aims – Identify

1 Anterior arch of atlas	2 Anterior cerebral artery	3 Anterior commisure
4 Aqueduct of Sylvius	5 Basilar artery	6 Body of corpus collosum
7 Cerebellum	8 Cervical spinal cord	9 Cingulate gyrus
10 Fornix	11 Fourth ventricle	12 Frontal sinus
13 Foramen of munro	14 Lamina terminalis	15 Mamilary body
16 Nasopharynx	17 Medulla Oblangata	18 Pineal gland
19 Pituitary gland	20 Pons	21 Posterior commisure
22 Quadrigeminal cistern	23 Prepontine cistern	24 Sphenoidal sinus
25 Superior medullary velum	26 Third ventricle	25 Caudate nucleus

Practical 2 External topography of the brain (2)
Third Medical Year Hilary

Film: MR Brain

Aims – Identify as above

Practical 3 Cerebellum
Third Medical Year Hilary

Film: CT and MR Brain sections

Aims – Identify as above

Practical 4 Spinal cord; blood supply of the CNS
Third Medical Year Hilary

Film: CT and MR of C-spine, carotid angiograms, clinical CTs showing intracranial hemorrhage.

Aims – Identify

1 Anterior cerebral artery 2 Anterior communicating artery 3 Internal carotid artery
4 Opthalmic artery 5 Maxillary artery 6 Middle cerebral artery
7 Occipital artery 8 Posterior cerebral artery

Practical 5 Internal structure of the brainstem

Third Medical Year Hilary

Film: Departmental Wiegert stains showing sections of spinal cord – cervical, thoracic, lumbar and pelvic and stains showing sections of midbrain, pons and medulla.

Aims – Identify in the pons

1 Corticopontine fibers 2 Corticospinal fibres 3 Pontine nuclei
4 Pontocerebellar fibres 5 Trigeminothalamic tract 6 Medial lemniscus
7 Spinal lemniscus 8 Superior cerebellar peduncles - Upper Pons
9 Lateral lemniscus - Upper pons 10 Trigeminal pontine nucleus - Middle pons
11 Middle Cerebellar peduncles - Middle pons 12 Facial nucleus and facial nerve
13 Abducens nucleus

Aims – Identify in the upper medulla

1 Inferior olivary nucleus which form the olives 2 Olivocerebellar tract
3 Corticospinal tract which forms the pyramids 4 Medial lemniscus
5 Hypoglossal nucleus and nerve 6 Vestibular nuclei
7 Nucleus of tractus solitarius 8 Trigeminal spinal nucleus and tract
9 Inferior cerebellar peduncle

Aims – Identify in the lower medulla

1 Corticospinal tract 2 Gracile fasciculus and nucleus
3 Cuneate fasciculus and nucleus 4 Internal arcuate fibres
5 Medial lemniscus 6 Trigeminal spinal nucleus and tract
7 Pyramidal decussation 8 Posterior spinocerebellar tract
9 Great sensory decussation

Practical 6 Internal structure of the brain

Third Medical Year Hilary

Film: CT and MR brain, Wiegert stains

Aims – Identify

As above

Appendix D

Survey Questions

Course Survey

1. The objectives of this course have been communicated to me:
2. Information communicated to me about the content was:
3. The various parts of this course (eg Lectures, tutorials, laboratories) were linked:
4. The amount of material in each part of the course was about right
5. The relevance of each topic of the syllabus was made clear
6. Information about the assessment requirements of the course was clearly communicated to me
7. Overall, I would rate my level of satisfaction with this course as:

Timetable

1. Insufficient time was available to me for private study.

Practicals

1. I found that adequate help was available.

eLearning Resources

1. The language used in the instructional material (notes) is appropriate, user sensitive and free of jargon and repitition.
2. The font and style are easy to read.
3. There is too adequate information given on each topic.

