

The suitability of a multimedia resource for teaching undergraduate histology in a developing country.

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Philosophiae Doctor
2004



Universiteit van Pretoria

University of Pretoria



The suitability of a multimedia resource for teaching undergraduate histology in a developing country.

By

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Thesis

Submitted in fulfilment of the requirements for the degree

Philosophiae Doctor

In

Information Science

In the

Faculty of Engineering, the Built Environment and Information Technology

At the

University of Pretoria

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May 2004

University of Pretoria

Abstract

The suitability of a multimedia resource for teaching undergraduate histology in a developing country.

A thesis by

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This thesis reports on a literature survey and an investigation that was done on the Histology course for MBChB II learners at Medunsa. All aspects of the course were investigated including the present course as well as the possibility of replacing the lectures by multimedia computer presentations and a video. The multimedia computer presentations were specially developed for the study while an earlier developed video was also included into the study. Two instruments were used to gather information from the learners. Responses from a questionnaire as well as learner records were statistically evaluated. This information as well as information gathered from the literature was used to design a new proposed course in histology.

A number of issues emerged from the study. The first issue is that histology is the least favourite of all the subsections of Anatomy. Learners prefer to study their histology by watching a video. The learners who watched the video more than four times did not do better than the others. Multimedia changed the attitude of the learners towards histology to some extent. Learners have a perception, which could not be proved, that if they study with the aid of multimedia their marks and their recollection will improve.

Learners often left lectures before the end or did not attend. The reason that the learners indicated for this tendency was lack of concentration. Most learners want the system of lectures changed. They want some lectures to be replaced by multimedia. Most learners rate the histology lectures as good. The majority of learners do not want the histology course to be changed into a multimedia course.

From the study it is clear that the microscope can be successfully replaced by an instructivist way of learning like a video or a multimedia computer presentation. It is however not ideal to replace a constructivist way of learning, like using a microscope,

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with a way of learning that is only instructivist, therefore it is suggested that the microscope is replaced by another constructivist way of learning. Providing groups of learners with unique images from the histology slides to be studied and annotated was suggested.

It also became clear that if a computer-based histology course is to be implemented in future, learners will have to go through a transitional phase where the lectures and practicals are gradually replaced by multimedia.

Keywords:

Histology; anatomy; multimedia computer presentations; practicals; lectures; video; histology textbook; questionnaire; records; microscope;

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Acknowledgements

Soli Deo Gloria

The Author also recognises the following contributions:

- Johannes Cronjé - For his guidance.
- Mike van der Linde - For compiling the questionnaire.
- Rene Ehlers - For the statistics.
- Colleagues in my department - For support.
- Amanda Coetzer - For the language editing.
- Pieter Lategan - For formatting the thesis.
- My family - For their patience.

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CHAPTER 1

INTRODUCTION AND BACKGROUND

This thesis reports on a study that investigated the suitability of a multimedia resource in the teaching of histology. Many of the Medical University of Southern Africa (MEDUNSA) learners come from disadvantaged communities. The schools in these communities often have teachers that are under qualified and limited facilities. Many learners also have to attend school in their second language. These factors prevent learners from fulfilling their true potential at school. At MEDUNSA learners with a Swedish rating scale (SRS) value of 10 are allowed into the MBChB class. This means that a learner with a D for mathematics and a D for science is given a chance to study medicine. Few, if any, other university in South Africa would allow learners like this to study medicine. The results from this study will determine if learners like we have at MEDUNSA can be taught effectively using a special developed multimedia resource. The study will also determine to what extend multimedia can be used to improve or replace aspects of the old histology course for second year medical and dental learners.

Many teachers have used the new technology which has emerged over the last years to develop teaching material. I soon also realized that the new technology could be used to great advantage in the teaching of histology which relies heavily on two dimensional images and drawings to explain the morphology of tissues and cells. A computer screen is highly suitable for displaying these graphics.

E-learning in the field of medicine is rare. The emphasis, in most medical disciplines, is on practical work. At MEDUNSA the only E-learning course is a post graduate course in Public health.

The utilization of new technology in teaching at MEDUNSA is limited to a few lecturers lecturing with the aid of a notebook computer and a data projector. Most lecturers are not interested in, or are ignorant or sceptical about the possibilities of new technology in teaching.

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Much has been done by teachers world wide to support the teaching of histology with computers. There is no doubt that new technology should be used to teach histology to our learners so the question arises: What would be the most efficient and also the most acceptable way to utilise new technology in the teaching of histology for the type of learner that we have at MEDUNSA.

Before the implementation of a new way of teaching could be contemplated, the traditional way of teaching should be investigated to see whether there are shortcomings and also to see if any of the traditional ways are effective and should therefore be retained. The traditional way of presenting a histology course includes lectures and practicals where a microscope is used. A textbook is prescribed and notes are supplied.

For this study developmental research was done. The study can be divided into a developmental section and a research section. For the developmental section multimedia teaching material were developed consisting of a video and multimedia computer presentations. For the research section two instruments were used to gather information on the traditional course and the use of the multimedia material that was developed. Many aspects relating to the development and use of multimedia were investigated. Issues like the learner's perceptions of multimedia, lectures and practicals and the video were investigated. The study will also indicate how *PowerPoint* can be used as an authoring tool to create standalone computer presentations for the teaching of histology.

This study was conducted in four parts. Firstly a literature study was conducted to determine what information was available regarding the development and use of multimedia. Secondly the multimedia computer programs were developed and implemented as they were completed. Thirdly information was gathered through a questionnaire and by drawing learner's records. From this the relationships between selection criteria, the use of multimedia and performance could be investigated, statistically analysed and written up.

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The dental and medical courses at MEDUNSA are changing into outcome-based courses. This is in line with what is happening throughout South African medical schools. The dental course changed in the beginning of 2003 and the medical course will change with effect from 2004.

The results of this research will be used to determine how and if E-learning could be incorporated into the new course. Possible changes include changing the histology course into a full E-learning course or partial E-learning partial conventional course. The status and future use of the microscope in histology teaching will also be evaluated.

Vaughan (1998) defines multimedia as:

“Any combination of text, graphic art, sound, animations and video delivered to you by computer or other electronic means”.

The thesis will be divided into five chapters, namely:

Chapter 1: Introduction and background;

Chapter 2: Literature survey;

Chapter 3: Development and collection of data;

Chapter 4: Results;

Chapter 5: Discussion and recommendations.

The structure of this, and all the subsequent chapters, will be presented graphically by way of a matrix. The main headings are numbered while the subsequent headings are bulleted. The headings are in colour boxes. The colour of the box corresponds with the colours of the matrix in the beginning of the chapter. The matrix for this chapter is divided into three columns. In the first column are the two main topics of the chapter, namely the background of the project and a description of the project. Under background, there is a description of the subject, information on how the course is

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presented, how tests and exams are conducted, the learners that are taught at MEDUNSA and a discussion of what we want to achieve by changing the histology course. Under the project, the history of the project, what the literature says about the project, what the practical and academic limitations of the project are, the value of the research, what makes this study unique, and lastly the two types of questions, developmental and research questions are dealt with.

Table 1.1: Layout of Chapter 1

Background	Histology	
	How is histology taught?	
	Histology tests and exams	
	The learners at MEDUNSA	
	What problems do we want to solve by changing the histology course?	
The project	History of the project	
	Literature on similar projects	
	Value of the research	
	What makes this study unique	
	Limitations and boundaries of the project	Practical limitations
		Research limitations
	Myths surrounding multimedia and computer based learning	
The Questions	Developmental questions	
	Research question	

1.1 Background

In this section the significance of histology and what the subject is about will be explained. The way in which histology is currently taught, the way in which tests and exams are conducted, the type of learner we are teaching and what we hope to achieve with this project will be explained in this chapter.

1.1.2 Histology

The second year Bachelor of Medicine and Surgery (MBChB) and Bachelor of Dental Science (BDS) courses include anatomy as a subject. Anatomy is subdivided into gross anatomy, neuroanatomy, embryology and histology. A third of the anatomy time and marks are allocated to histology.

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Histology is a subject that deals with the cells and tissues of the human body. It encompasses terminology, descriptions of morphology, pictures and drawings that have to be memorized. Histology only deals with a few processes like tooth and bone development which are of a higher cognitive order.

In histology cross sections through tissues and cells are studied by examining microscope slides and electron micrographs. The surface of cells or tissues is studied by examining scanning electron micrographs. All three - micrographs, electron, micrographs and scanning-electron micrographs are in the form of two-dimensional images. These modes of studying make it very difficult for the learner to compile a clear picture of exactly what the tissue or cells look like in three dimensions, therefore drawings are used extensively in histology to explain the morphology, especially the three dimensional morphology of cells and tissues. Physiology deals mainly with the functions of the tissues and cells. To understand the function of tissues and cells one has to understand the morphology.

1.1.2 How is histology taught?

The traditional way of presenting histology is in the form of lectures and practicals. The lectures are given using overhead transparencies and photographic slides. The transparencies are used to display drawings and text. The photographic slides are photographs (called micrographs) of cross sections through tissues and cells.

The histology lectures at MEDUNSA are not compulsory, since the lecture hall that is used for histology lectures can take only 300 learners and there are 345 learners in the class. During the histology lectures that were presented as part of this study the hall was never full. A large number of learners did not attend the lectures that were part of this study. Another habit that many learners have is to leave the lecture before the end. Many learners also tend not to pay attention in class, and one is often aware of learners taking a nap.

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During the lectures there is very little interaction between the lecturer and the learners. This may be due to the fact that few learners have the confidence to stand up in front of a large class and ask a question. The time allocated for each histology lecture is one and a half hours. Most of the lectures that formed part of this study were completed within an hour.

During practical sessions learners view microscope slides (cross sections through tissues) under a light microscope. Certain cells and tissues then have to be identified. This is done with the help of a histology atlas and presentations that are shown to them on overhead monitors.

Five years ago I started to display images on overhead monitors. Using this method the teacher is sure that the learner sees a good example of a specific tissue and that the correct structures are seen and identified by the learners.

A histology textbook is prescribed. For the purpose of this study a three hour video covering the practical aspects of histology was developed as well as multimedia computer presentations covering some of the topics of the course.

1.1.3 Histology tests and exams

At the end of each block a test is conducted. The test consists of a practical and theoretical section. The written section of the test counts out of 150 with 50 marks allocated for histology. The practical histology test consists of a first test out of 30 marks and a second test out of 40 marks.

Second year medical and dental learners do not have to qualify for the exam. Learners automatically qualify for the exam when they register. Neither lectures nor tests are compulsory. During the study the year mark that a learner obtained was only considered when it was to the learner's benefit. Learners could get exemption if they passed all their tests and got a year mark of 60%.

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These rules changed in 2001. In future the year mark that a learner accumulates will either secure exemption if it is above 60% and no tests were failed or it will count 60% towards his or her final mark with the exam mark making up the rest.

1.1.4 The learners at MEDUNSA

MEDUNSA learners are mainly black. A quota system is used for admitting learners into the medical class. Black learners make up 77% of the selected learners, Indian learners 3%, white learners 11%, brown learners 8% and others (foreigners) 1%. The Swedish rating scale (SRS) system for the selection of learners is used at MEDUNSA. Only mathematics and physical science marks are taken into account.

Table 1.2: Swedish rating system

SRS system	
Distinction	8
B symbol	7
C symbol	6
D symbol	5

Additional credits are also given for passed subjects from other courses and for degrees obtained. The lowest rating on which a learner will be admitted directly into the MBChB course after metric is 10. Learners with lower SRS ratings are also allowed but only if they have additional credits.

1.1.5 What problems do we want to solve by changing the histology course?

Traditionally histology used to teach learners to use the microscope and to identify normal tissues so that they would be able to diagnose pathology with the aid of a microscope in their third year. However anatomical pathology has changed to a more

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macroscopically orientated course including very little or no microscopy. It is therefore no longer necessary for second year histology learners to do a thorough course in the use of the microscope.

Micrographs and electron micrographs viewed on a computer screen look exactly the same as when viewed under a light or electron microscope. This makes the computer ideally suited as a teaching tool for histology. This teaching tool should therefore be investigated and utilized to the fullest.

A number of learners are admitted late every year because of administrative problems. These learners start their course when a number of lectures and practicals have already been completed. Most of these learners have problems catching up. Allowing learners to register and start a course late places a responsibility on the university to help learners to catch up the work that they have missed. Providing the learners with multimedia study material may be a way of dealing with this problem.

Admitting learners with poor academic backgrounds also places a responsibility on the university to help learners to adapt to the high standard expected at a university. Providing multimedia resources that are designed to address learner's needs may help to achieve this.

The anatomy course for medical learners is changing to an outcome-based course in 2004. It has already been implemented for the BDS (Bachelor of Dental Science) learners in 2003. In addition, many anatomy departments in South Africa have already changed to outcome-based courses. This means a reduced number of contact hours for lectures as well as for practicals. The amount of information conveyed to the learners will therefore have to be reduced unless a way is found to convey the information outside of formal lecture or practical time. Multimedia computer presentations and videos supported by a website containing additional information as well as assignments could be the solution. Using this way of teaching could make it possible to maintain the standard of the course in spite of the reduced allocated time. Learners could do much of

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the course in their own time. The practical could be replaced by a tutorial presentation during which the best possible slides are shown to the learners instead of a learner sitting at a microscope wasting time looking for structures that may not even be on the slide. E-learning would not only give learners an opportunity to catch up missed lectures but also make it possible to revise lectures that were attended months ago.

A multimedia course that could replace the lectures and practicals or some lectures and practicals would take a huge burden off the teaching staff and may even bring about a saving in personnel. An E-learning course in histology does not have to be attended at the university but could be studied anywhere as long as the right hardware is available. Learners with concentration problems could go through the work at their own pace, repeating sections not well understood and take a break whenever they lost concentration. The lecture time could then be used for the higher level cognitive sections of the course. For an E-learning course to be acceptable it does not have to be better, although better is preferred, but simply needs to be just as good or the same as the traditional way of teaching histology.

1.2 The project

The topics in this section begin with the history of the project. The value of the research is discussed as well as the limitations and boundaries of the project. The latter is subdivided into practical and academic limitations. The reasons that make this study unique and lastly the developmental and research questions are also discussed.

1.2.1 History of the project

Over the years certain problems regarding the histology practicals have existed but have not been addressed.

The following problems occur when doing histology practicals in the traditional way using a light microscope, microscope slides and a histology atlas.

- The microscope slides available to the learners are not all equally good.

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- We only have a few examples of some of the slides like *olfactory epithelium* and the *pineal gland*.
- Of some of the other microscope sides we only have a few good examples like the *developing tooth*.
- Learners often waste a lot of time trying to find structures, which may even be absent in a specific slide.
- Learners often identify structures incorrectly without their or the lecturer's awareness.
- Theory and practicals are often dealt with as two separate subjects whereas the practical is supposed to support the theory.

Over the years the number of learners admitted to the MBChB course has steadily been increased. The increased numbers has meant that the number of practicals had to be increased because the histology laboratory where the practicals are done only has 110 microscopes. Currently we have to repeat the same practical four times to accommodate all the learners.

Much of the learning material in histology consists of facts that learners have to memorize. Because of this, lectures can easily change into sessions where the lecturer stands in front of the class and disseminates facts. Learners may feel that in stead of attending a lecture where the lecturer quotes facts from the textbook, they can read the textbook in their own time. Thus many learners do not attend lectures or leave lectures before the end.

Outcome-based histology will however have to demonstrate the clinical relevance of histology to link the histology to the clinical subjects taught in the dental or medical courses. At other institutions that have changed to outcome-based courses in anatomy, the contact hours for histology have been drastically reduced.

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To solve the problem of having to repeat the same practical four times, I started to videotape the microscope slides and the commentary that were shown on the overhead monitors during the first practical; this ensured that the practical was presented in exactly the same way to the 2nd, 3rd and 4th groups. In this way learners are all exposed to the best examples the lecturer could find. Slides of which only one or a few examples exist could be included. This has ensured that learners know exactly what they are looking at.

Because of requests from learners, these videos were put together on videotape and made available to them. However the way in which these videos were made resulted in a very unprofessional product, and the need arose to produce something more professional.

When the first 486 PC came out with the ability to display pictures and to play sound, the potential of this device as a teaching tool was immediately clear. When *Visual Dbase* came out with the ability to display graphics and to play sound I started to experiment with this program because I had experience in programming in *Dbase*. In *Visual Dbase* a database could be opened with sound and graphic (bitmap) files in it. These files could then be displayed in a form. On a 100Mhz Pentium computer this was a very slow process and became ever slower as more files were added to the database. Writing a program that displayed forms one after the other solved this problem. Each form displayed a number of text files, a graphic file and played a sound file. Making these forms was a very time consuming process. Arrows had to be put into the pictures permanently by using a graphics-editing program.

These programs were first compiled to help the learners during the practicals, replacing the videos that were originally made. The programs were shown to learners on overhead monitors during the practicals. A video converter was used to change the Super VGA signal into a video signal.

I also started to compile tests in the same way. The test consisted of a graphic image on part of the screen, a question on something in the image and five or six multiple choice

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answers from which to choose one. The test was answered on a multiple choice question (MCQ) form.

With the use of the video converter the signal could also be videotaped. The new presentations were then modified and video taped and made available to the learners, replacing the earlier made videos that were made directly from the video camera. Making videos in this way was a big improvement from making them directly from the video camera. When a video is made from a video camera and something needs to be changed the whole video has to be redone, otherwise one ends up with supplying a third generation video tape to the learners. If one makes the video from a computer, one can edit the presentation and simply copy the whole presentation again onto a master tape from which second-generation copies can be made for use by the learners.

The next step forward occurred when I was introduced to *PowerPoint*. *PowerPoint* could do everything that my own *Visual Dbase* program could do and more. Everything became much easier. Removable and changeable arrows and other indicators could be used. I started to remake all my presentations and MCQ practical tests in *PowerPoint*. The ideal situation would have been to make the presentations available on CD for the learners but because so few learners have access to computers the presentations were video taped as a master copy. Second generation copies were made from the master copy and made available to the learners. Videotapes were also placed in the library where there are facilities for watching videos.

Before tests and exams learners used to request to do revision using the microscopes. This could only be allowed with supervision, because microscopes had been stolen in the past during revision sessions without supervision. When the videotapes became available to the learners there were no more requests for using the histology laboratory for revision purposes.

When video taping slide shows from a computer there is a noticeable loss of graphic quality due to the reduced number of lines on a television monitor. The use of text on a

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video is limited to large fonts only. The interactivity is also limited to rewinding and fast forwarding. Presentations on a computer screen are much better than video due to the higher resolution of the super VGA screen and the fact that one can navigate through the program and the computer can react to learner's answers in response to questions.

1.2.2 Literature on similar projects

The literature reports on a number of studies done on computers in the teaching of histology. Mars and McLean (1996) developed a program and tested it on learners. Moga (S.A., Online) suggested that electronic means can be used to make more images available to learners. Richards et al (2000) found that learners would prefer a multimedia approach to histology. According to Meyer (1999), computers enhance the effectiveness of teaching and learning histology and can make the microscope obsolete. David A Begg from the University of Alberta (S.A., Online) anticipate that computers will reduce the cost of teaching histology and can make it possible to change histology in a distance learning program.

A new development in the teaching of histology is the virtual microscope where numerous micrographs are taken of a histology slide and compiled into a montage. The individual micrographs are then linked to the montage through a zoom in function. According to the Microbrightfield company (S.A., Online), this invention can replace the microscope as a teaching tool.

1.2.3 Value of the research

This study may prove useful in convincing the university to invest in facilities, convincing lecturers to develop teaching material like multimedia computer programs and videos and helping to decide whether we should retain the microscopes in the new computer centre.

According to the policies of the department of health, 80% of medical learners in South Africa will in future be from disadvantaged communities. This would mean that other universities with high selection criteria will be forced to admit more learners with poorer

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academic backgrounds. Universities are adopting more progressive recruitment strategies admitting learners on other criteria rather than school performance, admitting many under prepared learners (Multimedia Research Group, University of Natal Durban, S.A., Online). If a resource exists that is an effective tool for teaching disadvantaged learners, other universities that are also allowing disadvantaged learners into their programs can make use of this resource.

There is much pressure on Afrikaans universities to present courses like medicine in Afrikaans and in English, placing a burden on lecturers to give the same lecture twice. To prevent this, some universities have started to make use of interpreters to translate lectures while in progress. Multimedia programs can be presented to a learner in his or her language of preference.

1.2.4 What makes this study unique?

Previous studies dealt with learner perceptions and whether they prefer computer-based learning or not. This study investigates various aspects of teaching in histology. A large section of the course (just more than 40% of the lectures) was made available to the learners as multimedia computer presentations. Revision of all the practical work was made available as a video. This study not only investigates the possibility of changing the histology course into a multimedia course but also looks at the traditional way of teaching and testing histology. Learner profiles are compared to the different perceptions and also to the test results. Learner perceptions and learner likes and dislikes were investigated.

1.2.5 Limitations and boundaries of the project

A number of limitations were experienced in this project. These limitations could be divided into practical and research limitations. Practical limitations are limitations that limited the development, implementation and use of the multimedia and the information gathered by the instruments. Research limitations limit the accuracy and interpretation of the findings.

1.2.5.1 Practical limitations

The biggest practical limitation was the fact that not enough facilities existed to allow all the learners to use the multimedia computer presentations. This included facilities at MEDUNSA as well as facilities at home. Only 15 computers could be assigned for this project. The multimedia computer presentations were also available on the computers at MEDUNSA's computer centre but most of these computers did not have sound cards and to obtain a booking on one of them was difficult. Learners also had to pay to use these computers. The lack of facilities also prevented learners from using the multimedia computer presentations as much as they would have preferred to do. Not many learners (19% of respondents) had computers at home.

The multimedia computer presentations could also not be made as the author would have liked them to be. The only program available was *PowerPoint* which is not the ideal authoring program for a task like this. The limitations of *PowerPoint* also limited the features of the multimedia computer presentations. It was however felt that *PowerPoint* was good enough for a project like this as this was a study testing the possibilities of multimedia and not a final product for commercial distribution.

Another limitation was that no artist was available to make the many drawings that were used in the presentations, thus scanned images from books had to be used in many instances. The sound was also not nearly as good as I would have liked it to be as no proper sound studio was available for the development of the multimedia. *Windows'* sound recorder was used for the sound recordings.

1.2.5.2 Research limitations

This project was not additional, but was conducted as part of the academic program. Learners that volunteered were given permission to use the multimedia instead of attending classes and practicals. Because the project covered almost half the histology course there was no time to repeat any topic if the multimedia turned out to be unsatisfactory. Therefore the learners could not be forced to use the multimedia only as this could be used as an excuse if they did not do well in the test. Learners that used the

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multimedia could still attend classes and practicals. Learners could also not be prevented from using the multimedia as this could be seen as preventing them from improving their chances to do well in the test.

The questionnaire also had some limitations. Because the names of the respondents were required to link the responses of the questionnaire with the records, learners may not have been honest when answering some of the questions for fear of victimization (for example the rating of the lectures' questions). Many learners did not give their names. This prevented many responses from being linked to the records.

The tests that were written were not compulsory; therefore some learners may not have taken the tests as seriously as they should have.

The fact that no interviews were conducted with the learners may be viewed as a limitation but it was felt that sufficient evidence was gathered by the questionnaire. Some of the information would have been difficult and inaccurate had it been acquired from the learners during an interview. Learners may not have been honest in an interview when asked how they rate the lecturer or how they rate the multimedia.

The study was conducted at a single university, MEDUNSA with a unique student body. If the same study was conducted at another university with different learners, the results may have been different. Repeating the study with a different group of learners at a later stage may also give different results because every new group of learners that arrives at university differs from the previous group. More and more of the learners that arrive at university are computer literate. In each new group there are more learners that have used a computer as a study aid.

The findings of this study are all my interpretations. Another researcher may have interpreted the same information differently.

1.2.6 The myths surrounding multimedia and computer based learning.

Before the development could start a number of issues had to be clarified. Many claims are made regarding the value of multimedia and computer-based learning. The first issue that was investigated was “What are the myths surrounding multimedia and computer- based learning?”

1.2.7 The questions

The literature was reviewed for answers to the questions asked in this study. Obviously, answers to all the questions were not found in the literature. Some of the questions asked in this study will be answered by either the literature or the field study or by both. This is a study in developmental research and can therefore be divided into a developmental section and a research section. A set of questions were compiled for each section.

1.2.7.1 Developmental questions

The developmental questions deal with the development of the multimedia, namely the video and the computer presentations as well as with the development of the tests. The first two questions are about the value of multimedia, namely: “What are the advantages and disadvantages of multimedia in learning?”

When multimedia is used for learning purposes, pedagogical issues should be taken into consideration during development. What these issues are is the next question. The pedagogical considerations comprise constructivism, learning objectives and evaluation of the learners and the multimedia.

The next three questions deal with how multimedia should be delivered, designed and implemented. The question on delivery deals with the best format to deliver the multimedia in, looking at specific circumstances. The question on the design of multimedia looks into issues like the interface and the components of the interface such

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as images, text, colours and sound. Implementation looks at how the multimedia is made available to the learners.

The last developmental question is what the issues around tests are? The answer to this question will indicate how tests in this field are conducted.

1.2.7.2 Research questions

The research questions are divided into three main questions. The first question deals with the two instruments that were used (questionnaire and the records), the second question is: "What is the profile of a MEDUNSA learner?" The third question asks: "How should an E-learning course in histology be presented?"

The first consideration of the first main question deals with how a questionnaire should be designed, what the purpose of the questionnaire is, what types of questions can be asked in a questionnaire and what the arrangement of the questions should be. The answers to these questions will help to draw up the questionnaire. The last consideration is what the motivation for each question is.

The first question that was asked in the questionnaire was about the learner's subject preferences. The questionnaire enquired about what subsection of anatomy the learners prefer and why. The hypothesis is that learners do not like histology. The study will test this hypothesis.

The next question is about facilities. Questions are asked about video and computer facilities that learners have at home and whether they can afford a computer. These answers will also give insight into the financial situation of our learners.

A number of questions are asked about learning. The questions on learning are divided into tutored learning, self learning, favourite ways of studying and how learners would like their course.

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Under tutored learning the learners were first asked to rate the lectures. Secondly, a number of questions were asked about lectures, namely: why do learners not attend lectures, why do learners leave a lecture, do learners concentrate during lectures, are there too many lectures, are certain lectures more important than other lectures and which is the best way, from a learner's perspective, of presenting a lecture.

Another way of tutored learning is to attend practicals. Learners were asked why they did not attend practicals or left practicals.