Lecturers/demonstrators Survey

1. The lecturers/demonstrators clearly indicated what was important to learn.
2. The lecturers/demonstrators were helpful in answering questions
3. The lecturers/demonstrators encouraged me to participate
4. Overall, I would rate my level of satisfaction with the lecturers/ demonstrators as:

Radiolology section

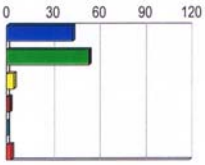
1. The radiology module helped me understand the anatomy under review.
2. The radiology module made the anatomy more complex or difficult.
3. The radiology module helped to link anatomy with clinical medicine/surgery.
4. The radiology module encouraged my own study of the subject

Appendix E: Full results of Survey 1

CAPSL (Centre for Academic Practice & Student Learning) Student Surveys - Based on 107 Sheets
Anatomy Department
- 2nd Year Meds

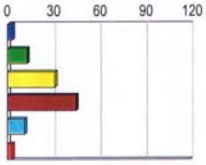
1. The course ran regularly and according to timetable.

Option	Qty	Perc.
Strongly Agree	43	40%
Agree	54	50%
Neutral	5	5%
Disagree	2	2%
Strongly Disagree	0	0%
Blank	3	3%



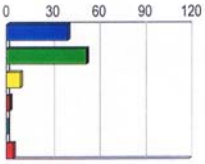
2. Sufficient time was available to me for private study.

Option	Qty	Perc.
Strongly Agree	3	3%
Agree	13	12%
Neutral	31	29%
Disagree	45	42%
Strongly Disagree	11	10%
Blank	3	3%



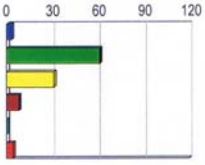
3. The practicals linked with this course were useful.

Option	Qty	Perc.
Strongly Agree	40	37%
Agree	52	49%
Neutral	9	8%
Disagree	2	2%
Strongly Disagree	0	0%
Blank	4	4%



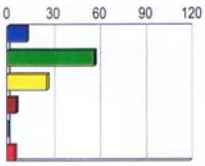
4. I found the supervision was good.

Option	Qty	Perc.
Strongly Agree	3	3%
Agree	61	57%
Neutral	31	29%
Disagree	8	7%
Strongly Disagree	0	0%
Blank	4	4%



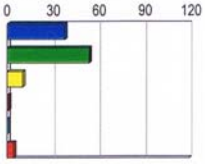
5. The language used in the instructional material (notes) is appropriate, user sensitive and free of jargon and abbreviation.

Option	Qty	Perc.
Strongly Agree	13	12%
Agree	57	53%
Neutral	26	24%
Disagree	6	6%
Strongly Disagree	0	0%
Blank	5	5%



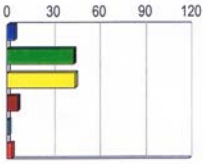
6. The font and style are easy to read.

Option	Qty	Perc.
Strongly Agree	38	36%
Agree	54	50%
Neutral	10	9%
Disagree	1	1%
Strongly Disagree	0	0%
Blank	4	4%



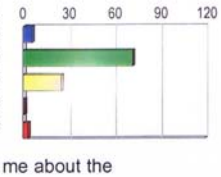
7. The navigation and direction through the instructional material is intuitive.

Option	Qty	Perc.
Strongly Agree	5	5%
Agree	44	42%
Neutral	45	43%
Disagree	7	7%
Strongly Disagree	1	1%
Blank	3	3%



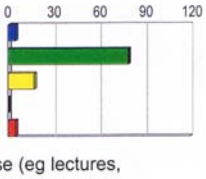
8. The objectives of this course have been communicated to me:

Option	Qty	Perc.
V. Clearly	6	6%
Clearly	72	67%
Unclear	25	23%
V. Unclear	1	1%
Blank	3	3%



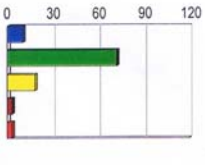
9. Information communicated to me about the content was:

Option	Qty	Perc.
V. Clear	5	5%
Clear	79	75%
Unclear	17	16%
V. Unclear	0	0%
Blank	5	5%



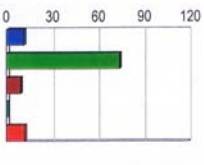
10. The various parts of this course (eg lectures, tutorials, laboratories) were linked:

Option	Qty	Perc.
V. Well	10	9%
Well	72	68%
Poor	18	17%
V. Poor	3	3%
Blank	3	3%



11. The course seemed:

Option	Qty	Perc.
V. Organised	11	10%
Organised	74	70%
Disorganised	9	8%
V.Unorganised	0	0%
Blank	12	11%



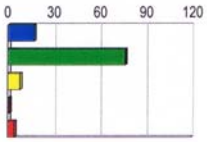
Printed on 11/01/2005

Page 1

CAPSL (Centre for Academic Practice & Student Learning) Student Surveys - Based on 107 Sheets
Anatomy Department
- 2nd Year Meds

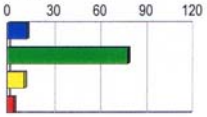
12. Classroom facilities were:

Option	Qty	Perc.
V. Good	17	16%
Good	77	72%
Poor	8	7%
V. Poor	1	1%
Blank	4	4%



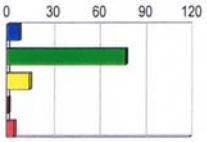
13. The main texts for this course were:

Option	Qty	Perc.
V. Useful	13	12%
Useful	79	74%
Useless	11	10%
Blank	4	4%



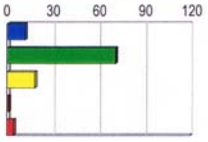
14. Overall, I would rate my level of satisfaction with this course as:

Option	Qty	Perc.
V.Satisfied	8	7%
Satisfied	78	73%
Unsatisfied	15	14%
V.Unsatisfied	1	1%
Blank	5	5%



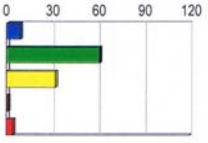
15. The lecturers clearly indicated what was important to learn.

Option	Qty	Perc.
Always	12	11%
Often	71	67%
Rarely	18	17%
Never	1	1%
Blank	4	4%



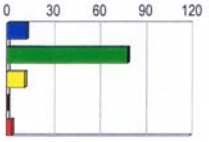
16. The lecturers stimulated me to think about the course.

Option	Qty	Perc.
V.Frequently	9	8%
Frequently	61	57%
Rarely	32	30%
Never	1	1%
Blank	4	4%



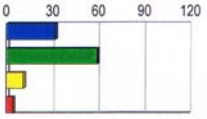
17. The lecturers' use of visual aids was:

Option	Qty	Perc.
V.Effective	13	12%
Effective	79	74%
Ineffective	12	11%
V.Ineffective	0	0%
Blank	3	3%



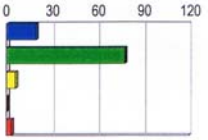
18. Taking into account the size of the class, the lecturers accessibility on matters relating to the course was:

Option	Qty	Perc.
Sufficient	32	30%
Neutral	60	56%
Insufficient	11	10%
Blank	4	4%



19. Overall, I would rate my level of satisfaction with the lecturers as:

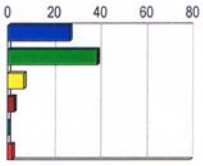
Option	Qty	Perc.
V.Satisfied	19	18%
Satisfied	78	74%
Unsatisfied	6	6%
V.Unsatisfied	0	0%
Blank	3	3%



CAPSL (Centre for Academic Practice & Student Learning) Student Surveys - Based on 79 Sheets
Anatomy Department
- 3rd Year Meds

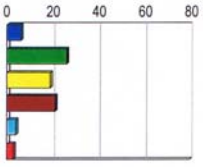
1. The course ran regularly and according to timetable.

Option	Qty	Perc.
Strongly Agree	27	35%
Agree	39	50%
Neutral	7	9%
Disagree	3	4%
Strongly Disagree	0	0%
Blank	2	3%



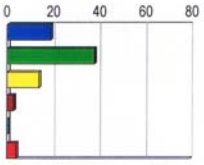
2. Sufficient time was available to me for private study.

Option	Qty	Perc.
Strongly Agree	6	8%
Agree	26	33%
Neutral	19	24%
Disagree	21	27%
Strongly Disagree	4	5%
Blank	3	4%



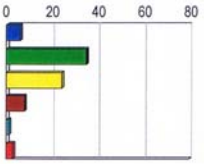
3. The practicals linked with this course were useful.