The questions on self learning deal with the prescribed book, the internet, multimedia computer presentations and the video. The first four questions query the extent to which the four ways of self study were used. The following questions deal with the different issues concerning the multimedia computer presentations, namely: why they were not used, why learners used only some of the presentations, how much time learners spent using the presentations, whether the presentations were enjoyable to use, whether learners spent more time on histology because of the presentations, and whether learners helped one another when they encountered problems with the presentations. Respondents were also asked to evaluate the interface and if they found any technical problems or navigational errors. Questions were also asked on the perceptions that learners have about the multimedia computer presentations, namely: do respondents feel that the multimedia computer presentations improve recollection, do learners feel that their marks improved because of the presentations, is a computer presentation better than a lecture and did the presentations change the learners' attitude towards histology.

The questions on the video included a question on the number of times the learner watched the video as well as a question on the problems, if any, the learner encountered with the video.

A question was also asked about the learner's favourite way of studying histology.

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An important section of the questionnaire deals with the question on how learners would like their histology course to be structured. In this section the learners were asked whether they think multimedia can replace the traditional course and replace the microscope. Learners were also asked if they prefer watching the video or using the multimedia computer presentations.

Regarding tests, the learners were asked whether they feel that they will do well in histology if they work hard.

From the responses the following two questions, namely how successful were the multimedia computer presentations and how successful was the video, could be answered.

The research was conducted during the first two anatomy blocks. After each of these blocks tests were written by the learners. The last questions are: how did the learners perform in the tests and are there any relationships between the marks obtained and other parameters like selection criteria, the use of the multimedia computer presentations, the number of times the respondent watched the video and whether the respondent favours histology.

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Table 1.3: Issues investigated

Summary of the issues investigated.	
D E V E L O P M E N T	Advantages of computer- based learning
	Disadvantages of computer-based learning
	Pedagogical considerations
	Delivering multimedia
	Designing multimedia
	Implementation of multimedia
	Issues surrounding tests
R E S E A R C H	Subject preferences of learners
	Facilities at Medunsa
	Issues regarding lectures
	Issues regarding practicals
	Issues regarding video and multimedia computer presentations
	The use of the prescribed book
	Learner suggestions
	Learner profiles
	Suggestions for the presentation of an E-learning course

CHAPTER 2

LITERATURE SURVEY

The literature was reviewed to explore the research questions asked in this study. Many of the research questions are aimed at our specific type of learner but many other questions deal with issues that are of a more general nature. Questions such as how to develop a multimedia program, what instruments to use, issues surrounding lectures and tests are all questions for which the literature provides answers. Questions that are aimed at our learners are questions such as: “Do our learner’s use the prescribed book, are they satisfied with the lectures, what are our learners’ favourite way of studying and how did they perform in their tests?” Some of the information found in the literature will be compared with the information gathered in the research section of the study.

Since this is a developmental research study, the literature cited is divided into two sections, namely:

- Literature concerning the development of multimedia and E-learning;
- Literature on the issues around learners using multimedia and E-learning.

The matrix describing this chapter is divided into 6 columns. The main topic “The project” is in the first column. The second column contains the four subdivisions of the project, the myths, development, the future of teaching in general and histology in particular and the research. The development is divided into multimedia and the issues around tests. The subdivisions that fall under multimedia are the advantages and disadvantages, the pedagogical considerations, how to deliver, the design issues, elements of the interface and how multimedia and computer-based learning should be implemented. The advantages are divided into the general advantages and the advantages for histology. The pedagogical considerations are divided into general, constructivism, learning objectives and evaluation of multimedia which is further divided into rules of evaluation, evaluation of the users of multimedia and the evaluation of the programs. How to deliver multimedia is divided into three ways in which multimedia can be delivered, video,

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internet and on removable disk. The design issues and elements of the interface are divided into: navigation, buttons and metaphors, changes in state, interface consistency, media integration and biases, coaching the user, progressive disclosure, visual momentum, tool availability, monitors and colour, digital audio, text, things that work, things that should be avoided and design for a web based system. The research is divided into instruments and learner profiles. The two instruments comprise the questionnaire and the records. The questionnaire is divided into issues regarding the traditional course and the issues regarding the use of multimedia. The issues regarding the traditional course embrace to what extent learners use the prescribed book, how learners rate their lectures, how important lectures are and the length of the lectures. The issues regarding the use of multimedia are concerned with the learner's favourite ways of studying, what influences recollection, whether marks improve when using multimedia and whether multimedia should replace the traditional course. An outline of the above follows.

Table 2.1: Layout of Chapter 2

The project	What are the myths surrounding computer-based learning?				
	Development	Multimedia	What are the advantages?	In general	
				For histology	
			What are the disadvantages?	In general	
				Constructivism	
			What are the pedagogical considerations?	Learning objectives	
				Evaluation of multimedia	Rules of evaluation
					Evaluation of users of multimedia
					Evaluation of programs
				How to deliver multimedia?	On video
			On the Internet		
			On a removable disk		
			What are the design issues and elements of the interface?	Navigation	
	Buttons and metaphors				
	Changes in state				
	Interface consistency				
	Media integration and biases				
	Coaching the user				
	Progressive disclosure				
	Visual momentum				
	Tool availability				
	Monitors and colour				
	Digital audio				
	Text – font choosing and reading on screen				
	Things that work				
	Things that should be avoided				
	Design for a web based system				
	How should multimedia be implemented?				
What are the issues around tests?					
What lies in the future for teaching in general and histology specifically?					
Research	Instruments	Questionnaire	What are the issues regarding the traditional course?	To what extent do learners use the prescribed book?	
				How do learners rate lectures?	
			What are the issues regarding the use of multimedia?	How important are lectures?	
				What role does the length of a lecture play?	
		Records	What are learners' preferred ways of studying?		
			What influences recollection?		
			Do marks improve when using multimedia?		
			Can multimedia replace the traditional course?		
Learner profiles					

2.1 The project

According to Balasubramanyam (S.A., Online) “The computer is the most striking innovation in the field of educational technology after the printing press”.

2.1.1 What are the myths surrounding computer-based learning?

According to the literature, the following myths surround multimedia and computer-based learning.

Computers enhance learning.

Success derived from the use of multimedia is often attributed to the technology used. Research has shown that there is more variance within technology than between technologies like radio, television, film, video and overhead projection. The effectiveness of technology depends more on how the technology is used than the technology itself (Oliver, 1998).

Multimedia and the WWW have become favoured educational technologies because they enable the flexible use of instructional models. They support a variety of learning processes and styles simultaneously. A range of learning enhancing instructional tools can be accessed through multimedia. How these tools are used determine learning outcomes (Oliver, 1998).

Computer-based learning is a superior instructional format.

Many studies have been done to show that computer-based learning (CBL) is a superior instructional format and have proved their point (Oliver, 1998). If however CBL is compared to, not conventional instruction but to other innovative teaching methods like smaller class groupings and cooperative learning, CBL is found to be just as good or slightly less effective. From this one can assume that it is the change in instructional format that brought about the improvement and not the computer (Oliver, 1998).

Multimedia provides an easy way to learn.

Teachers are always looking for ways to make learning easier. However if a medium is perceived as easy, lower mental effort is exerted by the learners which means less learning. To achieve the required outcomes with computer-based learning, programs must be kept challenging and difficult (Oliver, 1998).

Multimedia will replace the need for face to face teaching.

Multimedia can never replace the face-to-face environment completely. At the most it can be a powerful supplement to conventional lecturing. If the multimedia is only a replication of a book on computer little is gained from it. The unique attributes of the technology must be exploited. Even with distance learning, much of the study material is still delivered on paper (Oliver, 1998).

Multimedia is enjoyable and motivating to use.

Well designed materials can be stimulating and challenging, but not all materials are like that. In some cases learners even prefer conventional materials and have avoided using the multimedia. This is the case when the multimedia is repetitive and dull (Oliver, 1998).

Computers are required for every task.

This is called distributed intelligence and is a myth. Even with computer aided instruction (CAI) there is still space for other modes of instruction and ways of acquiring knowledge (Reeves, 1999).

2.1.2 Development

The topics in this section will deal with the development of multimedia as well as issues surrounding tests.

2.1.2.1 Multimedia

The advantages, disadvantages, pedagogical considerations, delivery, design and implementation of multimedia will be looked at under this heading.

2.1.2.1.1 What are the advantages?

The advantages that multimedia have for teaching and learning in general but also for histology more specifically will be covered under this heading.

➤ In General

Multimedia presentations are engaging because they are multimodal, in other words they stimulate more than one sense at a time and in the process may be more attention getting and attention holding (Jonassen and Reeves, 1996). Many educators feel that multimodal access is essential when teaching today's video generation (Perelman, 1992).

Cairncross and Manion (2001) claim that interactive multimedia can create a high quality learning environment that promotes deeper learning but this potential may not be fulfilled in many programs.

McCormack and Jones (1997) state that there is an increase in demand for education resulting in larger class sizes. Higher learner to staff ratios result in a decrease in the interaction between staff and learners. Increased learner numbers may result in lectures being repeated. Higher numbers of learners mean learners with widely different backgrounds, cultures, previous learning experience, preferred learning styles and personal situations. Because of the cost of education, learners expect value for their money. Learners want more feedback, attention and resources. In a traditional situation it is difficult to track a learner's participation and progress. With a web based education system however a learner's participation and performance can be tracked. A web based

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system also allows for learning material to be adapted to suit the special needs of learners.

Kearsley (1990) reported on the results of evaluations done on various interactive multimedia projects and concluded that learners learn material to a deeper level and understand more connections among concepts. There is also evidence that most learners adopt a different type of learning style when using interactive multimedia. A problem solving approach that involves the testing of hypotheses and the building of models about a topic should be adopted.

Multimedia can offer learners:

- Greater access to the subject content (Lesewski and Settle, 1996);
- Increased flexibility in their times and pace of study (Lesewski and Settle, 1996);
- A better understanding of the visual and practical elements of the module (Lesewski and Settle, 1996);
- An appealing and motivating environment (Oliver, 1998);
- Customized individualized instruction to suit the needs of the learner (Oliver, 1998);
- Access to multiple media with increased learner control (Oliver, 1998);
- A colourful and aesthetically pleasing interface to learn from (Oliver, 1998);
- A motivating learning environment (Oliver, 1998);
- Learners learn quicker and learning is more enjoyable. (MacPherson and Brueckner, 2003).

➤ For histology

Harris et al, (2001) mentions that computers provide a very efficient way to learn visual material. At the University of Natal, Mars and McLean (1996) did a study on the perceptions of learners of a computer-aided instructional course in histology. They identified problems through a questionnaire. The main problem was identifying specific structures and cells in histological preparations. These problems were addressed in their program through adequate labelling of difficult cells and structures. Voice/sound files were played explaining images on the computer screen.

The best way to stimulate learning is one on one interaction between teacher and learner or small group interaction (Heidger et al, 2002). Margaret Moga (S.A., Online) states that an important objective of a medical histology course is to train learners to recognize cells and tissue types at the light and microscopic level. However due to space constraints and economics only a limited number of histological images can be shown in histology books, whereas optical disks and websites can be used to make many images available to learners.

In a study by Richards et al (2000) a questionnaire was given to second year medical and dental learners asking them questions about:

- training in microscopy;
- technology and the teaching of histology;
- microscopy in the health sciences workplace;
- the operation of the microscope.

Medical and dental learners were undecided on the issue of a training course in microscopy probably because they feel that the microscope will play a limited role in their careers and was therefore not of great importance to them. They see the microscope as an instrument to be used in specialist postgraduate work. These learners however felt that histology could not be taught without the aid of visual material. To the medical learners alternative forms of histology teaching seemed attractive because they have

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already been exposed to alternative media. Both the medical and dental learners indicated that they would prefer a truly multimedia approach to histology; however they did not feel that the optical microscope should be abandoned.

Meyer (1999) from the University of Western Australia developed a program that is called the “Histology Practical Assistant” to teach learners the practical side of histology. According to Meyer (1999), computers can greatly enhance the effectiveness of teaching and learning histology. A histology course can be completed using a computer program without ever having to use microscope slides or microscopes.

This has a number of advantages (Meyer, 1999):

- Learners can study histological sections outside of normal teaching hours reducing the need for large numbers of microscopes and slide collections;
- Academic staff is no longer needed in practical classes;
- Each learner can be provided with “limited” preparations;
- Self-assessment can be done.
- Teaching costs can be reduced enormously both in salaries and also in resources.

David Begg from the University of Alberta and his colleagues (S.A., Online) are developing a series of modules to teach basic human histology to medical and dental learners which will replace histology laboratory sessions. These computer modules remove the need to learn how to use the microscope to study histology and could reduce the cost of teaching histology significantly. The modules could also be used for distance learning programs.

According to MacPherson and Brueckner (2003), the computer presentations enhanced access to learning material and brought about self paced learning.

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Begg et al (S.A., Online) state that the lessons learned during the development and implementation of their histology modules are of potential interest to other disciplines in the health sciences.

A recent development in the field of histology teaching is the virtual microscope. Lutz Slomianka of the School of Anatomy and Human Biology from the University of Western Australia has made *Blue Histology – The Virtual microscope* - available on the internet (S.A., Online). The website contains descriptions of tissues and cells as well as a simulation of the functions of a microscope. The field of view is however very small and they claim that certain tissues are not well suitable for this type of presentation. According to this website computers are not yet performing well enough to create a virtual microscope for all biological tissues.

This virtual microscope consists of a window that is placed over a larger image and can then be moved around like a slide is moved around on the stage of a microscope. Magnification can be increased from 4X to 10X and 40X. To move the field of view around, coarse or fine steps can be selected.

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Below is an example of the Blue histology virtual microscope.

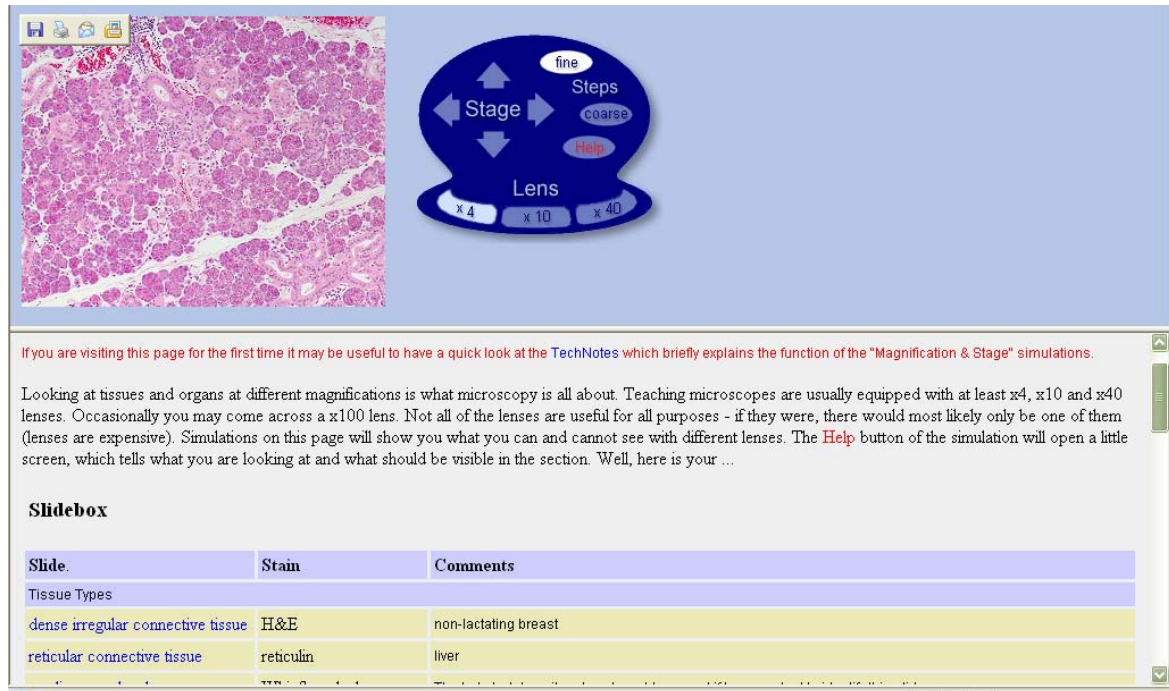


Figure 2.1: First example of the virtual microscope

The Microbrightfield (MBF), Inc. of Williston, Vermont (S.A., Online) developed the virtual slice module which is used to digitise an entire glass microscope slide. The module has a motorized stage which moves the slide around while it is being photographed to obtain a series of contiguous images. These images are then merged into a single seamless montage. The shading error is removed to obtain an image with even illumination. Because the resolution of the individual fields is maintained, the user can zoom in on any section of the slide without loss of resolution. These virtual slides can be made available on an intranet.

If this invention catches on the classroom microscope may share the fate of the slide ruler (Microbrightfield company., S.A., Online). Virtual slice removes the limitation of a microscope not being able to view all of a single tissue section. This feature provides numerous new visualization possibilities (Microbrightfield company., S.A., Online).

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Another improvement on the microscope is the facility to display a macro view of the slide. This can be done in a separate window to show the user what section of the slide he is looking at under high magnification. Thousands of these images can be saved on a server and then streamed to the viewer over the internet. (Microbrightfield company).

Harris et al (2001) of the University of Iowa reported on a study where a virtual microscope was created by using the technology developed by the Microbrightfield company. An area of 1cm² on a histology slide was digitised. Digitising was done at 300 pixels per inch, 24 colour depth and a 40X magnification. Adjacent slides overlapped by 35 pixels so that they could be stitched to form a montage. This resulted in a graphic file which was edited and compressed as a *FlashPix* image of 125megabytes. The Virtual microscope is displayed in a 590X590 pixel html frame on a 800X600 screen on the intranet. Below is an example of such a screen.

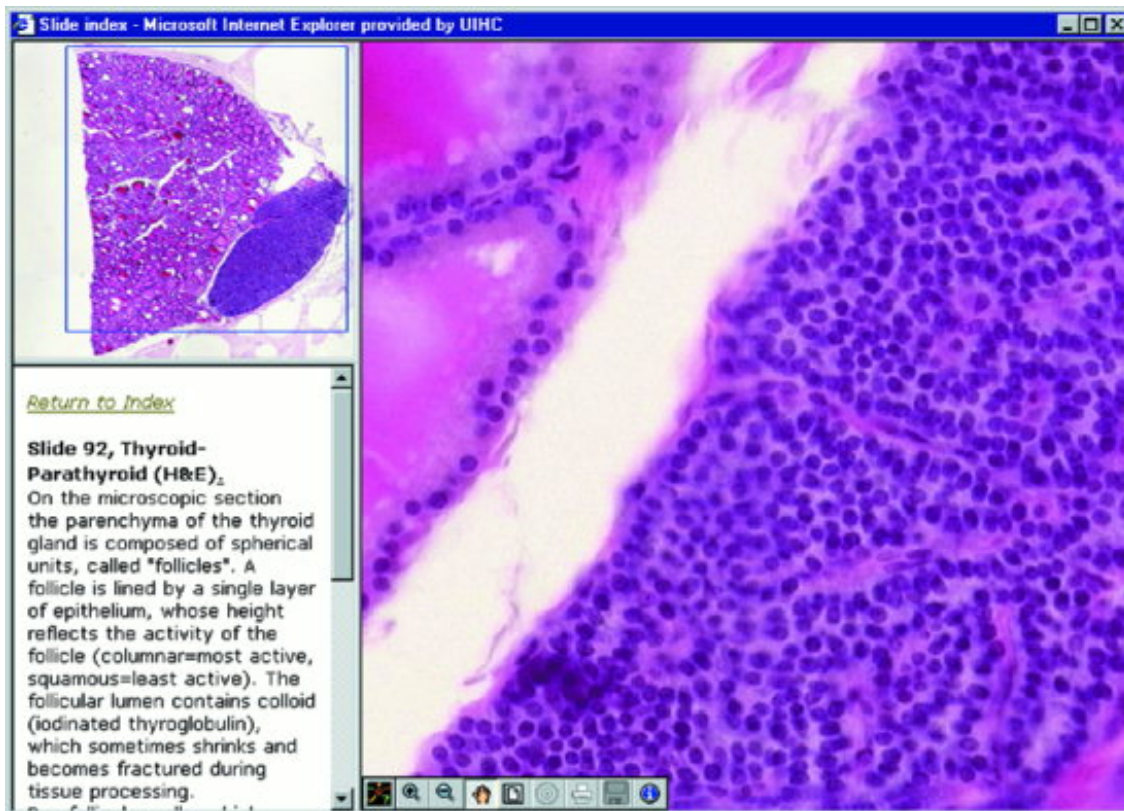


Figure 2.2: Second example of the virtual microscope

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Learners were asked to compare the virtual microscope with the light microscope regarding image quality, affectivity, ease of use, navigation and accessibility.

According to Harris et al (2001) the virtual microscope has the following advantages:

- Lecturers could use the virtual microscope for lecturing;
- Images are just as good as or better than that under the microscope;
- Slides are always in focus;
- The condenser and light adjustment are always ideal;
- The virtual microscope is easier and faster to operate than the light microscope;
- The virtual microscope is accessible on the intranet of the university.

According to the learners that participated in the study the virtual microscope has the following disadvantages (Harris et al, 2001):

- Does not indicate to the learners what they are looking at (there are no arrows indicating structures);
- Does not allow the user to change the focus when viewing thick sections.

In a study that was done by Heidger et al (2002), the Virtual microscope was made available to learners and evaluated by comparing it with the other study material that was at the learners' disposal. Learners were provided with the following study aids:

- Light microscope;
- Virtual microscope;
- Web based histology images (Labeled photomicrographs);
- Video disc atlas and CD Rom (Contain images with labels and text).

Only 8% of learners chose the microscope as their primary study tool, 16% used the virtual microscope as their study aid of preference while the rest (76%) preferred the images on the web, CD Rom and laser disc. The whole group succeeded in passing the

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exam which was conducted with the use of the traditional light microscope Heidger et al (2002).

This study revealed that learners embrace the easiest, fastest method of learning which will give the best results in a test. Learners have little intellectual curiosity and do not care for lasting, concept-grounded learning (Heidger et al, 2002).

2.1.2.1.2 What are the disadvantages?

According to Balasubramanyam (S.A., Online) computer instruction lacks the human and emotional factors of a normal classroom and may not be able to modulate all aspects of the learners' learning. Balasubramanyam also states that learning software in the medical field is currently limited. Development of such programs is time consuming and much more complex than authoring a book on the same topic.

The multimedia that was developed in recent years was done believing that it would increase teaching efficiency and could therefore replace lecturer led teaching (Davies and Crowter, 1996). This would lead to less contact between learners and lecturer which would free the lecturer with more time for research and so increase overall efficiency. Most developers however do not care about effectiveness or existing teaching methods. Materials are used without taking the capabilities and limitations of multimedia into account and therefore they do not exploit the full potential of this way of teaching. When it is claimed that multimedia is more efficient two factors are often forgotten, namely:

- It does not cost much to use multimedia if the facilities exist and the multimedia is already developed but the initial cost to produce the multimedia is often not taken into account;
- When using poorly designed multimedia it can take much longer to reach the required level of understanding than it would be with a lecture (Davies, Crowter, 1996).

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Salomon et al (1991) state that no impact can be expected when technology is only used to make an old activity faster or easier, for this to occur the activity must change. Reeves (1999) points out that when one changes to CAI one cannot keep the message the same, the message must also change.

The most common problem with multimedia is navigation. Multimedia presentations usually contain a mass of information with multiple links between the information. Some programs have many options but fail to give the user an idea of where to start and what route to follow. This has the result of users becoming disorientated, being unaware of how much they have seen and how much they must still do (Jonassen, Reeves 1996). This makes it difficult for learners to integrate the information acquired into their own knowledge structures (Jonassen, Beissner and Yacci, 1993). Learners do not create new knowledge structures when browsing through multimedia (Jonassen and Wang, 1993).

According to Lesewski and Settle (1996), if a learner does not understand a specific section of the course, the chances are that after repeating that section the learner will still not understand it. The computer cannot rephrase an explanation like a lecturer can in a lecture; therefore learners want the lecturer to be available.

Learners see viewing television as something pleasurable and relaxing. Learners view television and video as easy learning environments. However, if learners view a medium as easy they invest less mental effort which means less learning. The same will apply to multimedia on computer. For more effective learning learners must judge a medium as difficult so that they put more mental effort into the learning (Oliver., 1998).

2.1.2.1.3 What are the pedagogical considerations?

When multimedia is developed the developer must keep certain pedagogical considerations in mind. These considerations are discussed here.

 In general

According to Reeves (1999), pedagogy is defined as: “The art, science or profession of teaching”. Pedagogical dimensions are concerned with the aspects of design and implementation of CBI that have a direct effect on learning.

Reeves (1999) points out seven pedagogical dimensions that a comprehensive online learning environment should fulfil. These include:

- Task-Oriented: Give learners a task that is to their benefit;
- Constructionist: learners need to produce knowledge representations that show their progress. Learners should receive constructive feedback and opportunity to revise these representations;
- Conversational: Learners should discuss, debate and argue over topics. They must learn how to listen and to reflect and to change their minds. Learning is constructed through online discussions;
- Collaborative: Web based tools for collaboration and group work should be available to prepare learners for team work;
- Challenging: Online learning should not be easy. It should be as difficult as the problems learners will face in the real world;
- Responsive: Online learning communities should respond quickly, accurately and with respect. Supportive networks should form to continue to function throughout a career;
- Reflective: Teachers and learners must learn to engage in thoughtful reflection and metacognition.

Romiszowski (1993) fears that training is moving in a direction, because of technology, which is not pedagogically sound but economically and politically convenient, and would therefore like to see integrated design and development of the product and the supporting environment. Instructional multimedia may be exciting but does not necessarily lead to better educational programs (Romiszowski, 1993). Good instructional design is necessary in any medium.

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Efficient teaching is not always efficient learning. You can teach a dog to whistle but he may not learn to whistle (Davis, 2002). The availability of learning material is no guarantee that learning will take place, learners need guidance as how to use the technologies (Lesewski and Settle, 1996).

Lecturers using multimedia should therefore be more concerned about the learning process (Davies, Crowter, 1996). The emphasis should be on the learning environment and not the medium of delivery (Lesewski and Settle, 1996). The quality of the multimedia is most important. Intellectually stimulating multimedia will motivate learners which in turn will improve their performance. Learners may become overwhelmed by the material and may therefore become lost. When learners do a multimedia course the lecturer's role changes from presenting knowledge to facilitator in the learning process, so multimedia cannot replace the lecturer (Davies, Crowter, 1996). The Multimedia Research Group, University of Natal Durban, (S.A., Online) reports that this change from teacher to facilitator at tertiary institutions may face many obstacles but once the change has occurred, staff will enjoy their new roles and be more involved with the learners.