Option	Qty	Perc.
Strongly Agree	19	24%
Agree	38	49%
Neutral	14	18%
Disagree	3	4%
Strongly Disagree	0	0%
Blank	4	5%



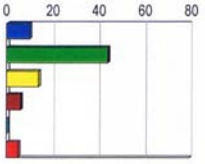
4. I found the supervision was good.

Option	Qty	Perc.
Strongly Agree	6	8%
Agree	35	45%
Neutral	24	31%
Disagree	8	10%
Strongly Disagree	1	1%
Blank	3	4%



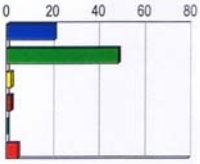
5. The language used in the instructional material (notes) is appropriate, user sensitive and free of jargon and abbreviation.

Option	Qty	Perc.
Strongly Agree	10	13%
Agree	44	56%
Neutral	14	18%
Disagree	6	8%
Strongly Disagree	0	0%
Blank	5	6%



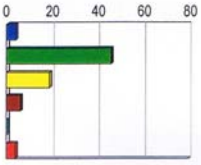
6. The font and style are easy to read.

Option	Qty	Perc.
Strongly Agree	21	27%
Agree	49	62%
Neutral	2	3%
Disagree	2	3%
Strongly Disagree	0	0%
Blank	5	6%



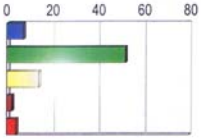
7. The navigation and direction through the instructional material is intuitive.

Option	Qty	Perc.
Strongly Agree	4	5%
Agree	46	58%
Neutral	19	24%
Disagree	6	8%
Strongly Disagree	0	0%
Blank	4	5%



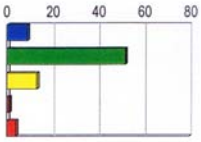
8. The objectives of this course have been communicated to me:

Option	Qty	Perc.
V. Clearly	7	9%
Clearly	52	66%
Unclear	14	18%
V. Unclear	2	3%
Blank	4	5%



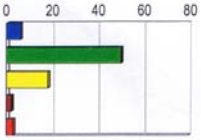
9. Information communicated to me about the content was:

Option	Qty	Perc.
V. Clear	9	11%
Clear	52	66%
Unclear	13	16%
V. Unclear	1	1%
Blank	4	5%



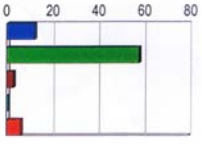
10. The various parts of this course (eg lectures, tutorials, laboratories) were linked:

Option	Qty	Perc.
V. Well	6	8%
Well	50	63%
Poor	18	23%
V. Poor	2	3%
Blank	3	4%



11. The course seemed:

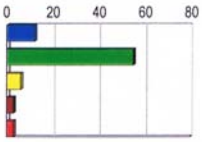
Option	Qty	Perc.
V. Organised	12	15%
Organised	58	73%
Disorganised	3	4%
V.Unorganised	0	0%
Blank	6	8%



CAPSL (Centre for Academic Practice & Student Learning) Student Surveys - Based on 79 Sheets
Anatomy Department
- 3rd Year Meds

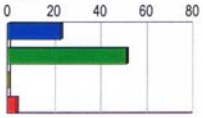
12. Classroom facilities were:

Option	Qty	Perc.
V. Good	12	15%
Good	55	70%
Poor	6	8%
V. Poor	3	4%
Blank	3	4%



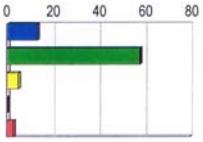
13. The main texts for this course were:

Option	Qty	Perc.
V. Useful	23	29%
Useful	52	66%
Useless	0	0%
Blank	4	5%



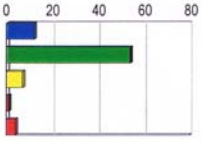
14. Overall, I would rate my level of satisfaction with this course as:

Option	Qty	Perc.
V.Satisfied	13	16%
Satisfied	58	73%
Unsatisfied	5	6%
V.Unsatisfied	0	0%
Blank	3	4%



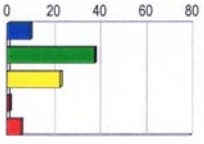
15. The lecturers clearly indicated what was important to learn.

Option	Qty	Perc.
Always	12	15%
Often	54	69%
Rarely	7	9%
Never	1	1%
Blank	4	5%



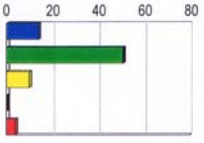
16. The lecturers stimulated me to think about the course.

Option	Qty	Perc.
V.Frequently	10	13%
Frequently	38	49%
Rarely	23	29%
Never	1	1%
Blank	6	8%



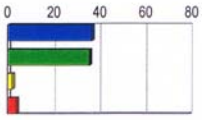
17. The lecturers' use of visual aids was:

Option	Qty	Perc.
V.Effective	14	18%
Effective	51	65%
Ineffective	10	13%
V.Ineffective	0	0%
Blank	4	5%



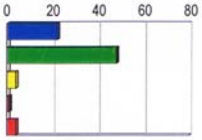
18. Taking into account the size of the class, the lecturers accessibility on matters relating to the course was:

Option	Qty	Perc.
Sufficient	37	47%
Neutral	36	46%
Insufficient	2	3%
Blank	4	5%



19. Overall, I would rate my level of satisfaction with the lecturers as:

Option	Qty	Perc.
V.Satisfied	22	28%
Satisfied	48	61%
Unsatisfied	4	5%
V.Unsatisfied	1	1%
Blank	4	5%

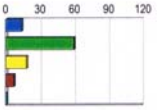


Appendix F: Full results of Survey 2

CAPSL (Centre for Academic Practice & Student Learning) Student Surveys - Trinity Term 2005
- Based on 109 Sheets, Anatomy Department
- 2nd Year Medical Students

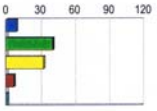
1. The objectives of this course have been communicated to me:

Option	Qty	Perc.
Strongly Agree	14	14%
Agree	60	61%
Neutral	18	18%
Disagree	7	7%
Strongly Disagree	0	0%



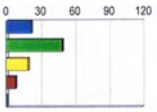
2. Information communicated to me about the content was:

Option	Qty	Perc.
Strongly Agree	9	10%
Agree	41	45%
Neutral	33	36%
Disagree	7	8%
Strongly Disagree	1	1%



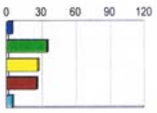
3. The various parts of this course (eg Lectures, tutorials, laboratories) were linked:

Option	Qty	Perc.
Strongly Agree	22	22%
Agree	49	50%
Neutral	19	19%
Disagree	8	8%
Strongly Disagree	0	0%



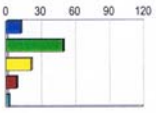
4. The amount of material in each part of the course was about right

Option	Qty	Perc.
Strongly Agree	4	4%
Agree	35	36%
Neutral	27	28%
Disagree	26	27%
Strongly Disagree	5	5%



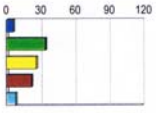
5. The relevance of each topic of the syllabus was made clear:

Option	Qty	Perc.
Strongly Agree	13	14%
Agree	50	52%
Neutral	22	23%
Disagree	9	9%
Strongly Disagree	2	2%



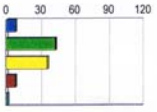
6. Information about the assessment requirements of the course was clearly communicated to me:

Option	Qty	Perc.
Strongly Agree	6	6%
Agree	34	35%
Neutral	26	27%
Disagree	22	23%
Strongly Disagree	8	8%



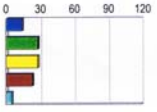
7. Overall, I would rate my level of satisfaction with this course as:

Option	Qty	Perc.
Strongly Agree	8	8%
Agree	43	45%
Neutral	36	38%
Disagree	8	8%
Strongly Disagree	1	1%



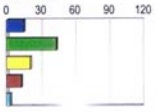
8. Insufficient time was available to me for private study:

Option	Qty	Perc.
Strongly Agree	14	14%
Agree	28	29%
Neutral	28	29%
Disagree	23	23%
Strongly Disagree	5	5%



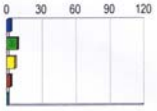
9. I found that adequate help was available:

Option	Qty	Perc.
Strongly Agree	15	16%
Agree	44	46%
Neutral	21	22%
Disagree	13	14%
Strongly Disagree	3	3%



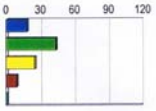
eLearning Resources

Option	Qty	Perc.
Strongly Agree	3	14%
Agree	9	41%
Neutral	7	32%
Disagree	3	14%
Strongly Disagree	0	0%



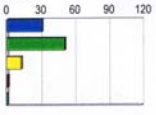
10. The language used in the instructional material (notes) is appropriate, user sensitive and free of jargon and repetition.