Learners can approach learning in different ways; some learners may use:

- Surface approach – learning by rote;
- Deep approach – actively searching for meaning (Biggs, 1989; Marton and Saljo, 1984).

To support the learning processes of learners, multiple perspectives in computer facilitated learning should be applied (Eizenberg, Kennedy and Kennedy, 1999). These authors developed a course in anatomy using the systemic and the regional approach as well as adding a third perspective – clinical anatomy, procedures, imaging, dissection and surface anatomy. This approach allows the learners to access information in a way most suitable to their needs while the material also supports higher levels of cognition.

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When Janda (1992) tested a multimedia method of instruction he discovered that learners have learned something but he could not determine what they had learned. From this result he concluded that multimedia advocates must demonstrate the value of this expensive technology by using better methods of research than is currently the case. Simon (1987) suggested that we move away from the idea that knowledge consists of facts and figures to one where knowledge is the ability to retrieve information from data bases and use it to solve problems.

Clark and Craig (1992) reviewed research on multimedia and interactive videodisc and concluded that:

- Multimedia is not the factor that influences learning;
- Gains in learning with multiple media are likely due to instructional methods such as interactivity;
- The aspects of dual coding theory which formed the basis for early multimedia studies have not been supported by subsequent research;
- Future multimedia and interactive videodisc research should focus on the economic benefits (cost and learning time advantages) of new technology.

According to McKenna (1995) many researchers use the term “more effective” in connection with CBL without indicating what is meant by “more effective”. She proposes that effectiveness can be measured in different terms, such as:

- Achievement of learning outcomes;
- Learner satisfaction and motivation;
- Development cost ratios;
- Redeployment of staff;
- Flexibility.

Most research on new technologies used in the learning process reports that there is no significant enhancement (McKenna, 1995).

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According to Flagg (1990), the evaluation of computer-based education (CBE) in its various forms, namely interactive multimedia, integrated learning systems and environments as well as microworlds lags behind the efforts put into development. The consumers of these products assume that because they are advertised as effective they are effective (Reeves, 1999). From Siegel (1994) and Shlechter (1991) it is however clear that the success of CBE is limited.

The Multimedia Research Group, University of Natal Durban, (S.A., Online) is of the opinion that a move away from the didactic mode is necessary to integrate computer technology into course work. Educational problems cannot be solved by computers which are merely another resource like books, experiments or films although more stimulating and much richer. Computers as a teaching tool make learners more responsible for their own learning.

➤ Constructivism

According to Savary (1995), humans explore their environment and from these experiences they construct knowledge. This means that in the multimedia paradigm learners are supplied with an authoring vehicle which they use to learn, and from what they learn they construct knowledge.

To prevent intellectual anarchy when each learner constructs his or her own knowledge Jonassen (1994) suggested a model which includes the following principles:

- Focus on knowledge not reproduction;
- Provide real world case based learning environments;
- Support collaborative construction not competition;
- Promote reflective practice, construction must be context and content dependant.

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According to Piaget's theory as described by Huitt and Hummel (2003), humans cannot understand and use information immediately. They construct knowledge through experience, then build mental models and then change the models through assimilation and accommodation.

Papert (1993) characterizes:

- Behavioural approaches as “clean” teaching – knowledge is broken down to be learned;
- Constructivist approaches as “dirty” teaching – holistic and authentic.

To achieve cognitive constructivism there should be less emphasis on directly teaching skills “clean teaching” and more emphasis on learning in a meaningful context “dirty teaching”. Multimedia offers many such opportunities (Papert, 1993).

According to Cronje (1995), multimedia is ideally suited for constructivist learning because:

- It can adapt to the learning style of each user;
- It can simulate “real life” through multiple options;
- It gives learners the opportunity to learn through doing;
- Incidental learning can take place in the search through hyperspace.

According to the Multimedia Research Group, University of Natal Durban, (online) integration of computer software (both commercial and homegrown) can be successfully integrated into coursework providing the teaching paradigm is changed to the constructivist mode.

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Reeves (1999) mentioned the following myths regarding constructivism:

- Telling (the opposite of constructivism) is always bad. Telling is not always bad it can be appropriate;
- Learners should always work in groups (Social constructivism) – this is not true for there is a time and place for individual work.

➤ Learning objectives

According to Clark (1999, S.A., Online) the learning objectives of a course (Bloom's theory) in ascending order should be:

- Recall and recognize specified information;
- Comprehend and digest the information;
- Apply what they have learned;
- Analyze the subject, with an understanding of the components and their relationships;
- Synthesize the subject, taking an overview;
- Evaluate knowledge, understanding and competence critically.

Multimedia courses focus on the first three learning objectives while some only address the first one. This is called the drill and practice approach (Davies, Crowter, 1996). The last three objectives would be difficult to achieve with the testing that is available on a computer. Therefore, according to Davies and Crowter (1996) multimedia is only suited to courses consisting of a series of concepts.

➤ Evaluation of multimedia

The rules of evaluation and the evaluation of learners and programs are discussed under this topic.

❖ Rules of evaluation

Under evaluation there are two issues (McKenna, 1995), namely:

- Evaluation of the learners after using multimedia;
- Evaluation of the programs.

What are the rules (levels) of evaluation?

Kirkpatrick developed four levels of measure for evaluation of a teaching program (Kirkpatrick, 1959a; 1959b; 1960a; 1960b). Kevin Oakes of Asymetrix Learning Systems sums up the Kirkpatrick levels this way:

Level 1: Smile-sheet evaluation. Did you like the training?

Level 2: Testing. Did you understand the information and score well on the test?

Level 3: Job improvement. Did the training help you do your job better and increase performance?

Level 4: Organizational improvement. Did the company or department increase profits, customer satisfaction, and so forth as a result of the training?

Only the first 2 levels are relevant to this study.

Level 1 - Feelings the learners have about the program (reaction).

Questionnaires at the end of the course can provide the instructor with insight into how the learners feel about the course (perception) and how to increase the popularity of the course (Boyle and Crosby, 1997). Questions such as how much the learners liked the instructor's presentations techniques, how well the topics were covered, how relevant the course contents is for their specific application and how they plan to use their new skills in their job can be asked.

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Learners know what they need to know to accomplish a task. If the training program fails to satisfy their needs it must be determined whether the problem lies with the design or the delivery of the program (Boyle and Crosby, 1997).

Because this level does not give any indication of what skills the learners have acquired or if the course will help them to improve their work, some people do not regard it as very valuable. However this level is important because people learn better when they feel positive about their learning environment (Boyle and Crosby, 1997).

Level 2 - To what extent did the learner learn the required material (learning).

The main question is – did the learner learn anything (Clark, 1995, revised 1996 and 1997)?

According to Clark (1995, revised 1996 and 1997) this level can be defined according to which extent the learner has:

- Changed attitude;
- Increased skills;
- Improved knowledge.

Examinations and quizzes can determine if these improvements have taken place (Clark, 1995, revised 1996 and 1997). Whether the learner has acquired the required knowledge can also be determined (Boyle and Crosby, 1997). Post-testing is only valid when combined with pre-testing to determine what was learned during the training program (Clark, 1995, revised 1996 and 1997). Learning measurements can be used throughout the training program (Clark, 1995, revised 1996 and 1997).

How much a learner likes a course does not necessarily mean that he or she has learned what was intended (Boyle and Crosby, 1997). One must be careful not to

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assume that success on one level will mean success on another level (Boyle and Crosby, 1997).

❖ Evaluation of users of multimedia

The purpose of evaluation is to determine if the materials and the methods used for instruction are accomplishing the objectives (University of Idaho, S.A., Online).

Analysis of evaluation data will expose weaknesses in the instructional process (University of Idaho, S.A., Online). This information can then be used to fix problems and to improve the system (Clark, 1995, revised 1996 and 1997).

Fontana et al (1993) want to see evaluation done that takes account of higher-order thinking skills and that does not measure recollection of facts. They also consider equity issues as being an important impetus from employing traditional evaluation methods to innovative strategies that assess higher-order thinking skills and complex behaviours denoting mastery. In their opinion, research suggests that current uses of information technology in education may be widening the gap between rich and less affluent schools and between high-achieving and at-risk learners.

When control and treatment groups are tested and 'no significant difference' between the two is found it is often based on an end of the course test. According to McKenna (1995), perhaps the test is not testing the right things or the testing is more appropriate for the teaching used with the control group.

❖ Evaluation of programs

Evaluation should be ongoing throughout the whole process of design, development and implementation (Clark, 1995, revised 1996 and 1997).

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According to McKenna (1995), material can be evaluated in terms of its:

- instructional quality;
- level and type of interactivity;
- cost effectiveness;
- ability to meet an identified learning need;
- ability to satisfy learning outcomes.

The evaluation of CBI is, according to Reeves (1999), often presented as statistics on money spent, ratios of learners per computer and time spent on CBI which gives very little information on the effectiveness of CBI. These figures which are easy to collect and to analyze can however be used to convince stakeholders to spend money on CBI (Reeves, 1999).

According to Reeves (1992a), a reason for the lack of evaluation of CBI is the fact that evaluations that have been done previously are not utilized adequately. Evaluation reports are often presented in a format which is almost useless to clients and audiences (Scriven, 1993). Evaluation is often also done too late to have an impact on the design and implementation of CBI (Reeves, 1992a).

When an instructional innovation is compared with another approach through traditional empirical evaluation methods the results of these studies have often been disappointing (Clark, 1992). The reason for this is that these programs often do not differ meaningfully (Cooley and Lohnes, 1976).

One form of CBI can be compared to another form of CBI or two different implementations of the same CBI can be compared through pedagogical dimensions (Reeves, 1999). Although some evaluation theorists deny the use of comparative evaluations (Cronbach, 1980) most clients want these evaluations to be done. Criteria

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for evaluating various forms of CBI should be developed which will result in more valid and useful evaluations (Reeves, 1999).

Eitel et al (S.A., Online) reported that learners suddenly started to reject the in house multimedia programs that were developed and were well accepted by learners earlier. According to Eitel et al (S.A., Online) the reason for this phenomenon was that more and more learners gained access to the internet starting to use web courses with multiple hypermedia links to relevant web sites. These web sites apparently became more popular than the programs that were developed in house.

2.1.2.1.4 How to deliver multimedia

Literature on three of the ways (video, the internet and removable disk) in which multimedia can be delivered are discussed under this heading.

➤ On video

The power of television is widely recognized but the disadvantage of television is the lack of interactivity. The fact that television has a strong visual emphasis and a wide range of possibilities makes television (video) a medium to consider for supporting or even carrying education (Cronje, 1996).


In a study done by Blanc and Martin (1994) video tapes were made of lectures. The advantages of these video tapes are that the learner can control the rate and flow of information, the quality of learner comprehension can be monitored, study skills and content can be integrated and the extended time makes it possible to identify and correct both content and skill deficits. Their aim was to use this new program to address the needs of marginally prepared learners.

Videos that were made specifically for medical learners were very effective, in four years the VSI (Video Supplementary Instruction) was used by 24 medical schools helping

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learners to perform well on medical boards (Blanc and Martin., 1994). This study found that if VSI is used as an alternative instruction at-risk learners can master difficult content and develop requisite skills at the same time. The key to the success of VSI is that the learner can listen to the lecture, stop the video machine and consider the meaning before continuing.

According to Nel et al (1997), video based supplemental instruction can help at risk learners that experience problems with a subject like anatomy. Nel et al (1997) claim that a lecture on a video tape can combine the positive qualities of a lecture with that of small groups discussions. This is done when learners sit and watch a lecture on video under the supervision of a facilitator. When the video is stopped a moment of silence is allowed, this give learners time to form questions, observations and opinions which are then shared with fellow learners (VSI – The center for academic development The University of Missouri-Kansas City). Learner responses on this program include remarks like “When I could not understand the video (lectures) I could listen to my peers to get a clearer understanding” and “It was impossible not to pay attention”.

 On the internet

According to John K Galbraith from eLearn Magazine (S.A., Online), online learning represents the biggest potential change in teaching methods since the inception of formal college education. Some experts believe that the new technology cannot be as good as the one it is replacing. Despite this expert disapproval there is high consumer demand for this user-friendly technology. Universities that refuse to put their courses online will eventually have to do so to survive.

In an experiment that was conducted by Cronje and Clark (S.A., Online) a virtual classroom was constructed. From this experiment it was concluded that this could be a very successful recipe providing certain criteria and rules are adhered to:

- Learners must be computer literate;

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- After exposure to theory and practice learners should be given collaborative projects;
- Course processes and learner progress should be evaluated;
- Learners should be encouraged to post messages;
- Course guides, outlines and information should be provided;
- Design should take research on design, metaphors and navigation into account;
- Communication should take place through classroom E-mail lists and replies should go to all learners;
- Exercises should reflect creativity as well as facilitate trust and rapport;
- Asynchronous learning should be supplemented by synchronous learning (CMC);
- Step by step learning as well as diversity should be catered for;
- Learners should help with the construction of the classroom by making their own websites.

The University of Idaho (S.A., Online), “Distance education at a glance” website points out the following considerations when using the Internet:

- The convenience of internet access may influence the success of the learner;
- Keeping track of learner’s computer problems should become part of the instructional process. Learners may face the following challenges all at once:
 - Learning computer skills,
 - Learning new software,
 - Learning communication skills;
- Learners may be hesitant to communicate through E-mail or at computer conferences because they are not sure of the protocols. Encourage learners early in the course to use the communication facilities. Learners may even be forced to send a minimum number of E-mail messages per week;
- Receiving E-mail from learners makes it possible for instructors to provide quick feedback. Delayed feedback may however make the instructor a facilitator that

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will stimulate learner interaction. Prompt responses to problems will generally increase learner motivation and performance;

- The instructor must be familiar with the resources on the Internet and how to use them most effectively.

will have to increase their instructional design staff and will have to include computer expertise as a criterion for appointing new members of faculty. Faculty members should be encouraged to teach online and should be given exclusive rights to the intellectual property contained in their courses (Galbraith, 2002).

➤ On a removable disk

Electronic documents that are prepared for publishing on a website can also be published on a CD Rom in HTML format (Raymond, 2001). According to Raymond (2001), delivering multimedia material on a CD Rom has the following advantages:

- Lower cost than print especially at high volume;
- Lower shipping costs;
- Very portable and lightweight;
- No Internet access required;
- Content can be viewed on PCs (Windows) and Macintosh if CD is created properly;
- Less expensive than print to publish a new edition;
- As with the Web, CD content can be in multiple formats and provide for flexible access, easy navigation, and print control.

MacPherson and Brueckner (2003), reports on a course in dental histology that was previously presented as 35 mm slides with accompanying text. Learners found this course boring; access was limited because the slides could only be viewed in the library. Learners did not perform adequately with this system. When computers arrived the

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course was digitized and made available on the internet as well as on CD Rom. Learners reported that the CD rom version was far easier because of the image intense nature of the programs and because learners did not always have access to the internet. MacPherson (2003) found that CD Roms facilitate linear access to study materials for personal use.

According to McKenna (1995), many Cd Roms on the market are just data bases of information with no learning strategies built into them.

The virtual microscope contains huge files, 125 megabytes per slide. This would mean that 5 slides would fill a CD Rom. Considering that more than a 100 slides are usually studied in a second year histology course for medical learners it would be impractical to put the virtual microscope on CD Rom. A DVD would be a better way to deliver the virtual microscope (Harris et al, 2001).

2.1.2.1.5 What are the design issues and elements of the interface?

According to Vaughan (1998), a good user interface is essential for a successful multimedia project. Before a program can be designed a set of requirements must be established (Preece et al, 2002). There are two types of design, namely:

- Conceptual design;
- Physical design.

Conceptual design has to do with what the program will do and how it will behave. Physical design has to do with the detail of the design like the appearance of the screen, the menu structures, icons and graphics (Preece et al, 2002). The ideal situation is where a product emerges through designing a prototype (on paper as a storyboard) which is then evaluated and redesigned. The storyboard can either be worked out in great detail and then quickly converted into a finished product or a less detailed

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storyboard can be used which will result in more work at the work station (Vaughan, 1998). The evaluation should be done by users (Preece et al, 2002).

Knowledge and skill in using a computer plays a major part in design (Vaughan, 1998). Talent in using graphic art, video and music is necessary (Vaughan, 1998). The designer must also be able to conceptualize logic pathways through information (Vaughan, 1998). A good interface design will have colours that look good, text fonts that speak and buttons of which the function is easily understood. Jones (1993) stated that screen and interface design should be considered simultaneously when developing a computer-based learning environment. Guidelines for screen and interface design should be flexible to allow for creativity and for the special needs of a project.

The perfect interface should (Fieffer, 1997):

- Give me everything I want
- State information in my terms
- Give information on one click
- Give me nothing I do not want
- Not surprise me.

The interface is the interpreter between user and computer and should provide an easy way for the user to get information without cluttering and without surprises, the program can surprise the user but not the interface (Fieffer, 1997).

User-centered design is a strategy that should be considered when constructing software (Dørup et al, S.A., Online). When this strategy is applied user needs are taken into account. A problem may be that different groups like teachers and learners may not have the same reaction to a program. Vincini (2001) states that experts, as well as representatives of the users of a program must be involved in the design of the program. Prototypes should be tried out and feedback should be given.

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Steyn (2001) did a study to determine the value of learner participation in the design of educational software. It was found that sometimes suggestions that were thought useful by the author were turned down by the learners while the learners sometimes made suggestions that were obviously wrong. The user interface consists of a navigation system and graphic elements. Poor graphics and a disorganized content can be the cause of a failed project (Vaughan, 1998). The type of end user must be taken into consideration. The fact that the end user can be computer literate or illiterate causes a problem. This can be overcome by designing two interfaces – one for novices and one for experts. A modal interface may confuse the user and is best avoided (Vaughan, 1998).

Screen changing should be animated to make sure that the user knows he is looking at a different screen. The user interface should be consistent. The best user interface demands the least learning effort (Vaughan, 1998).

A script was written for each screen for the program that was developed by Mars and McLean (1996). Each image contained detailed information. Clicking on images or words brought up interactions like highlighting of areas on the image, labelling or animation of the image, presentation of additional text, sound or a question related to the topic. Care was taken to make sure that the colour reproduction was faithful. Some images were filtered or enhanced when necessary. Images were sized to occupy a quarter of the screen. Diagrams were also used in the program. Voice files were used to introduce new concepts, give advice on how to use the interactions, ask questions and to supply answers. The voice was in a conversational style to give the impression of an individual tutorial.

A dictionary of new words encountered and references to prescribed textbooks were also provided. A menu offered access to different modules. The modules included self-assessment questions that were asked in the course of the module. Questions varied from MCQs, true/false, text response or drag and drop labelling questions. Spelling errors were allowed but the learner was informed of the error by a voice. Incorrect

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answers produced a verbal explanation as to why the answer was wrong. A mode consisting of a slide quiz was also included. The learner was constantly informed of the number of questions attempted and correctly answered.

A record was kept of each learner's progress. Time spent, module chosen and questions answered correctly was recorded. Learners did this program as an alternative to the usual way of studying that specific section and had to complete a questionnaire after completion of the course. In this study previous computer experience or lack thereof did not play a role in the positive response received by the learners after completion of the course. The use of sound was considered a positive feature.

The following example comes from software developed by Dørup et al (S.A., Online), and shows a sagittal section through the lip. The navigational buttons and the list of links are on the right while some information on the tissue is below the image.

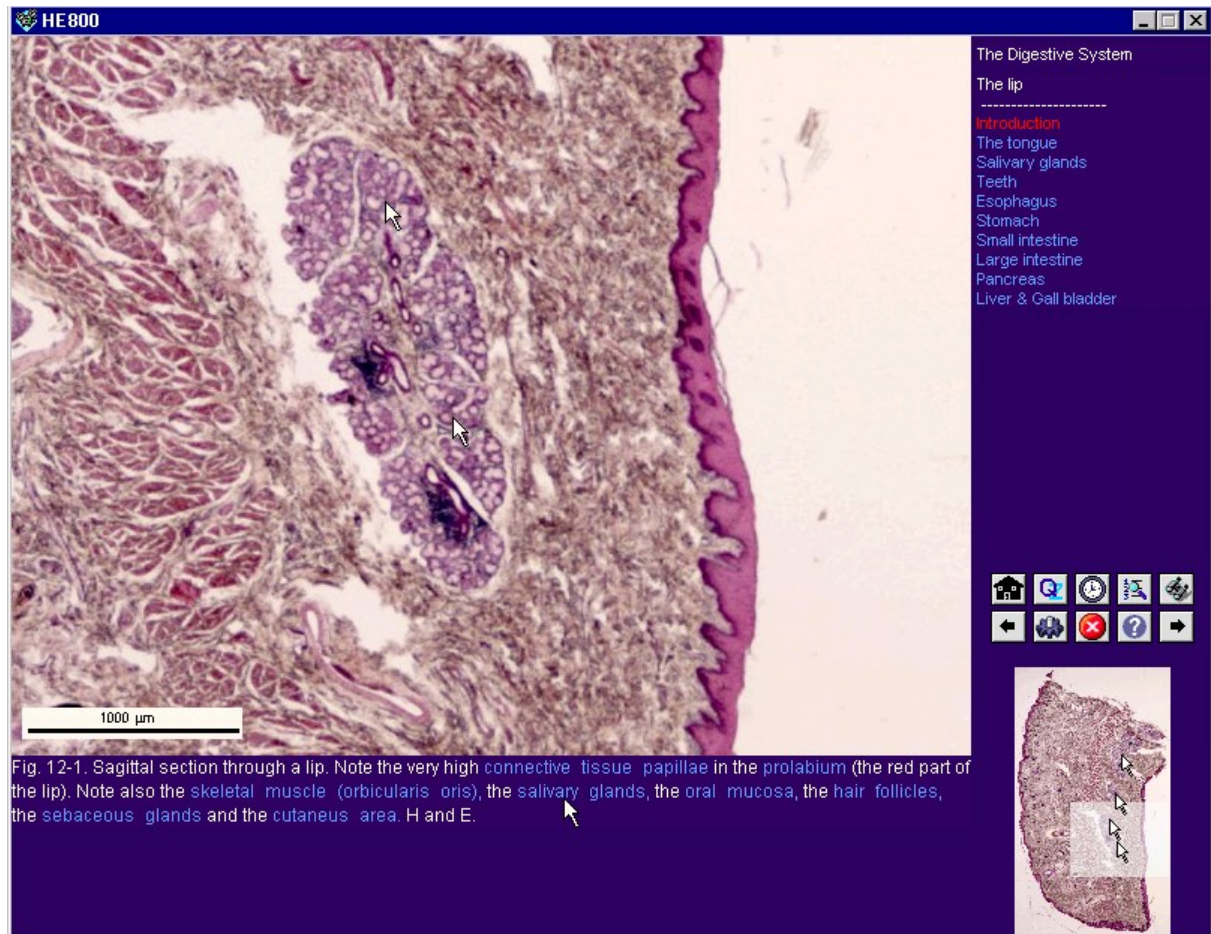


Figure 2.3: First example of the interface of histology multimedia

A course in oral histology developed and reported by MacPherson (2003) has an interface where the screen is divided into three main regions. The left region is for text while the right region of the screen is divided into an upper and a lower part. The upper part contains images and the lower part contains the legend for the images. The images can be enlarged and the user can navigate between pages and also between different modules. The navigational buttons are at the bottom of the screen.

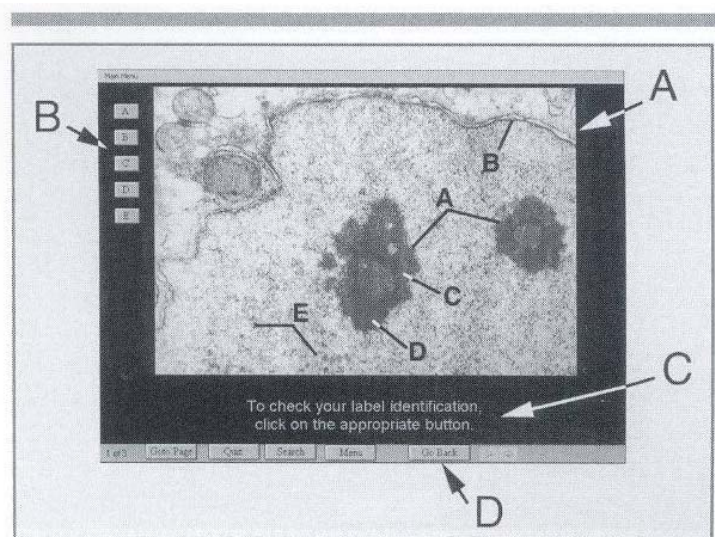
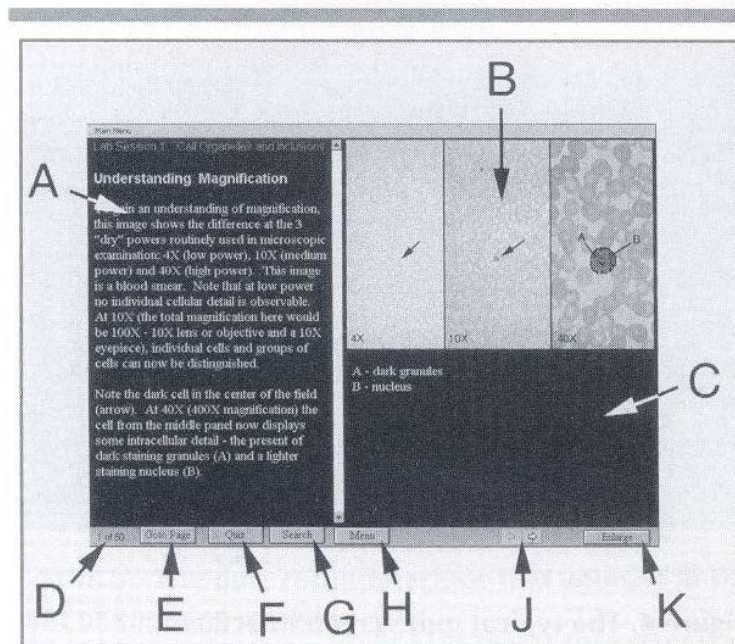


Figure 2.4: Second example of the interface of histology multimedia

➤ Navigation

Navigation is done through menus which supply the user with options (Preece, 2002). Menus can either be:

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- Drop down;
- Pop up;
- Single dialog.

The first two allow for logical grouping of topics (Preece, 2002). Names used in a menu should be unambiguous (Preece, 2002). Vaughan (1998) states that the simplest menu consists of text lists of topics. Text is necessary for the user to keep track of his location.

The following are important points to be kept in mind when designing the program (Laurel, Oren, and Don, 1992):

- A menu with a list of topics should be provided from which the user can then select one by clicking on it;
- Browsing should be flexible but not indiscriminate or uncontrolled;
- A user must know where a topic was found;
- A user must be able to find a topic again.

Navigation can take place in the following ways:

- Linear;
- Non-linear;
- Hierarchical;
- Composite.

In a linear presentation frames follow one another so the information is presented in a sequence which is meaningful to the author, the problem is that unwanted information is also presented so the background of the user is not taken into account (Fiefer, 1997).

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In a non linear presentation navigation takes place freely through the content. In this way of presenting information a response is given to a question when a question is asked during a conversation (Fiefer, 1997).

In hierarchical navigation, navigation takes place along the branches of a tree structure (Vaughan, 1998).

In composite navigation users navigate freely but have to follow some information in the linear way (Vaughan, 1998).

A navigation map should be drawn up early in the project. This will provide a chart of the logical flow of the interactive interface. The navigation chart should be done with the storyboard. The user should always know exactly where he is in the program (Dørup et al, S.A., Online).

A navigation system should take the user to a destination as quickly and with as few actions as possible. The user should not need help (Vaughan, 1998).

Too much freedom can cause users to get lost. To prevent users from getting lost a secure anchor should be given to which the user can return to at any time. If a multimedia project is good, users will get positive feedback within 20 seconds and this will make them to want to go further (Vaughan, 1998).

Most current multimedia is non-interactive and linear. This means that multimedia does not exploit the potential of the technology available (Fiefer,1997).

Lisewski and Settle (1996) designed and developed a multimedia course in weed biology. This course consisted of a series of concepts and it was therefore decided that the best delivery format for a course like this was linear. Any information could however be accessed through an index page.

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A program must have tools like a search engine or an index or both to search the information in a program (Laurel, Oren and Don, 1992).

➤ Buttons and metaphors

Buttons for navigation can easily be ambiguous and if a good icon does not exist text should be used (Fieffer, 1997). Elements already known to the user should be incorporated (Dørup et al, S.A., Online). According to Steyn (2001), the designer should try and stick to known metaphors like the hand, trashcan and hour-glass. Keywords or special codes should be avoided and provision made for users that make mistakes.

In a study done by Onibere et al (2001), a localized interface using icons from the local culture was tested against an international interface in a multicultural multilingual country. Nakakoyi (1996) showed that culture can affect human computer interaction. Because the effect of colour is small, the study of Onibere et al (2001) concentrated on phrases, jargon and icons. This study found that the preferred way of interaction in Botswana, is with menus rather than with buttons or with hot keys; people understand text-based commands better than icons so there is no need for localized icons.

Using metaphors (books, shelves) for navigation in a program enhances understanding and helps to organize program content. Metaphors should be applicable to the content of the program (Jones and Okey, 1995).

➤ Changes in state

This is where a movement or animation (screen wipes right or left, zoom, dissolving or fading) is used to give the illusion that the program is going forward or backward or that the user is going to a new topic (Nicol, 1990).

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➤ Interface consistency

The way of interaction with different media types should be consistent. Access to all media types should be in the same manner (Jones and Okey, 1995).

➤ Media integration and biases

Vaughan (1998) is of the opinion that users should be able to search and retrieve information from different media types.

According to media biases some types of media are more credible than others. Text is seen as the most credible while other forms of media are less credible. To integrate different forms of media can reduce the bias between different media types.

➤ Coaching the user

Vaughan (1998) states that help, overviews and examples should be provided to make it possible for users to find wanted information.

➤ Progressive disclosure

Information should be made available in small sections. This helps to reduce the complexity of the program. This will also ensure that the user is not overwhelmed by the amount of information (Jones and Okey, 1995).

➤ Visual momentum

According to Vaughan (1998), visual momentum is an important part of a program. The program has to keep the user's interest. Low visual momentum means that a user spends more mental effort on figuring out the program than on learning the content.

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➤ Tool availability

Only the tools that are relevant for a specific screen should be made available. The others should be hidden or greyed out (Vaughan, 1998).

➤ Colour

If a multimedia presentation is going to be displayed on a television monitor the following should be avoided:

- Patterns or mosaic;
- Horizontal lines;
- Extremely bright light or intense colours which will flare up on screen. (Stick to pastels and earth colours);
- Some reds may turn brown on a television screen.

➤ Digital audio

According to Vaughan (1998), sound is the most sensuous element of multimedia. The use of sound can make the difference between an ordinary multimedia project or a spectacular one.

Recordings can be edited using the following software features:

- Trimming (remove blank space);
- Splicing and assembly (removing noises and making longer recordings by adding shorter ones together);
- Volume adjustment, format conversion;
- Resampling or down sampling (change a 16 bit recording into a 8 bit recording);

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- Fade-ins and fade-outs, equalization (modify the frequencies to make it sound brighter), time stretching (change the length without changing the pitch) and digital signal processing (add effects such as reverberation) can be done.

Adding sound to multimedia:

- Decide what kind of sound is needed – fit the sound cues into the storyboard;
- Create or acquire source material;
- Edit sounds to fit the project;
- Test the sound to make sure it is timed properly.

Vaughan's (1998) law of multimedia minimums states that: *“There is an acceptable level of adequacy that will satisfy the audience. This level may not be the best that technology, money or time and effort can buy”*.

Many multimedia developers record sound on tape, choose the best recordings and then digitize them. For high fidelity sound the expensive equipment of a sound studio will be needed. Stereo audio circuits of VCRs can also be used for decent recordings (Vaughan, 1998).

➤ Text – font choosing and reading on screen

The term font is often used when the term type face would be more correct. Text where upper and lower case are mixed read easier than text where only one case is used (Vaughan, 1998).

In print Serif is used because it guides the eye of the reader along the line of text. Sans serif is used for headlines and bold statements. A computer screen is different; when there is a lot of text on the screen it is better to use sans serif. A serif font looks too busy

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and is tiring and difficult to read. A large bold serif looks elegant and gives character to the graphic layout (Vaughan, 1998).

According to Vaughan (1998) text is used in multimedia for:

- Titles – What it is about;
- Menus – Where to go;
- Navigation – How to get there;
- Content – What you see when you get there.

When designing a screen a large portion of text can be put on a screen before it becomes too busy. However if it is a live presentation large fonts and few words with lots of open space should be used. The audience should focus on the speaker and should not sit and try and figure out the writing on the screen. When a great deal of text is presented provide a printing link so that the reader can print and read the document rather than scroll through it on the screen (Vaughan, 1998).

How to choose a font for a multimedia presentation (Vaughan, 1998):

- For small type use the most legible font – decorative fonts are useless;
- Different fonts should not be used on the same screen – rather use italics, bold styles and different sizes to vary the weight;
- Adjust the leading for the most pleasant line spacing (not too close);
- Vary the size of the font according to the importance of the message;
- When you have a headline written with large letters, adjust the spacing between the letters so that it feels right;
- Experiment with different colour text on different backgrounds to make your text more legible;
- Use anti-aliased text for titles and backgrounds. (edges are dithered);

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- When using centered type keep the lines to a minimum;
- To grab attention graphically alter and or distort text;
- Experiment with shadowed text. (Copy a different colour on the original text and offset it);
- Surround headlines with plenty of space;
- For text links on web pages use colours consistently and avoid iridescent green, red, purple or puce;
- Emphasize text to highlight ideas. Make sure that it does not look like a button when it is not;
- On a web page put the important text elements or menu items in the top 320 pixels because only 10 to 15% of people scroll a page.

Reading on a computer screen is slower and more difficult than reading the same text in a book. People blink 3-5 times / minute when reading on a screen but 20-25 times / minute when reading text on paper. Monitors should be lower than eye level. Only a few paragraphs of text should be presented and the whole paragraph should preferably be on the same screen (Vaughan, 1998).

➤ Things that work

Vaughan (1998), suggests the following graphical approaches to be incorporated into the interface:

- Contrasts – like thick and thin text, big and small or bright and dark images or text;
- Simple clean screens with open white spaces (non information areas);
- Things that catch the eye like a single bright coloured object alone on a grey screen;
- Objects with shadows;

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- Important text or images emphasized by reversed graphics;
- Text in 2D and 3D.

➤ Things that should be avoided

According to Vaughan (1998), a graphic designer should stay clear of using the following graphical approaches when designing the interface:

- Colours that clash, most graphic artists know intuitively when colours are not matching;
- A cluttered screen with too much information;
- Funny sounds when a button is clicked;
- Requiring more than two button clicks to quit;
- Too many elements presented too quickly.

➤ Design for a web based system

According to McCormack and Jones (1997), the first step when planning a web-based education system is to identify goals. One should decide how one wants to achieve these goals and then prioritize one's list.

Goals may include:

- Provide the learner with early and regular opportunities for self testing;
- Identify learners having problems;
- Increase interaction.

McCormack and Jones (1997), suggest that the Web should not be used for everything. The Web will not always be the most appropriate, effective or efficient solution to a particular problem. A mixture of traditional (e.g. print based distance education) and Web

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based approaches should be used. This will provide a backup in case the technology fails.

McCormack and Jones (1997) also suggest the following:

- Multiple approaches should be used to cater for different learning styles and abilities;
- Keep your Web based classroom simple;
- Find out what others are doing to avoid their mistakes;
- Do not restrict yourself to existing methods; great benefits are possible with a new approach.

McCormack and Jones (1997) suggest the following guidelines to design a web based education system:

- Include no more than five elements per page. Most people's short term memory cannot hold more than five pieces of information;
- Concentrate on the content. The design of the interface should not distract attention from the content;
- A good design is a simple one;
- Make sure your pages are easy to read and to understand;
- Visitors to your pages must know where they are in relation to the rest of the pages;
- Be consistent. When you are consistent visitors can predict how to perform tasks;
- Be accurate;
- Be unique;
- Appearance must match the purpose of the page.

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At present multimedia presentations are a novelty, so learners may look forward to using it and may have a higher attention span. Designers will have to think about how to maintain this attention (McKenna, 1995).

Schroeder (1992) warns that some programs concentrate on breadth rather than depth of learning. A learning program should not be a click and see (Litchfield, 1993) program with 'surface-level interactivity' (Romiszowski, 1993) where learners have control to browse (jump around and get confused) through lots of information and become lost, and do not know what is important and what is not (Cates, 1992; Schroeder, 1992) or learners can form inaccurate mental models by making the wrong connections (Cronje, 1995). The learner must be given goals and the educational package should help the learner maintain a sense of mission and the instructional process must be planned.

Care must be taken not to give learners too much freedom and too little guidance because they might get lost in hyperspace or make the wrong mental models (Cronje, 1995).

2.1.2.1.6 How should multimedia be implemented?

The following issues concerning the implementation of an online forum which are also valid for the implementation of multimedia computer presentations are mentioned by McCormack and Jones (1997):

- Requirement fulfillment: Before multimedia computer presentations can be implemented the technical and nontechnical requirements must be in place. The technical requirements are the hardware and software and the nontechnical requirements are the support procedures.
- Training: Some training should be supplied to inform users how to utilize the multimedia computer presentations.
- Alternatives: An alternative system that does not rely on technology should be in place in case the technology fails.

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- Access: The users should have access to the multimedia computer presentations.
- Testing: The software must be tested under the same conditions and with the same hardware that the users will have access to.
- Starting: A face to face meeting with the users telling them what to expect before they start using the software will be very useful.

2.1.2.2 What are the issues around tests?

An important aspect of testing is reproducibility which means that the same mark should be obtained with two tests on the same work by the same learner (Norcini, 2002). The following table from Norcini (2002) gives the reproducibility of assessment formats studied by the American Board of Internal Medicine (estimates, based on three hours' testing time, will vary in other settings depending on quality of test material and heterogeneity of examinees). The higher the reproducibility coefficient, the better the reproducibility rate of the type of exam.

Table 2.2: Reproducibility of different types of exams

Format	No of cases or items	Reproducibility coefficient
Oral examination (long cases)	2	0.39
Computer simulation (long cases)*	3	0.55
Written simulation (long cases)*	6	0.70
Miniclinical evaluation exercise (short cases)†	9	0.73
Multiple choice questions: single best answer*	90	0.88

*Based on data found in studies by Norcini et al (1995).

†Based on data found in studies by Norcini et al (1986).

From this table it is clear that multiple choice questions have a very high reproducibility coefficient.

The following example of a histology practical test was found in the literature (Ogilvi, S.A., Online):

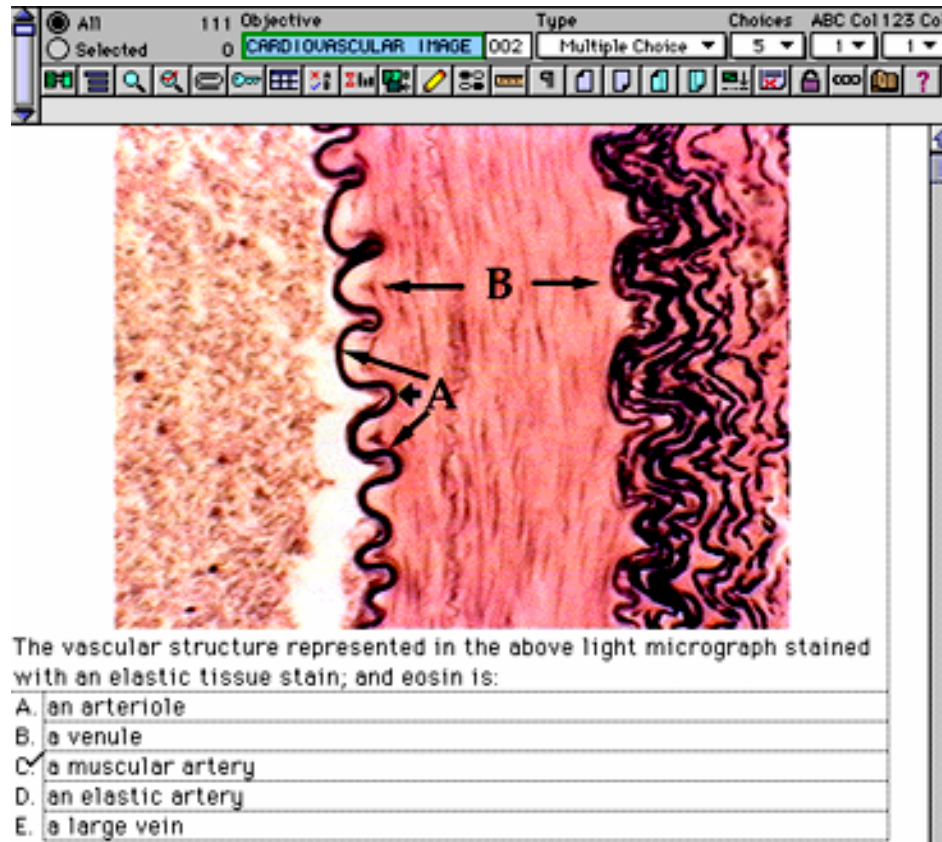


Figure 2.5: Example of the interface of a histology test

2.1.3 What lies in the future for teaching in general and histology specifically?

According to Monnard (S.A., Online), there is no agreement regarding the best way to use technology in the future or the future structure of educational institutions. The course website containing all the learning material will play a key role in the future of teaching. Teachers and learners together will form a virtual classroom. Online communication in the form of discussion areas and or help areas will provide a sense of community which will increase the amount of interaction between learners and lecturers and create an

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intellectual bond between them which is not always possible in the traditional classroom (especially in large classes) (Monnard, S.A, Online).

There will in future be less traditional lectures (Monnard, S.A., Online), and the role of the lecturer will change to that of a mentor that encourages, stimulates and guides much like the old apprenticeship system (Boettcher, 1996). Study material will be in the form of simulations, audio, video and electronic mail (Monnard, S.A., Online). Learning will be constructive, goal orientated, systematic and collaborative.

Universities of the future will collaborate more to deliver modules so learners will be able to take online and campus courses from different universities (Monnard, S.A., Online). According to the Yale Bulletin and Calendar (2002-2003) curricula of the future will be designed around small group learning and the use of technology. Hazari (S.A., Online) contemplates that electronic publishing will replace textbooks because updating is easier and availability is instant. According to Harris et al (2001) a comprehensive set of digital replicas of glass slides can replace the slides as well as the microscope. When cable modems and DVDs become commonplace the virtual microscope will be accessible in learners' homes.

2.1.4 Research

The research for this study was done by using two instruments namely a questionnaire and learner records. In order to compile the questionnaire the literature was searched for examples of similar studies. The literature was also searched for studies where learner records were analyzed. The following sections contain descriptions of information that was found in the literature.

2.1.4.1 Instruments

The instruments consisted of a questionnaire and records retrieved from the learners' files. Standards for questionnaires or data capture forms are supplied by the Department of Information Technology Research support.

2.1.4.1.1 Questionnaire

Naicker (1998) developed a tool for evaluating internet or multimedia courseware. This tool suggests that questions should be asked in the following categories: overview, implementation and planning, user interface design, pedagogy and interactivity and curriculum incorporation.

According to the guidelines for creating questionnaires supplied by the Department of Information Technology, the first decision that should be made is about the confidentiality of the questionnaire. If the information gathered from the questionnaire is going to be linked to other information the respondent must fill in some kind of identification on the questionnaire.

Different types of questions are suggested by the Research Support of the Department of Information Technology, such as:

- Sifting questions – if a certain response is given, follow-up questions must be answered;
- Open ended questions – the respondent has to write a comment or explanation and should only be used when absolutely necessary;
- Answer each one - questions: - each question gives options to choose from;
- Choose only one – respondent must choose only one option;
- Choose all relevant – respondent can choose any number of options;
- Ranking questions – respondent must rank options;
- Likert scales – measure intensity of feelings.

➤ What are the issues regarding the traditional course?

Some issues, as described in the literature, regarding the way traditional teaching is conducted are discussed under this heading.

❖ To what extent do learners use the prescribed book?

In a learner evaluation teaching survey done in the United States Air Force it was revealed that the quality and usefulness of course text was rated the lowest of all the criteria in the curriculum. Of the cadets questioned 76% said that they rarely if ever use the textbook. When one chapter from the prescribed textbook was evaluated it was found that only 38% of the content supported the learning objectives. The other 62% of the chapter went into considerable detail or contained material that was not prescribed. The instructors may see this extra information as adding to the overall understanding of the subject matter. When most of the study material is not included into the learning objectives the learners may see the material as unnecessary. The result may be that the learners fail to read the text altogether (Snodgrass, 2000).

A study done by Lawless et al (2001) revealed that when preservice teachers were asked to choose their most favourite way of studying from videotapes, a CD-ROM, hypertext, textbooks, lectures and classroom discussions, their favourite was the video and least favourite was the textbook.

❖ How do learners rate lectures?

The work of a teacher can be evaluated in three ways (Shelvin and Banyard 2001), namely:

- The development and change of a learner;
- Examination results;
- Learners can be asked to rate the lecturer.

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The first type of evaluation is the most difficult and can only be done over a long period and is difficult to quantify. The second and third ways are more measurable. The third way is the quickest and most used method. According to Shelvin and Banyard (2001), the problem with evaluation is whether we measure the most important variable or whether variables become more important because they are easier to measure. Another question is how valid are the measurements from learner evaluations.

According to March and Roche (1997), there is a positive relationship between prior interest in the subject and teaching ratings. There is also a strong positive relationship between leniency in the allocation of marks and ratings of teaching effectiveness (Greenwald and Gillmore, 1997). Fernández et al (1998), showed a weak relationship between class size and learner ratings where large and small classes give the most positive ratings.

If learners have a positive personal and or social view of a lecturer they tend to rate the lecturer more positively irrespective of actual teaching effectiveness (Shelvin and Banyard 2001). The charisma of the teacher also effects the judgement of the learners when rating learner effectiveness (Shelvin and Banyard, 2001).

❖ How important are lectures?

According to Light and Cox (2001), the lecture is almost synonymous with higher education at the undergraduate level. The lecture is seen as an effective way to teach large numbers of learners. The lecture has however also been criticized for not bringing about active learning and interaction between learners (Biggs, 1989). The learning pyramid of The National Training Laboratories (1998, Online) indicates that the retention of knowledge after a lecture is only 5%. The effectiveness of the lecture depends on the structure of the lecture and the relationship with the rest of the course (Biggs, 1989). Lectures are effective in developing low-level cognition like knowledge of terminology

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and facts and comprehension of examples. It is however ineffective in the development of high-level cognition like evaluation, synthesis, analysis and application (Clark, 1999).

❖ What role does the length of a lecture play?

The question – “how long can a learner concentrate during a lecture?” was answered by Loyd (1968) by saying that a learner’s concentration builds up during the first five minutes of a lecture and then starts to decline till just before the end of the lecture when there is slight rise in concentration again.

Johnston and Percival (1976) found that learners do better in questions of which the answers were mentioned earlier during the lecture than questions of which the answers were mentioned later in the lecture.

In a study done by Stuart (1978) on second year medical learners that were highly motivated doing a popular course it was found that learner concentration rises to reach a maximum 10 to 15 minutes after the start of the lecture and then declines till the end of the lecture. This tendency may have been due to the fact that learners reach a point of fact saturation or that learners just get exhausted or bored. Some lecturers could hold the learners’ attention for longer than other lecturers but invariably the learners would lose concentration. It was suggested by Stuart (1978) that a 25-30 minute lecture may be more appropriate than the usual 50 to 60 minute lecture and that the rest of the time could be used for other teaching methods.

➤ What are the issues regarding the use of multimedia?

Various issues on the use of multimedia as found in the literature are discussed under this heading.

❖ What are the learners' preferred ways of studying?

In a study done by Lawless et al (2001) a number of pre-service teachers were asked about their beliefs regarding instructional media. Their response was that to acquire knowledge in general, video discs, CD-rom and hypertext are the most useful while lectures and textbooks are the least useful. They also believe that more visual and auditory stimulation results in a more effective teaching tool.

❖ What influences recollection?

In a study done by Brennan (2001) on medical learners doing a course in psychiatry they found that although the learners felt that attending a lecture led to greater increase in knowledge, the learners that did computer-based teaching could assess, diagnose and manage anxiety better than the ones attending the lecture. According to Begg et al (S.A., Online) who are developing histology modules to replace practical histology laboratory sessions claim that working with interactive study material while studying increases recollection.

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The National Training Laboratories (1998, Online) did some research to determine the average retention rates for the various ways of learning and drew up the following pyramid:

Average learning retention rates

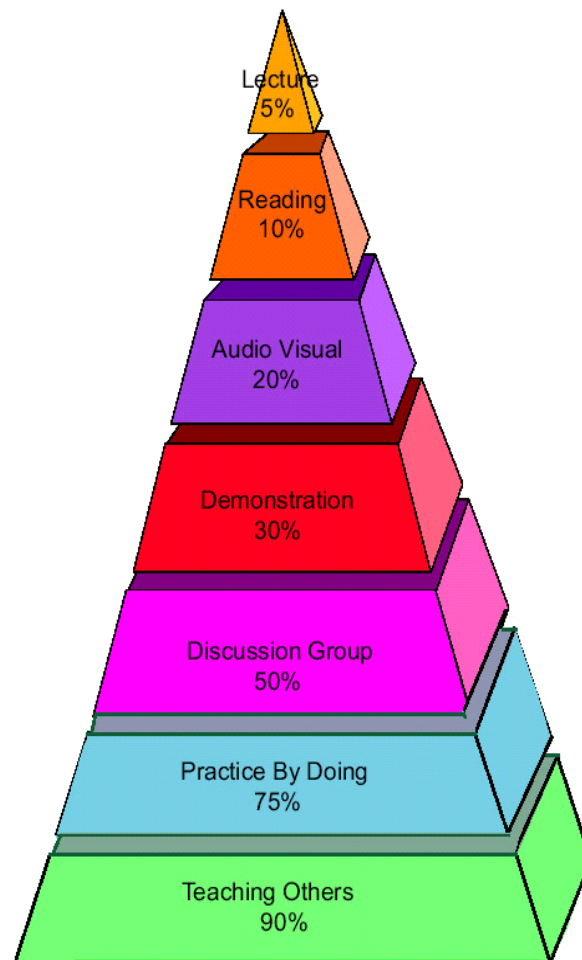


Figure 2.6: Average learning retention rates pyramid

According to the National Training Laboratories (1998, Online) lectures score the lowest retention rate of knowledge of all the ways of learning namely 5%. The average retention of knowledge from reading from a book and audio visual presentations are 10% and 20% respectively.

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❖ Do marks improve when using multimedia?

In the study that Lesewski and Settle (1996) did learners were of the opinion that multimedia help to improve their exam marks and that there will be less of a range between best and worst learner as it is a fairer system because it does not give the faster writers and the better note takers an advantage.

According to MacPherson (2003), replacing the laboratory part of the histology course with computer presentations did not improve the marks obtained by the learners during the practical exam but learners claim that they spend less time studying than previously when they used a 35 mm slide and text system.

❖ Can multimedia replace the traditional course?

The Multimedia Research Group, University of Natal Durban, (S.A., Online) reports that learners at the university of Natal adapted easily to the use of computer technology. Learners became productive learners very quickly. Computer technology does not further marginalize disadvantaged learners. All the learners taking part in their study reported that they enjoy using computers.

Reeves (1999) describes the principles that guide the use of computer software programs as cognitive tools in teaching and learning. According to these principles the microscope qualifies as a cognitive tool in teaching and learning because using a microscope for learning provides a constructivist learning environment which allows learners to construct their own knowledge rather than absorbing information given to them. The microscope challenges and stimulates deep reflective thinking that brings about meaningful learning rather than effortlessly instructing the learner like some innovations. For multimedia to replace a cognitive tool (the microscope in the traditional course) it will have to comply with these principles (Reeves, 1999).

2.1.4.1.2 Records

When a comparison is made between records where new technology was used and not used in the learning process there is no significant enhancement (McKenna, 1995).

In a study that Haddon et al (1996) did two groups of learners, one taught in the conventional way and the other with the use of multimedia did not show a significant difference in exam results but there was a significant correlation between learner ability and degree of improvement for the multimedia group. The lower the ability the bigger the improvement. This means that multimedia is more successful than conventional methods for learners of below average ability.

2.1.4.2 Learner profiles

According to the Multimedia Research Group of the University of Natal Durban (S.A., Online) their university has selection criteria other than school performance as a prerequisite for entry into university to allow more disadvantaged learners into university. 80% of their intake now consists of disadvantaged learners.

For most of the learners at the university English is their second language. Most of these learners including those for whom English is a first language have problems with sentence construction and essay writing. This apparently is not only a South African problem; American learners have the same problems.

Many of the learners at the University of Natal (Multimedia Research Group of the University of Natal Durban S.A., Online) come from deprived backgrounds with no three dimensional toys, music lessons and mechanical construction kits, all of which contribute to loss of skills, like dexterity, which are difficult to acquire in adulthood. In biology, dexterity is important in the understanding of anatomy.