Option	Qty	Perc.
Strongly Agree	18	19%
Agree	44	46%
Neutral	25	26%
Disagree	9	9%
Strongly Disagree	0	0%



11. The font and style are easy to read:

Option	Qty	Perc.
Strongly Agree	31	32%
Agree	51	53%
Neutral	13	14%
Disagree	1	1%
Strongly Disagree	0	0%



Printed on 21/04/2005

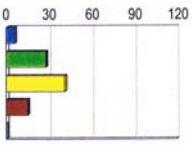
Page 1

22

CAPSL (Centre for Academic Practice & Student Learning) Student Surveys - Trinity Term 2005
- Based on 109 Sheets, Anatomy Department
- 2nd Year Medical Students

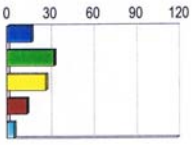
12. There is too adequate information given on each topic.

Option	Qty	Perc.
Strongly Agree	6	7%
Agree	28	31%
Neutral	41	46%
Disagree	15	17%
Strongly Disagree	0	0%



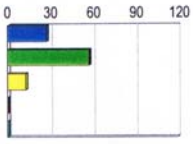
13. The lecturers/demonstrators clearly indicated what was important to learn.

Option	Qty	Perc.
Strongly Agree	17	18%
Agree	33	34%
Neutral	27	28%
Disagree	14	15%
Strongly Disagree	5	5%



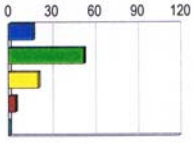
14. The lecturers/demonstrators were helpful in answering questions.

Option	Qty	Perc.
Strongly Agree	27	28%
Agree	57	59%
Neutral	13	13%
Disagree	0	0%
Strongly Disagree	0	0%



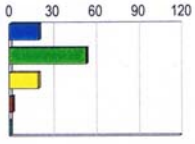
15. The lecturers/demonstrators encouraged me to participate.

Option	Qty	Perc.
Strongly Agree	17	18%
Agree	53	55%
Neutral	21	22%
Disagree	5	5%
Strongly Disagree	0	0%



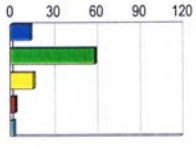
16. Overall, I would rate my level of satisfaction with the lecturers/ demonstrators as:

Option	Qty	Perc.
Strongly Agree	21	22%
Agree	54	56%
Neutral	20	21%
Disagree	2	2%
Strongly Disagree	0	0%



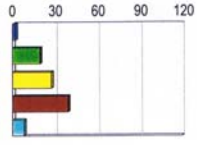
17. The radiology module helped me understand the anatomy under review.

Option	Qty	Perc.
Strongly Agree	14	15%
Agree	59	63%
Neutral	16	17%
Disagree	3	3%
Strongly Disagree	2	2%



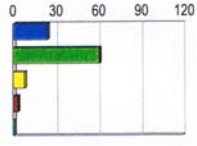
18. The radiology module made the anatomy more complex or difficult.

Option	Qty	Perc.
Strongly Agree	2	2%
Agree	19	20%
Neutral	27	28%
Disagree	39	41%
Strongly Disagree	8	8%



19. The radiology module helped to link anatomy with clinical medicine/surgery.

Option	Qty	Perc.
Strongly Agree	24	25%
Agree	61	64%
Neutral	8	8%
Disagree	3	3%
Strongly Disagree	0	0%



20. The radiology module encouraged my own study of the subject.

Option	Qty	Perc.
Strongly Agree	12	12%
Agree	29	30%
Neutral	36	37%
Disagree	14	14%
Strongly Disagree	6	6%