The education system that these learners come from is based solely on rote learning. Few learners develop the skills of observation and logical thinking. Because of these

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problems learners have difficulties in solving problems. This is demonstrated by the small number of black science and engineering graduates.

The Multimedia Research Group, University of Natal Durban (S.A., Online) states that the learners they are dealing with do not want to learn; they want to be taught. They only want to memorize information and learn how to answer exam papers. Most accept what they are taught blindly.

The following terms are used by people that use computers in teaching and learning. Terms have not yet been standardized. Some of the terms mean exactly the same.

- Computer based learning: Learning where the computer contains the main resource for learning.
- Computer based education: Refers to a system where a learner is educated by a computer. The computer is used for the whole process including tracking and keeping records.
- Computer based instruction: The computer gives the instruction, this instruction can be from a resource on the computer or it can be on the internet or both.
- Online learning: Learning material is on the internet.
- Web based education: The resource is on the internet
- Telematic material: Material that is delivered over a distance.
- Multimedia: Information that is delivered in a format that combines more than one of the following: text, graphics, still images, animation, audio and video.
- Multimedia resource: Study material that is presented in the form of multimedia.
- E-learning: A term that encompasses all forms of electronic application for learning namely web based learning, computer based learning, virtual classrooms and digital collaboration. The content for E-learning is delivered using

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any or more than one of the following: Internet, audio or video tape, radio, television and CD-Rom.

- Course work: A term that refers to all the work that has to be done for a specific course.
- Educational package: A term that includes all the ways of learning including books, lectures and computer presentations.

CHAPTER 3

DEVELOPMENT AND COLLECTION OF DATA

This chapter explains under what field of research this project belongs and will deal with the different stages of the project namely the development and implementation of the software, the video, the tests and how the different instruments were used to obtain the research data.

This table representing the layout of this chapter is arranged into seven columns with the main topic on the left and the lower order topics to the right. The first column contains the headings research in general and the project. The research in general is divided into an introduction, instructional technology research, and developmental research. The project is subdivided into development and research. Under development the topics introduction, multimedia and tests are covered. Multimedia is subdivided into production, implementation and problems encountered. Under tests the format and development are discussed. Examples of the interface are mentioned under development. The topic production is subdivided into video and presentations. Both these topics are divided into how it works and components of the interface. The components of the interface are: images, text, sound, and examples. Under components of the interface for presentation is a heading navigation and actions. The questions of the questionnaire are represented in Table 3.3.

Table 3.1: Layout of Chapter 3

Research in general	Introduction					
	Instructional technology research					
	Developmental research					
The project	Development	Introduction				
		Multimedia	Production	Video	How the video works	
					Components of the video	Images
				Text		
				Sound		
				Examples from the video		
				Presentations	How the presentations work	
		Components of the presentation Interface	Images			
			Text			
			Sound			
			Navigation and actions			
		Tests	Implementation			
			Problems encountered			
		Research	Instruments	Questionnaire	Purpose	
	Design					
	Different types of questions					
	Distribution and collection					
	Layout of the questions					
	Questionnaire Matrix					
	Records			Test results		
				Criteria for selecting learners	SRS	
	Additional credits					
	Relationships between responses and records			Statistical analysis		
Learner profiles						

3.1 Research in general

The usual sequence is to do research, to acquire basic knowledge and then to use this knowledge to advance technologically.

3.1.1 Introduction

Stokes (1997) suggests a classification whereby research is placed into a matrix that is called Pasteur's quadrant. The following table represents Pasteur's quadrant. The domain that belongs in each of the four blocks of the quadrant is explained.

Table 3.2: Pasteur's quadrant

<p style="text-align: center;">Bohr</p> <p style="text-align: center;">Pure basic research</p> <p style="text-align: center;">Work inspired by the quest for understanding but not by potential use.</p> <p style="text-align: center;">1</p>	<p style="text-align: center;">Pasteur</p> <p style="text-align: center;">Use-inspired basic research or strategic research</p> <p style="text-align: center;">Work inspired by both the quest for understanding and its potential use.</p> <p style="text-align: center;">2</p>
<p style="text-align: center;">Exploration of particular phenomena</p> <p style="text-align: center;">Work inspired by neither use nor the quest for understanding</p> <p style="text-align: center;">4</p>	<p style="text-align: center;">Edison</p> <p style="text-align: center;">Pure applied research</p> <p style="text-align: center;">Work inspired by potential use but not by the quest for understanding</p> <p style="text-align: center;">3</p>

This study falls under quadrant number two because in this study an attempt is made to acquire insight into learner perceptions of the traditional histology course and an attempt is made to investigate the possible success of a full or partial multimedia histology course.

3.1.2 Instructional technology research

One of the many types of research is instructional technology research. In this type of research different goals can be pursued (Reeves, 2000), such as:

- Theoretical goals;
- Empirical goals;
- Interpretivist goals;
- Post modern goals;
- Developmental goals;
- Action goals.

In this study developmental goals are pursued.

3.1.3 Developmental research

According to van den Akker (1999), developmental research focuses on complex and innovative tasks. Usually very few validated principles are available for structuring and supporting the design and developmental activities of the programs that are developed. This type of research aims at making practical as well as scientific contributions.

Reeves (2000) is of the opinion that developmental research should provide direct benefits to all stakeholders. Reeves (2000) stated that he is increasingly convinced that if instructional technologists want to contribute to meaningful educational reform they should do developmental research because this type of research focuses on complex and real problems critical to human learning and performance.

Under the topic “Use of technology in biology” The Multimedia Research Group, University of Natal Durban (S.A., Online) reports that we need to build a strong research culture in South African institutions on the use of computer technology in education.

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Presentation of these research findings to colleagues and university authorities could play a major role in challenging preconceived ideas by those who find technology threatening.

Teaching histology with the aid of multimedia computer presentations (E-learning system for a specific target group – medical learners) is a complex task that needs lots of innovation. No guiding design principles aimed at histology specifically could be found in the literature. The development of the programs provides a practical direct solution while the research part of the study tries to make a scientific contribution. This study is an effort to contribute to meaningful educational reform.

This study also forms part of an effort to build a research culture on the use of computer technology in education and will hopefully contribute in changing preconceived ideas that may exist amongst faculty members.

In this study an effort was made to follow the guiding principles of Plomp (2002), namely:

- Pose significant questions that can be investigated;
- Link research to relevant theory;
- Use methods that permit direct investigation of the question;
- Provide a coherent and explicit chain of reasoning;
- Replicate and generalize across studies;
- Disclose research to encourage professional scrutiny and critique.

In an effort to comply with these principles the following was done. A list of design and research questions that should be investigated was compiled. The literature was searched for answers to these questions. Research instruments were used to investigate the research questions. The findings will be discussed in relation to other studies, and will be published.

3.2 The project

The project consisted of two parts namely the development of the multimedia study material and the research part where the effectiveness, acceptability and success of the learning material were investigated.

3.2.1 Development

The development will deal with the development of the multimedia including the video and the computer presentations as well as the development of the tests and the problems encountered during development.

3.2.1.1 Introduction

Due to the lack of suitable study material to implement a telematic course in histology, computer presentations had to be developed. This part of the project dealt with the creation of the study material. The development of the multimedia involved the following:

- Literature search to gather information regarding the development of study material;
- Accumulating the necessary graphics - digital images and drawings;
- Mastering the software to compile the programs;
- Creating the video and the computer presentations.

3.2.1.2 Multimedia

The multimedia for this study consisted of a video and multimedia computer presentations. In this section the production, implementation and the problems encountered during these processes will be dealt with.

3.2.1.2.1 Production

Here the processes that the multimedia went through before the video and the computer

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presentations were ready to be used by the learners as well as the end product that was used by the learners are discussed.

➤ Video

The purpose of the video was to replace the microscope as the tool for revision of the practical histology. All slides that are viewed during the year in the practical histology sessions are included in the video. It consists of 441 slides and takes three hours to view. The learners only needed to view the topics that were covered during the two blocks of this study.

Video is linear. Interactivity between the video and the learner is limited to playing, stopping, fast forwarding and rewinding the video. Video is in the same linear format as a lecture. The linear format takes the learner through the study material in a specific sequence.

❖ How the video works

The video starts with a slide indicating the topic. This is followed by a sequence of images usually from a low magnification to a high magnification where the features of the tissue are vocally explained with the aid of indicators. In most cases the indicators appear on the screen as they are mentioned. Animations are also used, for instance to indicate the flow of ocular fluid from the anterior chamber in the eye through the pupil into the posterior chamber.

❖ Components of the video

The video contains images of the slides that the learners usually observe during histology practicals. No drawings or text pages were included in the video. Text that was used was kept to a minimum while a vocal explanation was used to illicit the characteristics of the images.

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◇ Images

The images used in the video were either digitised video images, scanned slides or images photographed with a digital camera. Indicators like arrows, lines and annotations of different colours were used to highlight and explain the features of the different tissues. Care was taken to make sure that the colour of the indicator used is clearly visible against the background.

◇ Text

The minimum text was used in the video. Fine structures that are visible on the Super VGA monitor are often not visible on the television monitor, due to the lower resolution of the latter. This also influenced the font that could be used. To make sure that text was clearly readable a font of 36 or bigger had to be used. The colour of the text was selected to contrast with the background.

◇ Sound

Sound plays an important role in the video. The different indicators, annotations and abbreviations used are explained vocally. The Windows sound recorder was used to make the recordings that were used in the video. The microphone that was used was not of a very high quality. Due to these factors the sound was one of the problem areas of the video which was not always of a high standard.

◇ Examples from the video

The following sequence of images explains the histology of the colon.

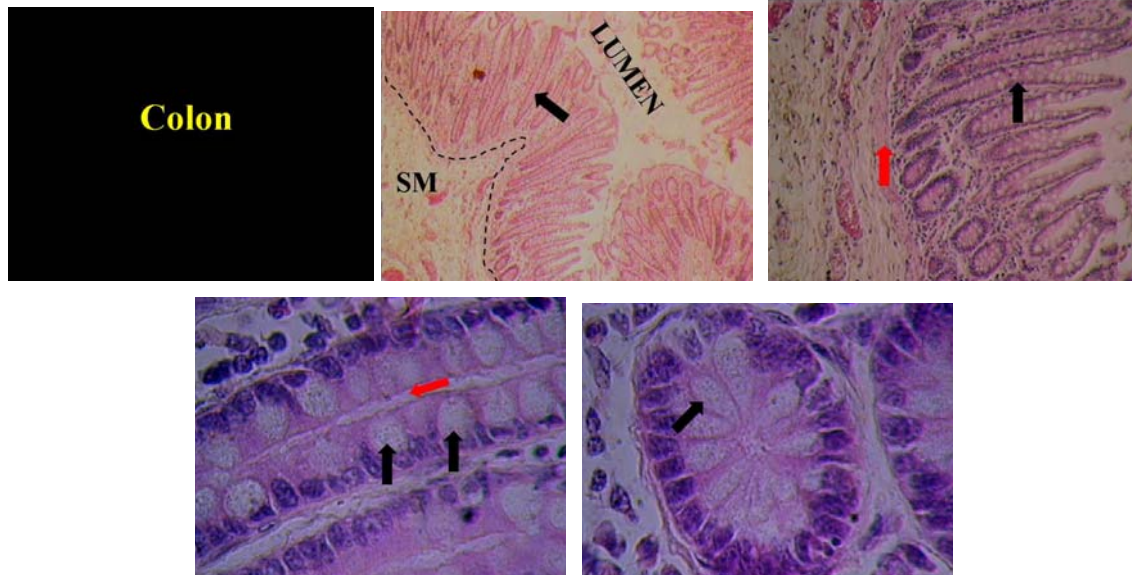


Figure 3.1: Examples from the video

The first slide indicates the topic. In the second slide the *lumen* is annotated, the arrow indicates the glands in the *colon* while the dotted line indicates the *basement membrane*. The SM indicates the *submucosa*. While the learner watches the slides there is a vocal explanation of the different features on the screen. The black arrow in the third slide indicates an *intestinal gland* while the red arrow indicates the *submucosa*. The red arrow in the fourth slide indicates the lumen while the black arrows indicate goblet cells.

➤ Presentations

The presentations that were used to make the video were developed first. When developing presentations for use on a computer, a number of additional features, not available on video, can be added. Due to the fact that the resolution is better on the super VGA screen than on the television monitor, fine detail can be displayed as well as smaller text fonts. Sound can also be played on demand. The presentations that were made for the video tape were used as a starting point for the creation of interactive presentations.

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The histology course is divided into two sections. Each section is presented by a different lecturer. Complete multimedia tutors were developed on the following topics:

- Epitheliums
- Common Connective tissues
- Cartilage
- Bone
- Muscle
- Lymphatic system
- Neurohistology
- Oralhistology
- Olfactory epithelium
- Ear

These presentations consist of a total of 588 slides (pages).

❖ How the presentations work

When designing multimedia software one has to decide between a linear and a nonlinear format.

Non-linear programs are suitable for acquiring information on a specific topic. If multimedia is developed for the purpose of replacing a lecture (which is linear) it has to be linear to expose the learner to the work in a specific sequence. When a learner has gone through the work in a linear fashion and has been exposed to all the facts, the learner can then use the multimedia in a non-linear way to revise the work.

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The multimedia for this project was designed in this way. The learner had two options, linear or non-linear. The linear option takes the learner through the work in an organized way while the non-linear option takes the learner directly to a topic.

When the computer presentations were developed, simplicity was kept in mind. The computer skills of the learners for which these presentations were developed varied from no skills to skilled. It was decided that no computer skills should be required for using these tutors. Menus and navigational buttons should be intuitive and easy to understand. An interface was decided upon and was used throughout the presentations. Grey was selected as a background colour. The various buttons were made colourful in an effort to make the screen pleasant to look at.

Clicking on an icon on the desktop starts the program. The program starts as a menu offering different topics. Different colours were used for the different topics. The idea was to highlight the available topics. Below is an example of the topics menu.

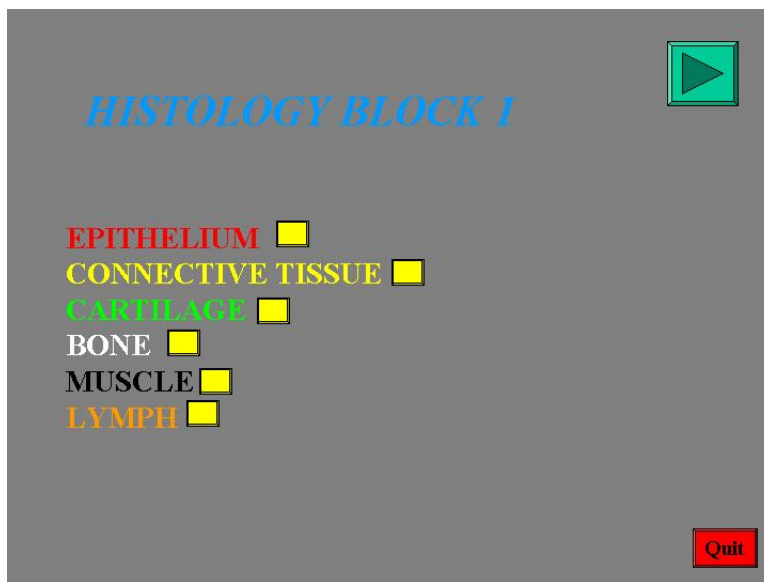


Figure 3.2: Menu of the multimedia computer presentations

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Selection of a topic from this menu takes the learner to an opening page with the title of the tutor. Below is an example of the opening page of the tutor on the soft tissues of the mouth. A user could at any time leave the program by quitting.

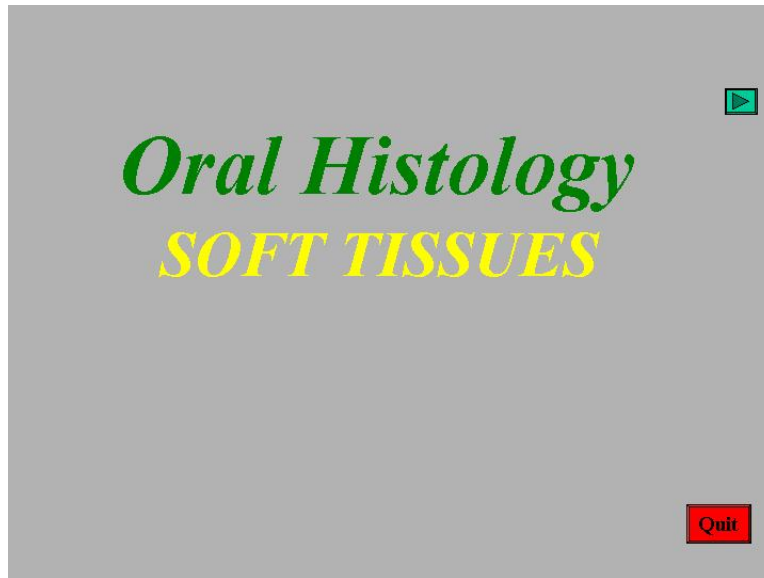


Figure 3.3: Opening page of the multimedia computer presentations

Advancing from this page takes the learner to a menu where he or she must decide between the linear and the non-linear way of using the presentations. Choosing the interactive presentation starts the tutor (linear) from the beginning. Choosing the slide menu (non-linear) takes the user to a specific page in the program. Below is the example of this menu.

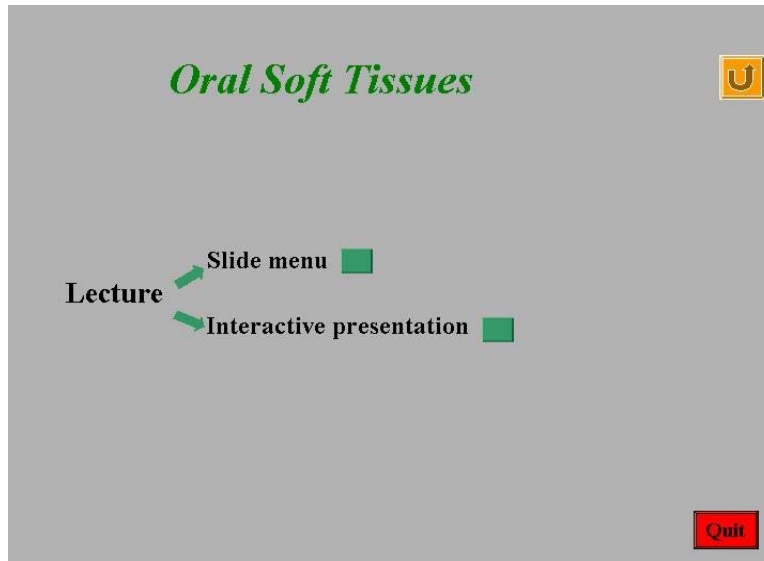


Figure 3.4: Selection page of the multimedia computer presentations

Selecting the slide menu will take the learner to a menu where a specific slide in the program can be accessed. The idea was that a learner could revise any part of the program or start at any point in the program for revision purposes. Below is an example of a slide menu.



Figure 3.5: Slide menu of the multimedia computer presentations

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The other option is to go to the interactive presentation. When choosing this option a screen with instructions on how the navigational and action buttons work, is displayed. The navigation and action buttons were placed on the right of the screen. This left a square block for text or a picture on the left hand side. Below is the example of the instruction screen.

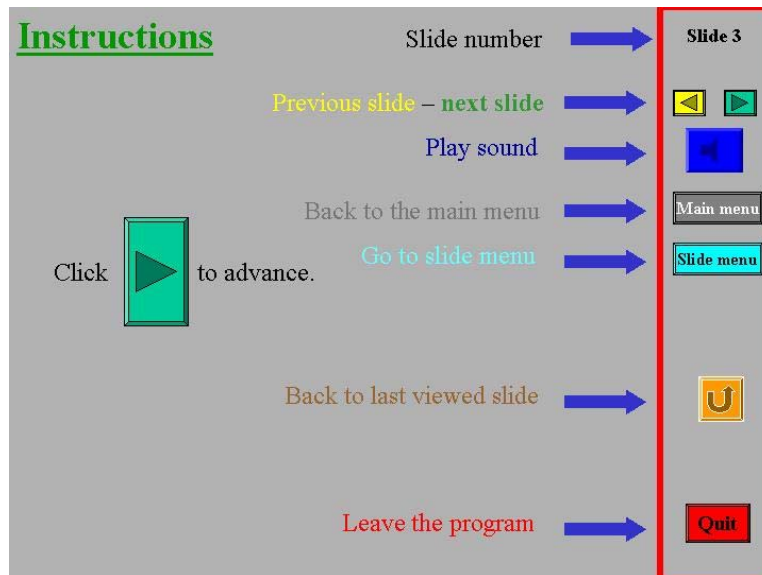


Figure 3.6: Instructions page of the multimedia computer presentations

When clicking on the advance button of the instruction screen the interactive presentation starts. The slides in the tutor contain images (micrographs, electron micrographs or drawings) and text.

❖ Components of the presentation interface

The interface consisted of a graphical component with text, sound and various navigational buttons.

◇ Images

Different methods were used to acquire images for the presentations. Digitised (grabbed) images from a video camera, digital photographs, scanned photographs,

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slides and drawings were used. The pictures were made as large and clear as possible. In some instances successive screens were used to build up a drawing to teach learners how to make the drawing.

Various indicators were used with the images to point out structures, areas or layers. Arrows, braces, lines, shapes like blocks or circles of various colours and sizes were used. Very little text was used on the images. Care was taken to make sure that the colour of the indicator used is clearly visible against the background. Below is an example of an image plus examples of some of the indicators used in the presentations.

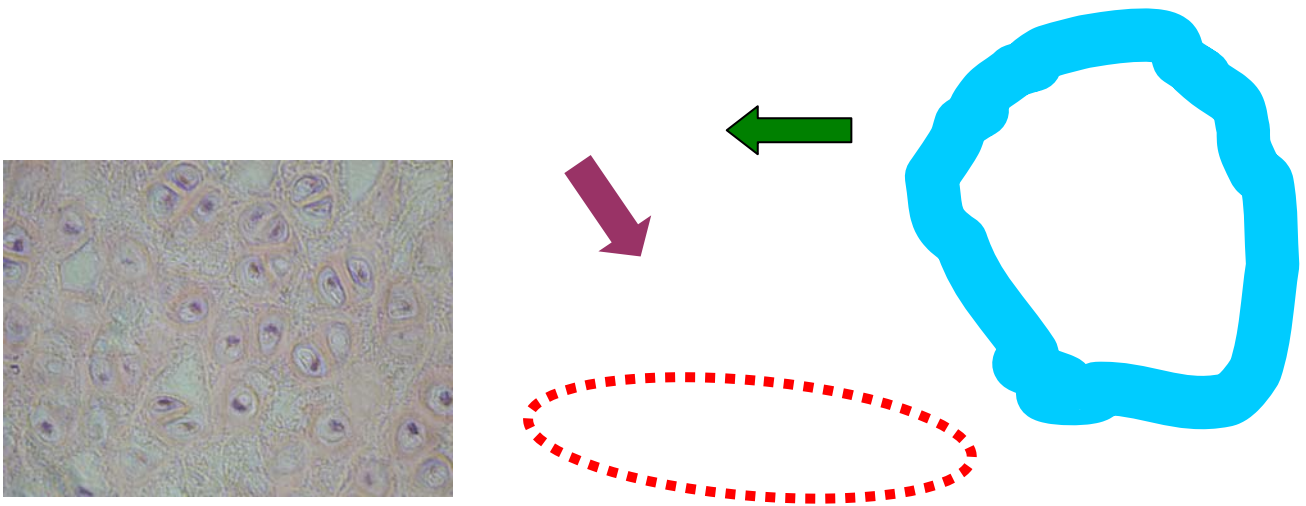


Figure 3.7: Examples of the elements of the multimedia computer presentations

◇ Text

The text screens that are used are the notes given to the learners. Explanations were kept as concise and clear as possible. Text was put at the bottom of the screen explaining the indicators used with the different graphical elements in the tutors.

Indicators were used instead of text. Instead of writing “arrow” an arrow of the same colour and direction as was used in the image was used in the text. Below is an example of how an indicator is used in the text.


“The  indicates the stratum corneum”.

Figure 3.8: Example of an arrow used with text

The text used was 18 font size Times New Roman. This was found to be a readable size and font on a 14” screen.

◇ Sound

Voice recordings for the presentations were made using the Windows sound recorder. The recordings were used to explain the graphical images and the indicators used. The voice recordings could be played by clicking a button. This could be done over and over if wanted. The button below was used for playing the sound.

Play commentary

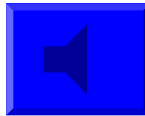
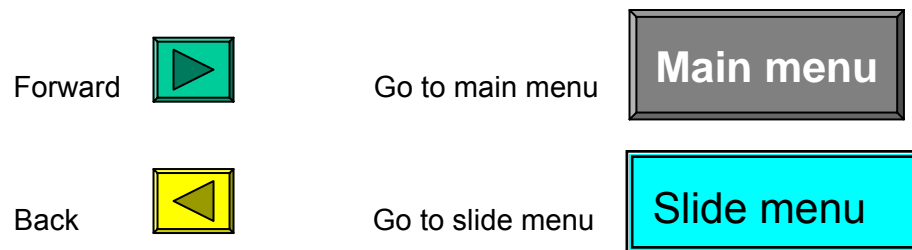


Figure 3.9: Button for playing a sound file

◇ Navigation and actions

The navigation and actions bar was put on the right hand side of the screen. Colourful and self-explanatory buttons were chosen for these actions.

Navigational buttons provided were:





Link in the text to a relevant drawing or image somewhere else

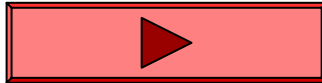


Figure 3.10: Navigation buttons

Navigation is done by the hyperlink function of PowerPoint. From any screen the user can go backwards and forwards, go to the main menu, the slide menu or to the last viewed slide. The user can also quit the program.

◇ Examples of the interface

In the example below a drawing of the *hyaluronic acid* found in cartilage with its linking protein, protein core and *chondroitin sulphate* chains were taken apart and reassembled to show the learner how to make a drawing of this structure.

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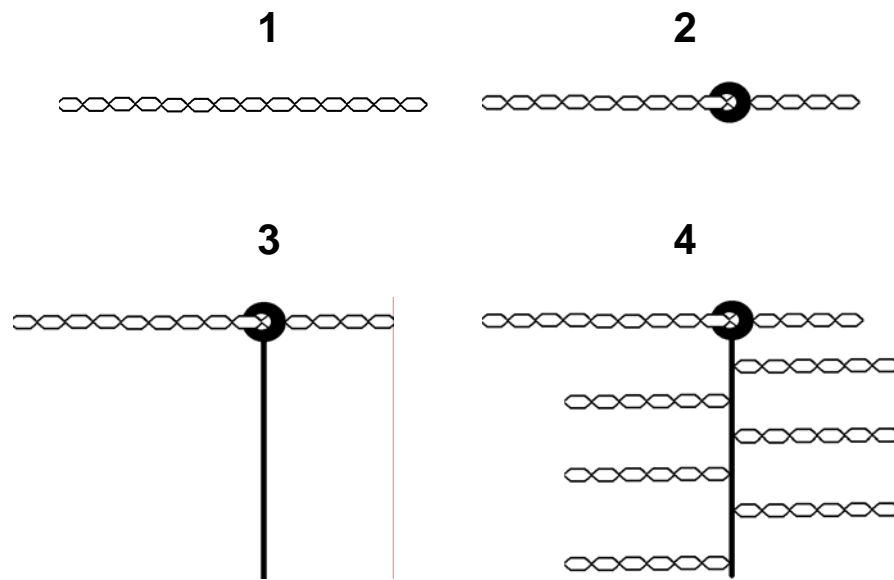


Figure 3.11: Example of how to make a drawing

Simple animations were also used to explain certain actions. In the two drawings below the two stages of muscle contraction are shown. Alternating between the two drawings illustrates how the different bands in muscle change during contraction.

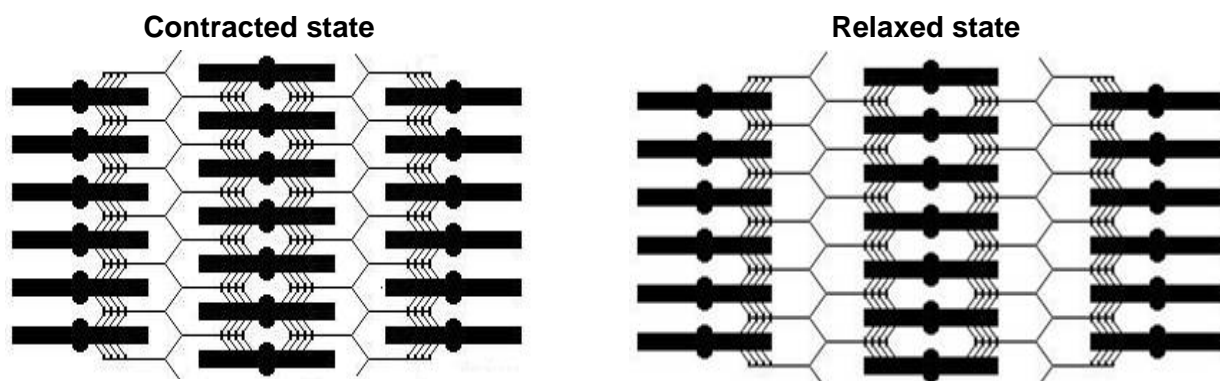


Figure 3.12: Example of an animation

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The teaching and understanding of the morphology of tissues has relied and still relies at most universities on practical work where learners use the microscope to find examples like the following image which is a cross section through a valate papilla. The yellow dotted lines indicate the underlying serous glands while the blue arrow indicates the trench of the papilla. On the right hand side are the navigational buttons. The blue button links to a sound file which gives an explanation of the slide.

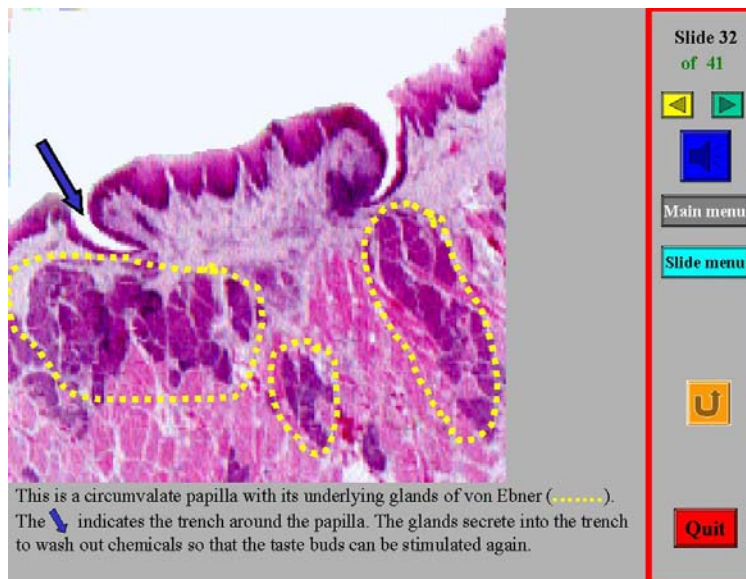


Figure 3.13: Example of a micrograph

Another way of studying histology is through scanning electron micrographs. Scanning electron micrographs give a different perspective on the three dimensional structure of tissues. Scanning electron micrographs like the one below of the fungiform papilla surrounded by filiform papillae were included in the presentations.

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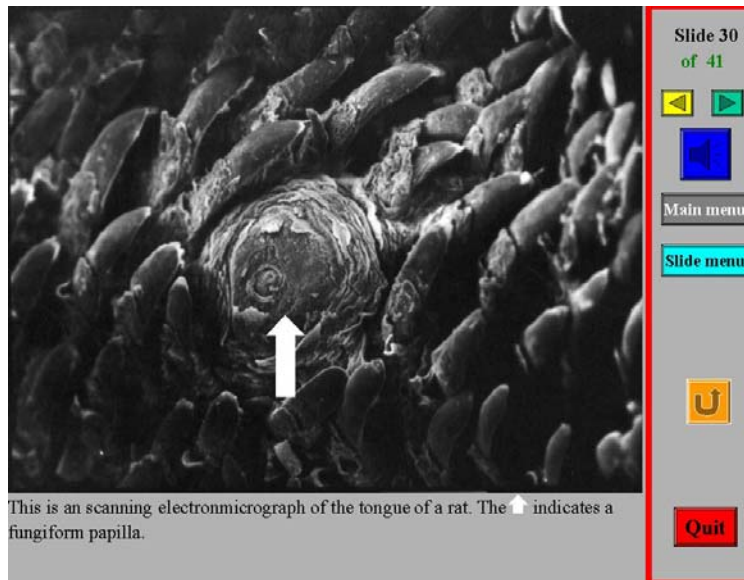


Figure 3.14: Example of a scanning electron micrograph

Microscope slides only provide two dimensional information. Researchers have applied various techniques like serial sections and scanning electron microscopy (like figure 3.14) to determine the three dimensional structure of tissues. From this information drawings of the three dimensional structure of tissues could be made. These drawings complement the microscope slides and play a major role in the understanding of histology. Below is an example of one such drawing which was used in the presentations. This drawing shows the arrangement of the attachment between epithelium on the surface and the underlying *connective tissue* (CT) in the mouth.

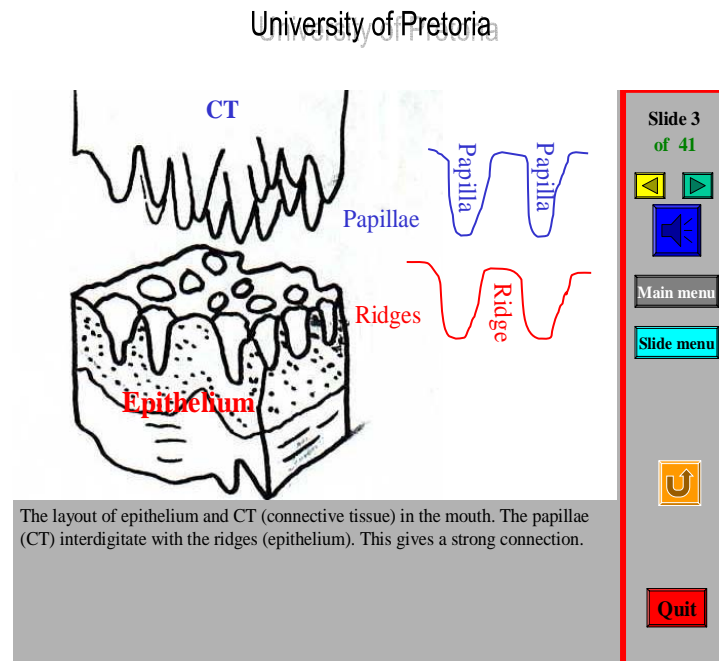


Figure 3.15: Example of a drawing

The notes that the learners receive was also included in the presentations. Text was provided in the presentations for reference purposes. It was however not intended that the learners should study from the screen. The text was written as briefly and simply as possible. Sometimes a link to the relevant drawings was included like in the example below. No sound file was included with the text pages.

Epithelium (keratinized and non keratinized types are found)

Keratinized epithelium in the oral cavity

Layers

- A specific cell moves through all the layers before it desquamates
- The cells originate in the basal layer.
- They then migrate or are pushed upwards.
- In this process they change and become specialized.
- At the surface they desquamate.
 - Stratum basale
 - Stratum spinosum
 - Stratum granulosum
 - Stratum corneum

Slide 4
of 41

Main menu

Slide menu

Quit

Figure 3.16: Example of text used in a multimedia computer presentation

3.2.1.2.2 Implementation

During the first block we had the use of twelve computers in a small computer centre. Twelve learner volunteers were selected for the first session and given short instructions on how to start the program and how to navigate through the different options of the program. They were then left to carry on. I attended the first session to solve any possible hiccups that may have occurred. No problems were encountered. Soon after being introduced to the multimedia computer presentations the learners were learning effectively.

The learners were told that they could use the multimedia programs instead of attending the lectures and the practicals. They were however still free to attend the lectures and the practicals. Every time there was a lecture or a practical these learners could then go to the computer centre to do the multimedia histology programs. The centre was also available during normal working hours for them to visit. The programs were also made available on the computers of the computer centre of the university. The problem here was that only five of these computers have sound cards therefore on most of the computers the sound option was not available. The programs were also written onto a CD. Learners could order copies of the CD for use at home. Thirty learners bought CDs for use on their own computers.

During the first block, which started in February and lasted for four weeks, the basic tissues are covered. After the lecture was given a practical was done on each topic. The topics done were:

- Epitheliums (2 lectures)
- Common Connective tissues (2 lectures)
- Cartilage
- Bone
- Muscle
- Lymphatic system (2 lectures)

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The function of the first part of the course is to give the learner an understanding of the basic tissues that make up all the different systems of the body. It is important that this basic knowledge is mastered before the histology of the systems is studied.

During the second block that started in April and lasted five weeks the same format as for the first block was followed. The following topics were covered:

- Neurohistology (2 lectures)
- Oralhistology (3 lectures)
- Olfactory epithelium
- Ear

3.2.1.2.3 Problems encountered

The problems encountered during the implementation of the programs had mainly to do with the number of learners we are dealing with (± 380) and the lack of facilities.

Although we selected a group of volunteers the other learners very soon found out about the programs and started to use them whenever they saw an empty station. It soon developed into a first come first serve situation. To prevent learners other than the volunteers from using the programs would have been impossible and also unfair.

Our lectures are not compulsory with the result that even during other anatomy lectures the 12 computers, which were later increased to 15, were all occupied. Learners were prepared to miss other lectures to get a chance to study the multimedia computer presentations.

The fact that there were no problems reported was an indication that the programs were user friendly enough or that the learners could sort out the problems that they encountered amongst themselves.

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Some of the CDs that were made available to the learners for personal use were brought back due to the fact that the CD Rom could not read the CD. This was found to be a hardware problem because upon testing the CD in another CD Rom the CD was found readable.

3.2.1.3 Tests

A way of testing had to be developed to suit the facilities that were available to us. Tests were developed in the form of PowerPoint presentations. Tests were conducted in a practical laboratory. The tests were shown to the learners on a 54 cm video screen. A video converter that plugs in between the video card on the one side and the SVGA monitor of the computer on the other side was used. This converter has a video out plug for a PAL monitor. This signal was then amplified by a video amplifier and distributed to a number of overhead monitors.

3.2.1.3.1 Format

Tests were not included in the tutors. Tests were conducted at the end of each of the two blocks. Learners wrote a separate practical and theory test. The histology theory test formed part of a combined test that was written on gross anatomy, embryology and neuroanatomy. Each test, practical and theory, consisted of short questions and MCQs. In the case of the theory test 25 questions were short questions and 25 were MCQs. In the case of the practical test, the first test consisted of 30 questions, 15 had to be answered by writing down the answer and 15 questions were MCQs. The second test had the same format except that the test consisted of 40 questions. The multiple choice part of the test was answered on a computer form that was marked with an optical scanner while the written part of the test was answered on paper.

3.2.1.3.2 Development

Previously tests were conducted using full screen video images. Learners were asked to identify the tissue and give reasons for the identification. It was found that learners

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studied the reasons beforehand and then only had to identify the tissue to know what reasons to give. Often the reasons given for identification by the learner were not present in the tissue shown on the monitor. It was decided that learners should rather be able to identify specific structures in a tissue than only to identify the tissue. A system of testing was developed where specific structures, layers or cells are indicated and asked. It was decided to explore the possibility of making the practical tests a multiple choice test.

❖ Examples of the test interface

For the purpose of this study two interfaces were developed. The one had the image on the left and the question at the top together on the same screen while the second interface was the same but with the multiple choice options added to the right of the screen. With a little experimentation the right size for the image and the font for the text were decided on. For the question at the top of the screen a 44 font was used while the options were written using a 32 font. It was important that the quality of the image be as good as possible. It was decided that 30 seconds be allowed to answer each question. A 30 second rest period was given after every ten questions.

The following is an example of one of the practical MCQs.

Identify the layer.

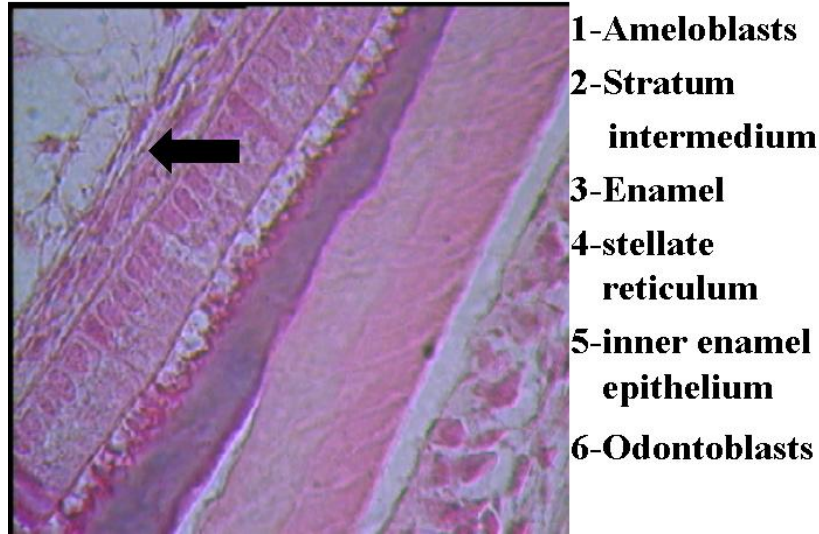


Figure 3.17: Example of a practical MCQ

In this example the learner is asked to identify one of the layers of the enamel organ. The layers that are visible are used as the options for the multiple choice question. The arrow points at the stratum intermedium.

The following is an example of a practical question where the answer had to be written down.

Identify this structure.

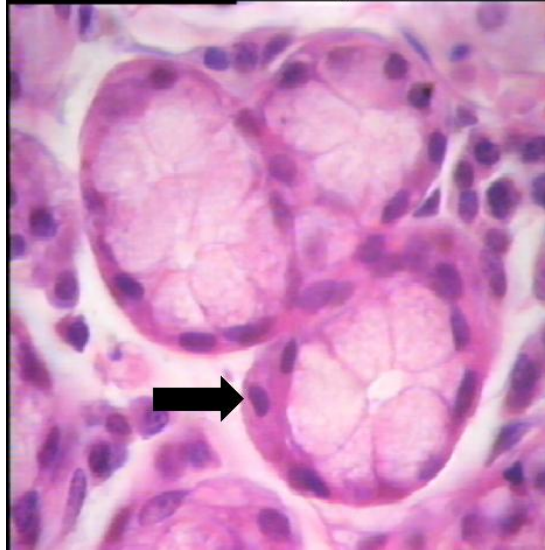


Figure 3.18: Example of a written practical question

This is a question on the salivary gland. The arrow in points to a structure called the demilune. The learner had to write the answer.

3.2.1.3.3 Problems encountered

The testing ran very smoothly from the start. The biggest problem was the large number of learners that had to be accommodated during a test. The learners were divided into three or four groups so that they wrote the test in groups of about 90. This required that learners that had finished the test were prevented from coming into contact with learners that still had to write the test.

3.2.2 Research

The second part of this chapter deals with the instruments that were used for data collection.

3.2.2.1 Instruments

Data was collected through the use of the following instruments.

- Questionnaires;
- Retrieval of information from the departmental records;
- Retrieval of learner records from administration;
- Statistical analysis to determine relationships between the different sets of information.

3.2.2.1.1 Questionnaire

The questionnaire was used to gather feedback from the learners that attended the second year anatomy class.

► Purpose

The purpose of the questionnaire was to gather information regarding the learners' experiences and perceptions of the histology course for MBChB II and BDS II presented at MEDUNSA. The teaching of the course included lectures, practicals and also the additional teaching material (SI) that has been discussed (videos (VSI) and multimedia computer presentations (MSI). Each questionnaire gathered 124 values that were put into a database. This data could then be analysed.

Relationships between the marks obtained in the different tests that were written and the answers given in the questionnaire could be determined. Only one questionnaire was given to the learners at the end of their second block just before the tests on the work done during that block.

➤ Design

The purpose of the questionnaires was to supply answers to some of the research questions dealing with study habits, perceptions, preferences, experiences and reasons for actions during the running of the course. The questionnaire had to be simple, clear and relevant and had to supply the needed information. Length was not considered when drawing up the questionnaire. The questions in the questionnaire were all of the closed type. Some of the questions came from the literature but many of the questions were compiled to address issues that I felt are important for the study.

➤ Different types of questions

The following types of questions were included in the questionnaire.

- Sifting questions – if a certain response is given, follow-up questions must be answered;
- Choose only one – respondent must choose only one option;
- Choose all relevant – respondent can choose any number of options;
- Ranking questions – respondent must rank options;
- Likert scales – measure intensity of feelings.

Questions were asked about all aspects of lectures, practicals, studying, the multimedia offered, tests, internet use, facilities and how the learners would like their course to be compiled.

➤ Distribution and collection

Learners were informed beforehand about and asked whether they were willing to fill in a questionnaire on the histology course and the multimedia study material that was offered to them. It was explained to them that the information gathered by the questionnaire was needed to obtain insight into their likes and dislikes and that the information would be used to the advantage of future histology learners.

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The questionnaires were given to the learners after a lecture and they were given enough time was given to complete the questionnaire after which the questionnaires were taken in. There were 201 out of a total of 380 learners present at the lecture when the questionnaire was handed out. Out of the total of 201, six learners handed in their questionnaire without filling in anything. One questionnaire had a page missing. The anatomy number was also asked in the questionnaire so that learner responses could be compared to the marks obtained in the tests. 53 learners did not fill in their anatomy numbers, possibly because they wanted to remain anonymous. Of the 141 learners that completed the questionnaire and could be identified by their anatomy numbers, 13 learners were dental learners and the rest were medical learners.

A limitation of the way in which the questionnaire was distributed was that it was only filled in by learners present in class on that specific day. The regular non-attendees did not take part in this study.

➤ Layout of the questions

The responses can be divided into two groups, namely:

- Ratings: Learners had to either rate a statement or an option by arranging them in a sequence or had to judge something like a lecture giving it a rating;
- Selection: Here learners had to select one or more options from a list.

➤ Questionnaire matrix

The table below shows the design of the questionnaire. There are two main columns Questions on and Question groups. The “Questions on” column is divided into four columns. The left hand column contains the main aspects covered in the questionnaire, the subject preferences, facilities, learning and tests. Learning is divided into tutored learning, self learning, favourite ways of studying and how learners would like their course. Tutored learning is divided into lectures which comprise ratings, attendance, presentation and practicals. Self learning is divided into the prescribed book, internet

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and multimedia computer presentations which again is divided under use, evaluation, technical aspects, and value. The last topic under self learning is the video. In the fifth column are the question groups asked in the questionnaire.

Table 3.3: Layout of the question topics and question groups

Questions on:		Question Groups		
Subject preferences		What is the learner's favourite subsection?		
		What are the reasons for this selection?		
Facilities		What video facilities do learners have at home?		
		What computer facilities do learners have at home?		
		Can learners afford computers?		
L E A R N I N G	T U T O R E D	Lectures	Ratings - How do learners rate their lectures?	
			Attendance	Why do learners not attend lectures?
				Did you leave a lecture or lectures and why?
				Do learners concentrate during lectures?
				Are there too many lectures?
				Are certain lectures more important?
		Presentation - Which is the best way to present a lecture?		
		Practicals - Why do learners not attend or leave practicals?		
	Prescribed book - To what extent is the prescribed book used?			
	Internet - To what extent is the internet used?			
	S E L F	Multimedia computer presentations	Use	To what extent were the computer presentations used?
				Why were the computer presentations not used?
				Why did learners only use some of the computer presentations?
				How much time did learners spend using the computer presentations?
				Were the presentations enjoyable to use?
				Did learners spend more time on histology because of the presentations?
				Did learners help one another with the presentations?
		Evaluation – What was the interface like?		
		Technical aspects - Were there navigational errors and technical problems?		
		Value	Do the learners feel presentations improved recollection?	
			Does the learner feel that his marks improved because of the presentations?	
			Is a computer presentation better than a lecture?	
			Did presentations change the learner's attitude towards the subject?	
	Video	How many times did learners watch the video?		
What problems were encountered?				
Favourite ways of studying				
How would learners like their course		Can multimedia replace the traditional course?		
		Do learners think multimedia can replace the microscope?		
		Do learners prefer computer presentations or video?		
Tests - Is effort rewarded?				

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Under the following headings each question that was asked in the questionnaire will be discussed giving the motivation behind the question. Hypotheses regarding the responses to the questions will also be mentioned.

The questions from the questionnaire are given just above the table in which the options are given. When a question has only a few options the options are given in the form of a short description.

❖ Subject preferences

The questions attempt to test the popularity of the different subsections of the anatomy course as well as the reasons for a subsection being popular or unpopular. Whether a subject is popular or not may have a major influence on motivation.

◆ What is the learner's favourite subsection?

From years of experience as a histology lecturer and from being a learner myself I know that there is a tendency amongst learners to dislike Histology. Learners often start the course with the perception that histology is a subject that is neither interesting nor enjoyable. This perception is carried over from year to year. This question tests that perception. Learners had to rate the subsections of anatomy by arranging them from 1 to 4.

Question

Which subsection of anatomy do you prefer most: 1 for most preferred and 4 for least favourite.

Options were the four subsections of anatomy namely gross and neuroanatomy, embryology and histology.

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◆ What are the reasons for this selection?

This question attempts to find the reasons why learners prefer one subsection of anatomy above another.

Question

Why do you enjoy this subsection most? Rate the options by numbering from 1 to 4.

Options included more relevant to the medical course, better presented, easier and more interesting.

◆ Facilities

The following questions attempt to determine whether the learners used MEDUNSA's facilities, their own facilities or facilities somewhere else. The response to this question will also give an indication of what facilities learners have at home, what their financial situation is and to what extent they rely on facilities from the university.

◆ What video facilities do learners have at home?
--

The answer to this question indicates what percentage of respondents have access to video machines. Video machines at home mean fewer learners using the facilities at the university. It also means that these learners have access to multimedia supplied on video.

Question

If you watch the video where do you normally watch the video?

Options for this question included the library, residence, own video machine, friend's video machine or a borrowed video machine.

◆ **What computer facilities do learners have at home?**

The purpose of the following question is to test the learner's knowledge on the technical side of computers.

Question

What computer did you use the program on? Write in the MHz.

The options for this question included the different Pentium models on the market as well as a computer at MEDUNSA.

◆ **Can learners afford computers?**

Do learners not have computers because they cannot afford them or do they not have a use for them? A value was given to a computer because many learners would not know how much a computer cost. In the question a value of R5000 was decided upon because a decent second hand computer or even a new computer can be bought for this amount.

Question

Can you afford a computer of R5000?

The options that the respondents had to choose from included a yes or a no as well as "If it is really worth it I will make a plan".

❖ Learning

The questions in this section investigate the ways in which the learners learned. It is expected (although there was no penalty for not doing so) of learners to attend the practicals and the lectures. Every learner received a set of notes. A histology handbook is prescribed to which was often referred to during the lectures and the practicals. Videos were available for personal use or could be viewed in the library. The multimedia computer presentations that were developed for this study were available for personal use (on a CD rom) or could be viewed on the 15 computers that were made available for the learners. It was impossible for all the learners to use the multimedia computer presentations as much as they would have liked to (except for the ones that bought the CD and have their own computers) because of limited facilities.

◇ Tutored learning

The questions on learning are divided into four groups. Learning that takes place while learners are taught by a lecturer (lectures) or where learners are under supervision of a lecturer (practicals) are grouped under tutored learning.

□ Lectures

In the following questions we try to determine the perceptions about lecture attendance and the issues that play a role in lecture attendance.

A limitation of the study is that learners that regularly do not attend lectures were not present when the questionnaires were filled in.

■ Ratings – How do learners rate their lectures

This question was asked to determine how learners rate the histology lectures which will also indicate how they rate the lecturers that give the lectures. Lectures can be assessed in three ways:

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- Learners can evaluate the lecturer.
- Marks obtained in the test can be analyzed and used to evaluate the lecturer.
- Graduates can be evaluated once they have completed their studies.

The first two ways are used in this study. This question is the first way in which a lecturer can be evaluated.

If no clear pattern emerges from this question it will confirm what Stuard (1978) said when he stated that ratings of lecturers by learners are not reliable.

For the purposes of the statistical analysis this question had to be broken up into a question for each lecture.

Question

Rate the presentation of the LECTURER for each course component below.

Use the scale:

- | | |
|--|-------------|
| 1 = Outstanding | (O) |
| 2 = Very good | (VG) |
| 3 = Good | (G) |
| 4 = Not good | (NG) |
| 5 = Bad | (B) |
| 6 = Very bad | (VB) |
| 7 = No comment – I did not attend | (NC) |

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Table 3.4: Ratings of lectures

Block 1	O	V G	G	N G	B	V B	N C
Epitheliums	1	2	3	4	5	6	7
Connective tissues	1	2	3	4	5	6	7
Cartilage	1	2	3	4	5	6	7
Bone	1	2	3	4	5	6	7
Lymphoid system	1	2	3	4	5	6	7
Muscle	1	2	3	4	5	6	7
Respiration	1	2	3	4	5	6	7
Vascular system	1	2	3	4	5	6	7

Block 2	O	VG	G	NG	B	VB	NC
Neurohistology	1	2	3	4	5	6	7
Soft tissues of the mouth	1	2	3	4	5	6	7
Tooth development	1	2	3	4	5	6	7
Eye histology	1	2	3	4	5	6	7
Ear and olfactory epithelium	1	2	3	4	5	6	7

■ Attendance

The attendance of lectures in the anatomy course is not compulsory. We do not have a way of compelling the learners to attend lectures. Many learners do not attend the histology lectures. We are aware of this because the lecture hall that we use can only accommodate 300 learners and there are 380 learners in class, therefore if all the learners attend, some would have to sit on the steps. This has never been the situation; because the class was never full we know that many learners did not attend the lectures.

◆ Why do learners not attend lectures?

In the questionnaire we are trying to find the main reason why learners do not attend lectures and practicals. Only learners that stayed away or left the lectures or practicals had to answer these questions. Learners that did not answer these questions were the

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ones attending lectures and practicals. For the purposes of the statistical analysis this question had to be broken up into a question for each lecture and practical topic.

Question

If you **DID NOT ATTEND** or **LEFT** any histology lectures below, please give your **MAIN** reason.

Table 3.5: Reasons for not attending or leaving a lecture

<i>Epitheliums</i>
I find it difficult to concentrate in class
I did not like the way the lecture was presented
I have too many lectures to attend
I do not like the topic
I would rather put effort into reading gross anatomy
Personal reasons
I study the notes
I study the prescribed book
I watch the video
I use the histology multimedia programs

◆ **Did you leave a lecture or lectures and why?**

During lectures learners often leave the lecture hall. The following two questions attempt to determine what the extent of this problem is and secondly what the reasons are for leaving the lecture.

Question

Have you ever left a histology lecture before the end?

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The respondents had to choose between never, once, regularly and every time.

Question

If you did leave a histology lecture, or lectures, before the end which of the following is/are applicable?

Table 3.6: Reason for leaving a lecture

It was during the same lecturer/s lecture/s
I could no longer concentrate
The lecture was too long
I could study the work on my own from the notes or textbook
The lecture was boring
I decided rather to look at the video or computer presentation
I was tired because I had not had enough sleep

◆ Do learners concentrate during lectures?

If a learner attends a lecture but loses concentration during the lecture he or she obviously does not gain much from attending the lecture.

As a lecturer one often becomes aware of learners not paying attention during a lecture. Some learners even sleep during lectures. Because of the size of the class it is difficult to know what the extent of this problem is. Questions under this heading attempt to determine how many learners have concentration problems during lectures and what they think the reasons for these problems are.

Question

Are you unable to concentrate during lectures?

Table 3.7: Concentration during lectures

Never
Sometimes
Only when listening to certain lecturers
When the lecture gets too long
Never during the first lecture
Only when I have not had enough sleep

◆ Are there too many lectures?

The question on the number of lectures gave various options. Option one determines whether a learner feels strongly about the number and contents of the lectures. The third option is to determine how many learners do not have a problem with lectures, the length and content. The other options suggest solutions to the problems. A learner that did not use the multimedia programs or does not like multimedia programs could choose option two or four as a solution. Options five and six suggest multimedia programs as a solution to the problems stated in the first question.

The idea behind this question was to see which option catches the learner's attention.

Question

Do you think you have to attend too many lectures?

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Table 3.8: Number of lectures

Yes, because there is too much to absorb
No, but I would prefer longer breaks in-between
No, I can sit through the lectures and concentrate all the time
The lectures should be shorter and certain topics should be left for self-study
Some lectures should be replaced by computer presentations
All lectures should be replaced by computer presentations

◆ **Are certain lectures more important?**

This question tries to determine the learner's perception of the importance of attending the lectures in the different subjects and not the importance of the different subjects. It is possible that the importance of attending a lecture is determined by the availability of the information given in the lecture. If the information cannot be gathered from another source the learners may see attendance of that specific lecture as important.

Question

Which lectures do you think are vital and cannot be missed?

The options under this question included the four subsections of anatomy (gross and neuroanatomy, embryology and histology) as well as the option that if a lecture is missed it can be caught up later.

Question

For what reason(s) should these lectures not be missed?

Table 3.9: Reasons for not missing a lecture

The information cannot be found anywhere else
The lecturer clears up difficult concepts
The lecturer gives useful tips for the test
The lectures are enjoyable
My sense of duty does not allow me to stay away

■ Presentation – Which is the best way to present a lecture?

When data projectors became available some lecturers adopted the new technology. This way of lecturing makes lecturing much easier for the lecturer and also allows more options, like video, to be included in the lecture. Many lecturers however still use slides, transparencies and the blackboard for lecturing.

This question was asked to determine whether learners think that lecturing from a computer with the aid of a data projector results in a better lecture than when the traditional way is used.

Question

How would you rate a lecture given with the aid of a computer and a data projector?

Table 3.10: Presentation of a lecture

Better than a traditional lecture (Using the chalk board, slides and overhead projector)
Not as good as a traditional lectures
The same as a traditional lecture
Some are better, while others are not
I wish all my lectures were given in this way

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□ Practicals – Why do learners not attend or leave practicals?

Practicals form a major part of the histology course. Traditionally the practical sessions were used to teach learners to identify normal tissues and cells. This knowledge is important in the third year when the pathology of these tissues is studied.

The practicals like the lectures are not compulsory. Because of the large class, the same practical has to be repeated three times. No attendance is taken during the practicals but from the empty seats in the practical laboratory we know that many learners do not attend the practicals. Many learners also leave the practicals before the end. The following question was repeated for each practical topic.

Question

If you **DID NOT ATTEND** or **LEFT** any practicals below, please give your **MAIN** reason.

Table 3.11: Reasons for not attending or leaving a practical

<i>Epitheliums</i>
I do not need to attend the practical I watch the video
I do not need to attend the practical I study the Multimedia programs on histology
The practicals are not necessary
I have difficulties with the microscope
Histology slides are confusing, I would rather put an effort into gross anatomy
Personal reasons

◇ Self learning

This heading was chosen for studying that learners conduct outside the official schedule without any supervision from a lecturer. This includes reading from the prescribed book, looking for information on the internet, using the multimedia computer presentations and the video.

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 Prescribed book – To what extent is the prescribed book used?

A histology handbook is prescribed for the second year histology course. Lecturers refer to this book during practicals and lectures.

During lectures and practicals I have noticed that very few learners have the handbook. The following question about the use of the handbook was asked to determine if and in which way the learners used the handbook.

Question

Which ONE of the following is true with regard to the prescribed histology book?

Table 3.12: Use of the prescribed book

No I have not read the prescribed book
I have just looked up a few things
I have studied from the book
I started to study from the book, but gave it up
The book is too complicated

 Internet – To what extent is the internet used?

The use of the internet was also investigated. At MEDUNSA learners have to pay a fee to get access to the internet. The responses to this question will give an indication of the facilities and also the utilisation of the facilities available to the learners.

The following question was asked to determine how many of the respondents have access to the internet at MEDUNSA and also outside the university. The second question was asked to determine whether learners also use the internet for academic purposes or just to visit entertainment sites.

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Question

Do you have access to the internet?

The respondent had to choose one or more of the following options: no internet access or a yes I had internet access at either MEDUNSA, at home or at a friend's.

Question

If your answer to the previous question is YES then answer this Question.

Table 3.13: Learners and histology on the internet

I looked for histology on the Internet
I found histology websites on the Internet
I found histology of the same standard as our course
The histology that I found on the Internet was as good as the presentations that are available to us
I found histology that was better than the presentations that are available to us
The histology that I found is not applicable to our course

Multimedia computer presentations

A large section of the questionnaire is used for questions on the multimedia computer presentations. For the purpose of this study it is important to gain information regarding the perceptions of learners about multimedia computer presentations. The questionnaire addresses the questions of time spend, the affectivity and various other aspects of the user interface as well as the programs themselves. These questions attempt to determine the quality of the presentations that were developed for this study.

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■ Use

The following questions probe whether the presentations were used and to what extent they were used which will help to indicate whether learners perceived the presentations as valuable for gaining knowledge more effectively.

◆ To what extent were the computer presentations used?
--

This question will indicate if learners that started to use the presentations kept on using the presentations or found them not worth the effort and stopped using them. It will also indicate whether learners found only some of the presentations worthwhile.

Question

Did you use the multimedia computer presentations that were available?

Table 3.14: Use of the multimedia computer presentations

Did not use it
Used some of it during Block 1
Used some of it during Block 2
Used only the multimedia for Block 1
Used only the multimedia for Block 2
Used it all

◆ Why was the computer presentations not used?
--

This question on the reasons why learners did not use the presentations will indicate whether the learners simply do not want to use computers for learning, whether some did not know about the presentations, whether the lack of facilities prevented the learners from using the presentations or whether the learners found the presentations unsatisfactory.

Question

I did not make use of the multimedia programs available because: (Choose the primary reason).

Table 3.15: Reasons for not using the multimedia computer presentations

Do not know about computers
Did not know about the programs
Did not have time
Looked at it but decided it was not worth it (do not need it)
The computers were always occupied

◆ Why did learners only use some of the computer presentations?

Some learners may have used the multimedia computer programs but quitted for some reason or other. The reasons why learners did not persist in using the programs are investigated under this heading.

Question

I used some of the multimedia programs available because: (Choose the primary reason).

Table 3.16: Reason for only using some of the multimedia computer presentations

I struggled with the computer
The computer programs were too difficult to use
Some of the programs were good and others were not good
I decided it was not worth it (do not need it) after I started to use it
The computers were always occupied

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◆ How much time did learners spend using the computer presentations?

Information about the time learners spend utilizing the computer presentations is important. This information can be useful in determining the facilities required. A possible problem with this question will be that the time indicated by the respondent may not be the time he or she may have wanted to spend on using the programs but was the only time they could find an available computer.

Question

How much time did you spend on the histology multimedia?

The various time options range from 2-4, 4-6, 6-8 or more than 8 hours.

◆ Were the presentations enjoyable to use?

If the hypothesis that histology is not a popular subject is true, ways of improving the popularity of the subject should be found. If a computer presentation that is enjoyable to use can be introduced this will do much to improve the learners' attitude towards the subject.

Question

Are the programs enjoyable to use?

Table 3.17: Enjoyment of the multimedia computer presentations

Yes
No, I prefer to read the notes
No, I prefer to watch the video
No, I prefer to read the prescribed book
No, but it is better than reading the notes

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◆ Did learners spend more time on histology because of the presentations?

If the multimedia computer presentations are enjoyable to use, one would expect learners to spend more time using the presentations than they would have spent using the notes and prescribed book.

Question

Did the multimedia computer presentations made you spend more time on histology than you would have if the presentations were not available?

The respondent had to either choose a yes or a no or could indicate that the programs made no difference to the time spent studying histology.

◆ Did learners help one another with the presentations?

Interaction between learners (teaching others) is an important way of acquiring knowledge (National Training Laboratories, 1998., Online).

Question

Was it difficult to get help when you had a problem with the program?

Respondents had to either say yes or no.

Question

Could your fellow learners help you with a problem?

The respondent had to choose between sometimes, always or sometimes the problem could not be solved.

Question

Did you help some other learner with a problem?

Respondents had to indicate that they either never, once or a couple of times helped a fellow learner.

<p>■ Evaluation – What was the interface like?</p>
--

The following questions were asked to determine if the user interface that was developed was generally acceptable to the learners and how the learners experienced the programs.

Respondents had to categorise their answers under always, sometimes or no.

The questions on the interface enquire about the following aspects of the interface:

Table 3.18: Aspects of the interface

Acceptability of colours
Acceptability of font type and size
Text readable and easy to follow
Pictures and text well laid out
Pictures used effectively
Is the program easy to use
Instructions clear and easy
Is the navigation easy

Question

Does using the program get easier as you use the program more and more?

Table 3.19: User friendliness of the multimedia computer presentations

Yes, it gets easier
No, it is clear from the beginning
No, it is still complicated after having used it a couple of times

Question

Is the use of speech helpful/necessary?

The options under this question varied from speech is important, not important, seldom used and unnecessary.

Question

Is the work well explained?

The respondent had to choose between always, most of the time, some topics are well explained and no topic is well explained.

Question

Is the work systematically explained?

This question enquires about the sequence of the work. Options varied from mixed up in all cases, mixed up in some cases, not bad but could be improved and correct.

Question

Were there many errors in the programs that you can identify?

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This question on errors in the programs gave the option of many, few and couldn't find any.

■ Technical aspects – Were there navigational errors and technical problems?

Technical problems and navigational errors will cause frustration, waste time and can discourage learners from using the presentations.

The following two questions enquire about possible navigational errors which means links in the presentations that did not work and also about technical problems where the computer that the learner used could not run the presentations.

Question

Were there navigational errors in the programs that you can identify?

This question on navigational errors in the programs gave the option of many, few and couldn't find any.

Question

Were there many technical problems when you used the programs?

Table 3.20: Technical problems

Never
Program wouldn't run
A red cross was displayed sometimes
Computers crashed
CD rom wouldn't read the CD

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■ Value

A number of questions were asked to determine the learner's perceived value of the multimedia computer presentations.

The following factors are thought to influence the value of the multimedia computer presentations, namely: recollection of knowledge; improvement of marks; improvement on a lecture and change of attitude of the learner.

◆ Do learners feel presentations improved recollection?

This question merely tests a perception as there is no real test to compare recollection in the same individual after using multimedia computer presentations and after using the conventional way of studying.

Question

Do the programs make it easier to remember the work? (Is your recollection better?)

This question gave the options yes, no and no difference.

◆ Does the learner feel that his marks improved because of the presentations?

This question is related to the previous question because better recollection will lead to better marks, as histology is mainly a subject of facts that must be remembered.

Question

Did you do better in the topics where programs are available?

The options for this question were yes, no, sometimes and no difference.

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◆ Is a computer presentation better than a lecture?

This is a very important question in this study. Learners will have to make a judgement on the grounds of what they have experienced when using the multimedia computer presentations and what they experienced when they attended lectures.

Question

A multimedia session done on a computer is better than a traditional lecture:

Table 3.21: Multimedia computer presentation versus a lecture

No
Depends on the lecture
Depends on the computer presentation
A good computer presentation is better than any lecture
A computer presentation is for revision

◆ Did presentations change the learner's attitude towards the subject?

If the hypothesis that histology is the least popular of the subsections of anatomy is true, the reasons for this unpopularity must be investigated. If possible an effort must be made to increase the popularity of histology amongst the learners. This question will determine whether we can change or have changed the attitude towards histology with the multimedia computer presentations.

Question

Did the programs change you attitude (rating of) towards histology? Did it make you enjoy histology more?

The respondent had to decide whether the programs changed his attitude towards histology a little, a lot or not.

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□ Video

The following questions are related to the issues around the three hour video on the practical aspects of the histology course. Questions address the use and popularity of the video as a study aid. The facilities available and the time spent watching the histology video is probed.

◆ How many times did learners watch the video?

This question attempts to verify the time learners spend studying the video. From conversations with learners it became clear that they assume that by sitting and watching the video a couple of times they are guaranteed a good mark for the practical test. The results from this question will be related to the marks obtained during the practical test.

Question

How many times did you watch the video?

Respondents had to choose between once, twice, three times, four times and more than four times.

◆ What problems were encountered?

The purpose of the question was to determine what frustrations regarding the facilities would be chosen if a number of potential complaints are given as options.

Question

When you watched the video in the library the following applied:

Table 3.22: Video in the library

I had problems finding a booking
I could easily find a booking
The video machines are always in working order
The video machines are not always in working order
The quality of the video is satisfactory
The quality of the video is not always good

◇ Favourite ways of studying

This question will test the popularity of the alternative ways of presenting information (video and multimedia computer presentations) against the traditional ways of presenting learners with information (lectures, slides studied under the microscope and reading textbooks).

Question

Rate the following from 1 to 6 in terms of your preferred methods of studying histology.

The respondents had to rate all the various components of the histology course, namely: notes prescribed book, video, multimedia, lectures and practicals.

◇ How would learners like their course?

In the following questions the learners are questioned on their opinions of multimedia in general and what they think the future of multimedia is in the teaching of histology after having been exposed to the multimedia that was developed for this study.

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◆ Can multimedia replace the traditional course?

This question tests the perception that the learners have developed of multimedia while using the multimedia that was developed for this study.

Question

What is your considered opinion on the histology course and the availability offerings of a multimedia environment?

Table 3.23: Replacing the traditional course with a multimedia histology course

Multimedia can completely replace the histology course
Multimedia histology should be supported by practicals and lectures
Multimedia histology should be supported by lectures
Multimedia histology should be supported by practicals
Multimedia should only be additional, for those interested

◆ Do learners think multimedia can replace the microscope?

The issue that is addressed in this question is whether the learners feel they need a microscope or not to study histology properly. This question is related to the questions above. If the response to the questions above is negative, this question will determine if the learners will accept replacement of the microscope as a teaching tool.

Question

Is the multimedia on a computer better than using a microscope?

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Respondents had to choose from much better, not better, the same and the computer can completely replace the microscope.

◆ Do learners prefer computer presentations or video?

Most people would assume that multimedia computer presentations would be preferable to video. Multimedia computer presentations include all the information that is presented on the video and more, and because it is interactive it should therefore be a better learning experience. From the literature we know however that the learners tend to prefer the way of studying that requires the least effort (Heidger et al, 2002). This question was asked to see whether this is also true for our group of respondents.

Question

Do you prefer a video to an interactive computer presentation?

Table 3.24: Video versus multimedia computer presentations

Yes, I would prefer to use videos as an additional way of studying histology
I would like to watch the histology video in addition to computer presentations
Videos are not necessary when you have interactive computer presentations

❖ Tests – Is effort rewarded?

Questions were also asked regarding the perceptions around tests. Learners should feel that a big effort should result in good marks. Sometimes learners feel that when they write a test they are not rewarded for the effort they have put into their studies. This is a problem when a subject consists of different subsections because a learner can decide to rather spend time on another subsection and try to compensate in this way.

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The theory and the practical tests are two separate tests. The same question is asked for the theory and for the practical tests in histology.

Question

If I put in a big effort into practical histology:

The respondents had to choose from doing well, may still fails get an average mark, rather spend time on the theory part of histology or rather spend time on the other subsections of anatomy.

Question

If I put a big effort into the theory of histology:

The same options as in the previous question applied here except that the one option was to rather spend time on the practical part of histology.

3.2.2.1.2 Records

The data base that was compiled using the information collected from the questionnaires was supplemented by data retrieved from the learner records. Only data from learners who wrote their names on the questionnaires were used. The following information was added to the data base.

➤ Test results

The histology part of the two tests that were written at the end of the two blocks were out of a total of 170 and the gross anatomy made up the rest to give a total of 600. The histology was divided into a practical part where multimedia computer presentations were available to the learners as additional study material and a part where no multimedia presentations were available. The written section of histology was similarly divided into the same two sections. The marks obtained in the written test on gross

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anatomy were also included in the data base containing additional records as well as the marks obtained in the practical test on gross anatomy.

Table 3.25: Test information

1	Written Histology /60 multimedia computer presentations available
2	Written Histology /30 multimedia computer presentations not available
3	Practical Histology /55 multimedia computer presentations available
4	Practical Histology /25 multimedia computer presentations not available
9	Written – Gross Anatomy /210
10	Practical – Gross anatomy /220

The marks for the different parts of histology, where multimedia presentations were available and the parts where multimedia presentations were not available, had to be retrieved from the learners' personal files because the marks are not usually recorded in this format.

➤ Criteria for selecting learners

Learners are selected for the MBChB and BDS courses on marks obtained in the matric exam (SRS rating) and on courses passed or degrees obtained from MEDUNSA or other institutions (additional credits).

❖ SRS ratings

To calculate the SRS value that is used for selection of learners at MEDUNSA only two matric subjects are taken into account namely: mathematics and science. Marks are awarded for the symbols obtained. (See Table 1.2). The SRS ratings on which the

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learners were selected were retrieved from the learner records and added to the data base.

❖ Additional credits

The data base also included a field indicating whether a learner has additional credits or not. A value could not be given to the credit because these credits are often subjectively awarded by the dean. A number of learners are foreign and therefore do not comply exactly with the requirements.

3.2.2.1.3 Relationships between responses and records

From studies reported in the literature (Oliver, 1999) it is known that when comparisons are made between learners that were taught with the use of multimedia or any other method of E-learning and learners that were taught the traditional way there is no significant difference in the outcomes.

❖ Statistical analyses

Because the marks were available it was decided to do an analysis.

The following comparisons were made:

1. SRS ratings correlated with the total histology mark

This was done to see what influence the selection criteria have on performance.

2. The marks of the learners with additional credits compared to the marks of the other learners.

This was done to see whether the more experienced learners do better.

3. The marks on the section for which multimedia computer presentations were available were compared between the following three groups.

- Used none of the multimedia computer presentations
- Used some of the multimedia computer presentations
- Used all the multimedia computer presentations

This was done to determine if there was a significant difference among the three sets of marks.

4. The number of times a learner watched the histology video compared to the practical histology mark.

This was done to see whether there is a correlation between the number of times a learner watches the video and the mark that he obtains in the histology practical test.

5. The histology marks obtained by the learners that indicated histology as their favourite subject compared with their gross anatomy marks.

This was done to see whether the motivation factor may have a significant influence on a learner's performance.

In the last three comparisons (3,4 and 5) the gross anatomy mark obtained was used as a co variant.

3.2.2.2 Learner profiles

The responses from the questions were used to put together a profile of the average MEDUNSA learner under the following headings.

- Subject preferences of the average MEDUNSA learner;
- Study preferences of the average MEDUNSA learner;

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- The average MEDUNSA learner and the internet;
- The average MEDUNSA learner and lectures;
- The average MEDUNSA learner and practicals;
- How the average MEDUNSA learner would like his course;
- The average MEDUNSA learner's financial situation;
- The average MEDUNSA learner and multimedia;
- Academic background.

CHAPTER 4

RESULTS

This chapter reports on the results gathered with the different instruments. This includes the responses obtained from the questionnaires, the records and statistical analyses of the relationships between responses and records.

This table representing this chapter is arranged into five columns with the main topic on the left and the lower order topics to the right. The main topic is research which is divided into instruments and learner profiles. The instruments are the questionnaire, the records and the relationships between responses and records. The responses from the respondents are represented in table 4.2. The records are divided into test results and criteria for selecting learners which is subdivided into SRS and additional credits. Under the relationship between responses and records is the statistical analysis.

Table 4.1: Layout of Chapter 4

Research	Instruments	Questionnaire	Learners' responses	
		Records	Test results	
			Criteria for selecting learners	SRS
				Additional credits
	Relationships between responses and records	Statistical analysis		
Learner profiles				

The data in this chapter is represented both in tabular and in graphic format to allow for individual reader preference as well as numerical clarity.

4.1 Research

The research deals with the different instruments that were used for collecting data. The data were used to compile learner profiles.

4.1.1 Instruments

Two instruments were used to collect two sets of data. A third set of data was compiled by combining these two sets of data.

4.1.1.1 Questionnaire

This chapter reports on the results obtained by means of the questionnaire.

➤ Learners' responses

This table is the same as table 3.3. The responses from the respondents to each question are reported in this chapter.

Table 4.2: Layout of the question topics and question groups

Questions on:		Question Groups		
Subject preferences		What is the learner's favourite subsection?		
		What are the reasons for this selection?		
Facilities		What video facilities do learners have at home?		
		What computer facilities do learners have at home?		
		Can learners afford computers?		
L E A R N I N G	T U T O R E D	Lectures	Ratings - How do learners rate their lectures?	
			Attendance	Why do learners not attend lectures?
				Did you leave a lecture or lectures and why?
				Do learners concentrate during lectures?
				Are there too many lectures?
				Are certain lectures more important?
		Presentation - Which is the best way to present a lecture?		
	Practicals - Why do learners not attend or leave practicals?			
	Prescribed book - To what extent is the prescribed book used?			
	Internet - To what extent is the internet used?			
	S E L F	Multimedia computer presentations	Use	To what extent were the computer presentations used?
				Why were the computer presentations not used?
				Why did learners only use some of the computer presentations?
				How much time did learners spend using the computer presentations?
				Were the presentations enjoyable to use?
				Did learners spend more time on histology because of the presentations?
				Did learners help one another with the presentations?
		Evaluation – What was the interface like?		
		Technical aspects - Were there navigational errors and technical problems?		
		Value	Do the learners feel presentations improved recollection?	
			Does the learner feel that his marks improved because of the presentations?	
			Is a computer presentation better than a lecture?	
			Did presentations change the learner's attitude towards the subject?	
	Video		How many times did learners watch the video?	
			What problems were encountered?	
	Favourite ways of studying			
	How would learners like their course		Can multimedia replace the traditional course?	
Do learners think multimedia can replace the microscope?				
Do learners prefer computer presentations or video?				
Tests - Is effort rewarded?				

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A description of the results with respect to each of the questions is given. To clarify the results each result is represented in a table and a graph. Pie charts and block graphs are used.

The responses can be divided into two groups:

1. Ratings;
2. Selecting an option.

❖ Subject preferences

The popularity of the different subsections as well as the reasons for being popular or unpopular are tested by means of the following questions.

◆ What is the learner's favourite subsection?

The hypothesis that histology is not a popular subject is tested with this question.

Question

Which subsection of anatomy do you prefer most?

Response

Instead of rating the different subsections from 1 to 4 as was asked, many learners used the question only to indicate their favourite subsection. This is indicated by the missing frequencies.

From the results an average rating was calculated. For each subsection the rating (x) was multiplied by the number of respondents (f) choosing that specific rating to give a value (xf). These values were then added up ($\sum xf$) and divided by the number of respondents (n). This resulted in an average rating for that specific lecture (\bar{x}). The closer to one the average rating is the more popular the option was. This method of average rating calculation was also used for other questions and will be referred to later.

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Table 4.3: Example of calculation of average rating for gross anatomy

Rating (x)	Frequency (f)	xf
1	125	125
2	43	83
3	14	42
4	6	24
	188	274 Total

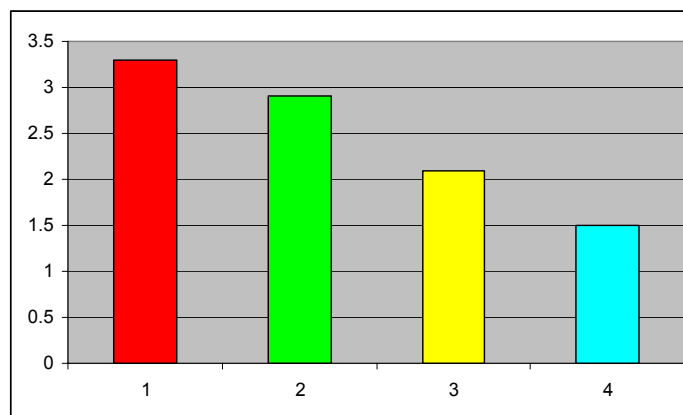
Average rating for Gross Anatomy: $274/188=1,5$

In the table below the percentage of respondents that selected the different topics as a first choice is also given.

Table 4.4: Subject preferences

Subject	% first choice	Average Rating	Frequency missing
Histology	5	3,3	16
Neuroanatomy	23	2,9	19
Embryology	11	2,1	18
Gross Anatomy	66	1,5	6

Average rating



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From this result it is clear that gross anatomy is the most popular subsection of anatomy, neuroanatomy is the second most popular subsection, embryology the third most popular and histology is the least popular subsection.

◆ What are the reasons for this selection?

This question will determine why certain subsections are more popular than others.

Question

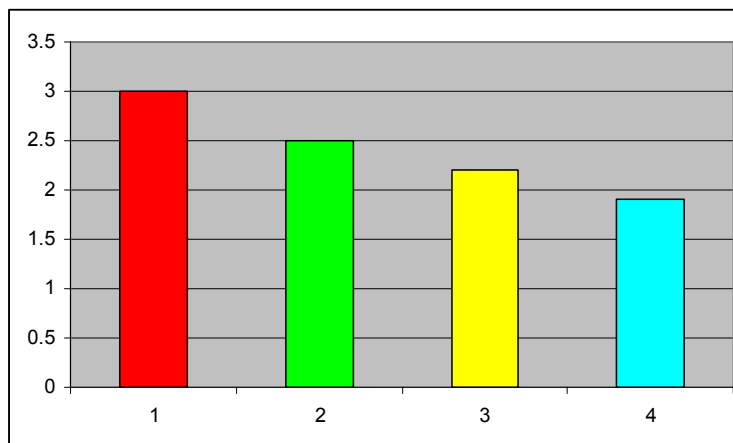
Why do you enjoy this subsection most?

Response

Table 4.5: Reasons for subject preference

Reason	% first choice	Average rating	Frequency missing
Easier	10	3,0	23
Better presented	16	2,5	18
Relevant to the course	33	2,2	16
More interesting	41	1,9	10

Average rating



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The average rating calculation method was also applied to the results from this question. Many learners used this question just to indicate their first preference as can be seen from the missing frequencies. The main reason for selecting a favourite course was (4) that learners felt that some of the subsections are more interesting, while the second most popular reason for selecting a favourite was (3) that some subsections are more relevant to the medical course. (2) The way in which the subject was presented and (4) the difficulty were the least popular reasons for preferring a subsection above another subsection.

❖ Facilities

The questions under this heading will indicate what facilities the learners have outside the university for using multimedia. It will also give some insight into the financial situation of the learners.

◆ What video facilities do learners have at home?

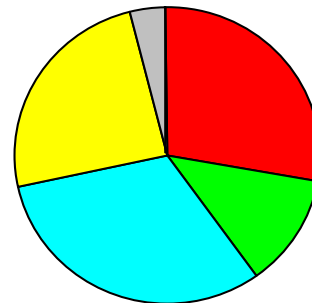
Video facilities that learners have at home will indicate how accessible the video study material is to learners.

Question

If you watch the video where do you normally watch the video?

Response**Table 4.6: Venue for watching video**

Where did you watch the video?	%
In the library	28
In the residence	12
On you own video machine	31
On a friend's video machine	25
On a borrowed video machine	4



72% of the respondents had access to a video machine other than MEDUNSA's video facilities. 31% (52) have their own video machines; the rest have family or friends where they can watch the video. 25 respondents did not answer this question.

◆ What computer facilities do learners have at home?

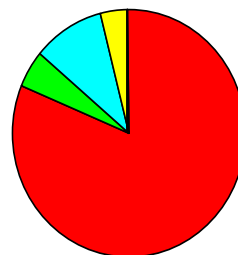
The computer facilities that learners have at home will give an indication as to how accessible the multimedia computer presentations are to learners outside the university.

Question

What computer did you use the program on?

Response**Table 4.7: Computer used**

What computer did you use the program on?	%
MEDUNSA's computer	81
My own Pentium I	5
My own Pentium II	10
My own Pentium III	4



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The majority of learners (81%) were dependant on MEDUNSA's computers. Only 19% of learners used their own computers (5% Pentium1, 10% Pentium II and 4% Pentium III). 29 respondents did not answer this question.

◆ Can learners afford computers?

This question will shed some light on the financial situation of the learners and also whether the availability of multimedia computer presentations would convince the learners to buy a computer.

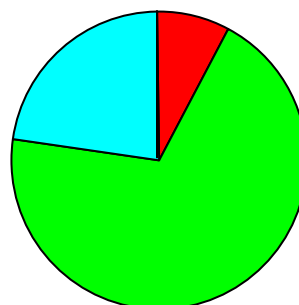
Question

Can you afford a computer of R5000?

Response

Table 4.8: Affordability of computers

Can afford a computer	%
Yes	8
No	69
If it is worth it will make a plan	23



Only 8% of the learners that answered this question (only two did not reply) said that they can afford a R5000 computer, 23% said that they may be able to get the money but only if it is worth it and 69% of the respondents cannot afford a computer.

❖ Learning

The results of the questions on learning are given under tutored and self learning.

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◇ Tutored learning

The results of instructivist learning that takes place.

□ Lectures

The results under lectures cover the different aspects of lectures.

■ Ratings – How do learners rate their lectures?

This question will indicate what standard the lectures are according to the learners.

Question

Rate the presentation of the **LECTURER** for each course component.

Response

An average rating method was used to calculate the average rating for each lecture. Only ratings from 1-6 were taken into account because option 7 was for learners that did not attend the lecture.

1 = Outstanding

5 = Bad

2 = Very good

6 = Very bad

3 = Good

7 No comment – I did not attend

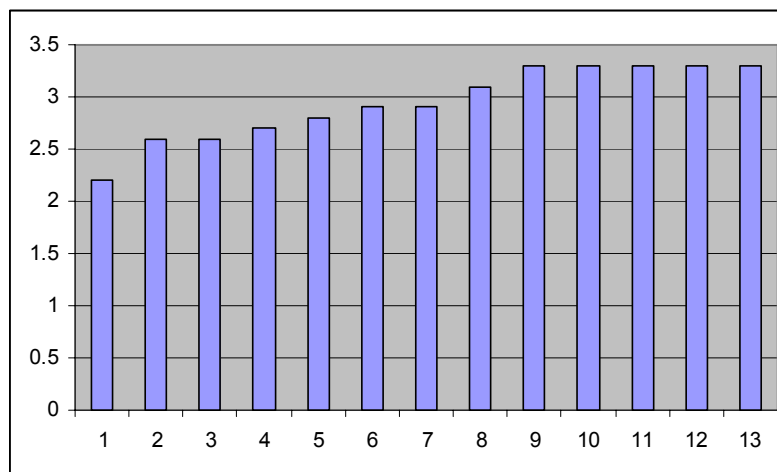
4 = Not good

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Table 4.9: Average rating of lectures

1	2	3
Topic of the lecture	Average Rating	Position
Eye histology	2,2	1
Neurohistology	2,6	2
Ear and olfactory epithelium	2,6	2
Tooth development	2,7	3
Soft tissues of the mouth	2,8	4
Muscle	2,9	5
Bone	2,9	5
Cartilage	3,1	6
Epitheliums	3,3	7
Connective tissues	3,3	7
Lymphoid system	3,3	7
Respiration	3,3	7
Vascular system	3,3	7

Average rating



All the average ratings, except for one – the lecture on the eye, lay between 2,5 and 3,5.

Of the 13 lectures six were rated as just below good and seven of the lectures were

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rated as just better than good of which one was rated close to very good.

■ Attendance

From the low lecture attendance and because learners often left lectures while in progress it was clear that learners feel that by attending lectures they do not get value for the time they spent.

◆ Why do learners not attend lectures?

To solve the problem of low lecture attendance or learners leaving lectures the reason for this behaviour must be determined.

Question

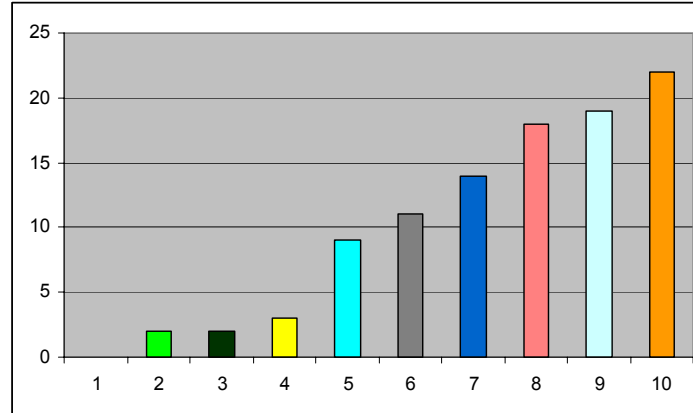
If you **DID NOT ATTEND** or **LEFT** any histology lectures below, please give your **MAIN** reason.

Response

Table 4.10: Reasons for not attending or leaving a lecture

Reason for not attending or leaving	%
I have too many lectures to attend	0
I do not like the topic	2
I would rather put effort into reading gross anatomy	2
I study the prescribed book	3
I study the notes	9
Personal reasons	11
I did not like the way the lecture was presented	14
I use the histology multimedia programs	18
I watch the video	19
I find it difficult to concentrate in class	22

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116 Respondents answered one or more of the questions in this section. The most popular response from the respondents that answered this question was that they do not attend class or leave the class because they struggle to concentrate during the lecture (22%). The second most popular answer from the respondents was that they watch the video instead (19%) while 18% of respondents said that they used the multimedia computer presentations instead. 14% of respondents did not like the way in which the lecture was presented. The rest of the responses are reflected in the table below.

◆ Did you leave a lecture or lectures and why?

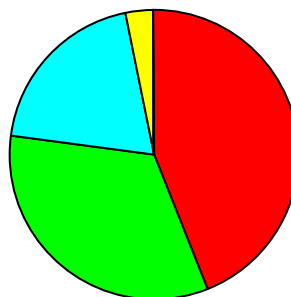
Since learners getting up in the middle of a lecture and leaving the hall is an uncomfortable experience for a lecturer, this question will determine the extent of the problem.

Question

Have you ever left a histology lecture before the end?

Response**Table 4.11: Leaving lectures**

Leaving lectures	%
Never left	44
Left once	33
Left regularly	20
Left every lecture	3



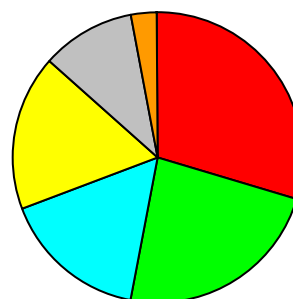
The response to the question about leaving the lecture before the end resulted in 44% of the respondents indicating that they never left a lecture before the end, 33% saying that they left a lecture once, 20% saying that they left lectures regularly before the end and only 3% stating that they left every lecture before the end.

Question

If you did leave a histology lecture, or lectures, before the end which of the following is/are applicable?

Response**Table 4.12: Reasons for leaving lectures**

Reasons for leaving lectures	%
Loss of concentration	31
Became bored	24
Too long	17
Use computer presentations + video	18
Use book and notes	11
The lecturer	3



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The most selected reason, given, for leaving a lecture before the end was loss of concentration (31%). The second most selected reason was that learners became bored with the lecture (24%). The next two most selected reasons for leaving a lecture was that the lecture was too long (17%) and that learners decided to rather look at the video or multimedia computer presentations (18%). Very few (11%) decided to go and study the notes or textbook on their own. The lecturer as a reason for leaving the lecture was only chosen by 3% of the respondents.

◆ Do learners concentrate during lectures?

Concentration problems were thought to be a factor in lecture attendance. This hypothesis was tested by means of the following question.

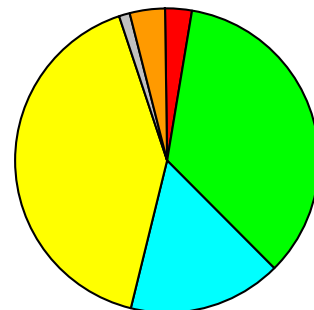
Question

Are you unable to concentrate during lectures?

Response

Table 4.13: Concentration during lectures

Concentration during lectures	%
Never	3
Sometimes	35
Only when listening to certain lecturers	16
When the lecture gets too long	41
Never during the first lecture	1
Only when I have not had enough sleep	4



From the respondents that answered the question only five (3%) reported no problems with concentration. Most learners (41%) indicated that they have concentration problems when the lecture gets too long. The second group (35%) indicated that they can concentrate throughout some of the lectures. The third group (16%) feels that their

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concentration problems are caused by certain lecturers. Only 1% said that their concentration problems only start after the first lecture and 4% blamed their concentration problems on not enough sleep. 15 respondents did not answer this question.

◆ Are there too many lectures?

Low attendance may mean that there are just too many lectures and that the learners cannot cope. This question aims at shedding light on this issue.

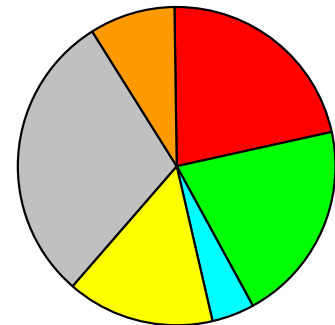
Question

Do you think you have to attend too many lectures?

Response

Table 4.14: Number of lectures

Do you have to attend too many lectures	%
Yes – Too much to absorb	22
No – want longer breaks	20
No problems with concentration	4
Shorter lectures – self study	15
Some lectures should be replaced by multimedia computer presentations	30
All lectures should be replaced by multimedia computer presentations	9



When a solution to this problem was offered 22% of students suggested fewer lectures with a reduction of information. 20% of learners want longer breaks between lectures. The biggest group of learners (54%) feels that a form of self-study should replace some lectures. The second biggest group (30%) indicated that multimedia programs should replace some lectures while 15% did not indicate a specific way of self-study. Few learners (9%) think that multimedia programs should replace the whole course. 18

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learners did not answer this question.

◆ Are certain lectures more important?

This question was asked to see whether learners perceive the availability of histology multimedia as a reason for not attending lectures.

Question

Which lectures do you think are vital and cannot be missed?

Response

Table 4.15: Lectures that cannot be missed

Topics	%
Gross anatomy	84
Embryology	42
Histology	32
Neuroanatomy	61
Lectures can be caught up later	4

This is a question where learners could choose more than one option (the percentages do not add up to 100%). The percentages are comprised out of a total of 194 respondents. The majority of respondents (84%) think that gross anatomy lectures cannot be missed (only 16% think that gross lectures can be missed) while histology is the subsection that most learners, 68% think can be missed. Only 4% of learners think that lectures can be caught up afterwards. Embryology and neuroanatomy lectures are seen as essential by 42% and 61% respectively.

Question

For what reason(s) should these lectures not be missed?

Response**Table 4.16: Reasons for not missing lectures**

Reasons	%
The information cannot be found anywhere else	11
The lecturer clears up difficult concepts	74
The lecturer gives useful tips for the test	24
The lectures are enjoyable	29
My sense of duty does not allow me to stay away	21

This is a question with multiple options (the percentages do not add up to 100%). The percentages are comprised out of a total of 194 respondents. The main reason why learners attend lectures is because the lecturers clear up difficult concepts (74% attend lectures for this reason while the remaining 26% do not see this as a reason for attending lectures). Only 11% think that the information given by the lecturer cannot be found anywhere else (89% reckon they can obtain the information from another source). 29% of learners enjoy lectures and 21% attend lectures because of a sense of duty. 24% of learners say that attending a lecture is important because the lecturers give tips.

<p>■ Presentation – Which is the best way to present a lecture?</p>

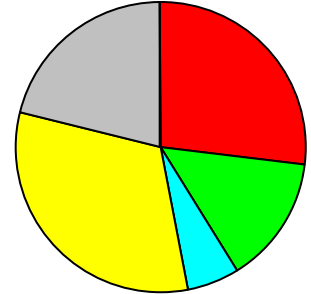
If the response to this question is positive it can be used as motivation for more lecturers to use data projectors in their lectures.

Question

How would you rate a lecture given with the aid of a computer and a data projector?

Response**Table 4.17: Presentation of lectures**

Lecture given with the aid of a data projector	%
Better than a traditional lecture	27
Not as good as the traditional lecture	14
The same as a traditional lecture	6
Some are better while others are not	32
I wish all my lectures were given in this way	21



The response on this question by 20% of the respondents was negative. These respondents think that a lecture given with the aid of a data projector is the same (6%) or not as good as a traditional lecture (14%).

A group (32%) felt that it can be better while a group of 48% think that using a data projector is a better way of presenting a lecture than the traditional way.

□ **Practicals – Why do learners not attend or leave practicals?**

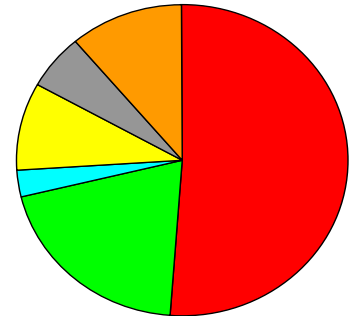
This question tries to determine if the availability of multimedia had something to do with the fact that some learners did not attend practicals.

Question

If you **DID NOT ATTEND** or **LEFT** any practicals please give your **MAIN** reason.

Response**Table 4.18: Reason for not attending or leaving practicals**

Reason for not attending or leaving the practical	%
I watch the video	51
I study the multimedia computer presentations	20
The practicals are not necessary	3
I have difficulties with the microscope	9
I rather spend the time on gross anatomy	6
Personal reasons	11



77 (40%) of the 194 respondents answered one or more of the questions in this section thereby indicating that they did not attend or left the practicals before the end. Out of 77 learners, 33 (17%) did not attend any practicals while 44 (23%) attended some practicals. The majority of these learners that did not attend all the practicals (39 - 20% of the 194) felt that watching the video provides them with sufficient knowledge for the practical histology test. A smaller group (15 - 8% of 194) indicated that they used the multimedia programs instead of attending the histology practicals. A small group of learners gave other reasons such as personal reasons, problems with the microscope, practicals are not necessary and that they would rather put a bigger effort into the other subsections, for not attending the practicals.

◇ Self learning

These results report on learning that the learner does on his own utilizing books, videos, internet and computer presentations.

□ Prescribed book – To what extent is the prescribed book used?

It was noticed during practicals that few learners have the prescribed histology book.

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The learner's opinions on the use of the prescribed handbook are tested by means of this question.

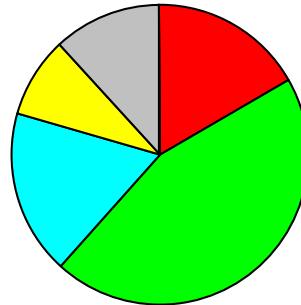
Question

Which ONE of the following is true with regard to the prescribed histology book?

Response

Table 4.19: Use of the prescribed book

Use of the prescribed book	%
I have not read the book	17
Looked up a few things	45
Studied from it	18
Started but gave up	9
Too complicated	12



Only 18% of learners indicated that they studied from the prescribed histology text book. The majority of learners 45% used the book for reference, 12% found the book too complicated and 9% started to use the book but gave up. 17% of learners did not use the book at all. Eight respondents did not answer this question.

Internet – To what extent is the internet used?

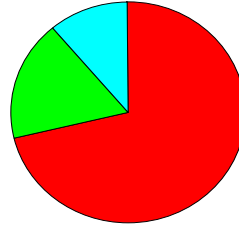
The information gathered from this response will give an indication of the facilities at MEDUNSA and give some indication of the financial status of the learners because internet access is costly. It will also indicate whether learners try to find additional information on the subject.

Question

Do you have access to the internet?

Response**Table 4.20: Internet access**

Internet access	%
No access	71
Yes at MEDUNSA	18
Yes at home	11



Only 57 (29%) respondents out of a total of 194 had internet access. MEDUNSA made internet available to 35 of these 57 learners (18%) while 22 have internet at home (11%). Of these 22 learners 13 have access to the internet via a friend's computer. Only three learners had internet access from more than one source.

Question

Did you look and find histology on the internet?

Response

Of the 36 learners who looked for histology websites ten found websites that were similar to the programs available to them while seven found websites that were better than the presentations that were available to them.

Multimedia computer presentations

These results report on the various aspects of the multimedia programs that were used.

Use

The questions under this heading will determine the value of the multimedia computer presentations.

◆ To what extent were the computer presentations used?

The responses should show whether the learners regarded the multimedia computer presentations as worth using.

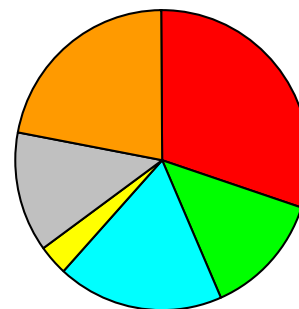
Question

Did you use the multimedia material that was available?

Response

Table 4.21: Use of the multimedia computer presentations

Use of the multimedia computer presentations	%
Did not use it	30
Used some of it during Block 1	13
Used some of it during Block 2	18
Used only the multimedia for Block 1	3
Used only the multimedia for Block 2	13
Used it all	22



Only 22% (39) of the respondents used all the multimedia programs that were available. 30% (53 respondents) of the respondents did not use any of it. The rest used the presentations to some extent.

◆ Why were the computer presentations not used?

This question should determine whether learners did not use the multimedia computer presentations because of shortcomings in the programs or lack of facilities.

Question

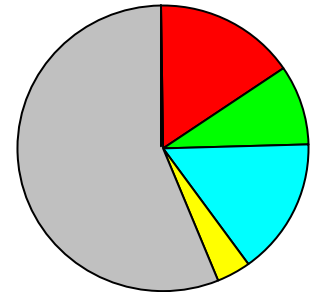
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I did not make use of the multimedia programs available because:

Response

Table 4.22: Reasons for not using the multimedia computer presentations

Why didn't you use the multimedia computer presentations	%
Do not know about computers	16
Did not know about the programs	9
Did not have time	15
Looked at it but decided it was not worth it (do not need it)	4
The computers were always occupied	57



The most common reason amongst the respondents that answered this question for not using the multimedia computer presentations was because the computers were always occupied (57%). Another 16% did not use the programs because they are not familiar with computers. 15% said that they did not have time to use the presentations while 9% claimed not to have known about the programs. 4% said that they have looked at the programs but decided it was not worth it.

◆ Why did learners only use some of the computer presentations?

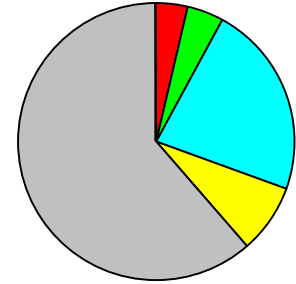
This question should determine why learners may have quitted using the multimedia computer presentations.

Question

I used some of the multimedia programs available because:

Response**Table 4.23: Reasons for not using all the multimedia computer presentations**

I only used some of the multimedia computer presentations	%
I struggled with the computer	4
The computer programs were too difficult to use	4
Some of the programs were good and others were not good	23
I decided it was not worth it (do not need it) after I started to use it	8
The computers were always occupied	62



The most popular reason (62%) for only using some of the multimedia computer presentations is that the computers were always occupied. A number of respondents (8%) decided after using it that the presentations were not worth it while 23% of respondents felt that some of the programs were not good enough. Only 4% felt that the programs were too difficult whereas 4% struggled with the computer. 116 of the respondents did not answer this question.

◆ How much time did learners spend using the computer presentations?

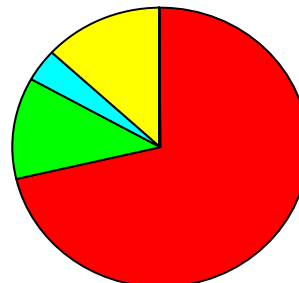
The number of learners using the multimedia computer presentations as well as the time spent by the learners using the programs can be linked to the success of the presentations.

Question

How much time did you spend on the histology multimedia?

Response**Table 4.24: Time spend using multimedia computer presentations**

How much time did you spend on the histology multimedia?	%
2 – 4 hours	71
4 – 6 hours	12
6 – 8 hours	4
More than 8 hours	13



The majority of learners (71%) (41% of the total number of respondents) chose the minimum time option of 2-4 hours. 11% spent 4-6 hours, 3% spent 6-8 hours using the multimedia and 13% spent more than 8 hours on the multimedia. Of the 194 respondents 82 did not respond to this question.

◆ Were the presentations enjoyable to use?

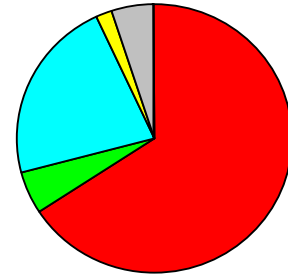
If histology is not popular, study material that is enjoyable to use may improve popularity of the subject.

Question

Are the programs enjoyable to use?

Response**Table 4.25: Enjoyment of using multimedia computer presentations**

Are the programs enjoyable to use?	%
Yes	65
No, I prefer to read the notes	5
No, I prefer to watch the video	22
No, I prefer to read the prescribed book	2
No, but it is better than reading the notes	5



65% of the learners regarded the multimedia programs as enjoyable to use while 22% prefer watching the video. Reading the notes or the prescribed book was chosen by 5% and 2% respectively. 5% said that the programs are not enjoyable to use but better than reading the notes. 27 of the respondents did not answer this question.

◆ Did learners spend more time on histology because of the presentations?

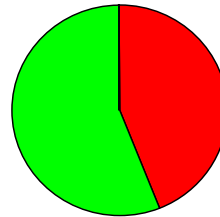
This question links to the previous question because if the multimedia computer presentations were enjoyable to use learners should spend more time using the programs.

Question

Did you spend more time on histology than you would have if computer programs were not available?

Response**Table 4.26: Time spent on histology because of the multimedia computer presentations**

Did you spend more time on histology than you would have if computer programs were not available?	%
No	44
Yes	56



36 of the 194 respondents did not answer this question. 56% of the learners that answered the question said that the programs made them spend more time on histology than they would have without the programs. For 44% of the respondents the availability of the multimedia computer presentations did not make a difference to the time that they spent on histology.

◆ Did learners help one another with the presentations?

Collaborative learning is desired, this question tests whether there was collaboration between learners while using the multimedia computer presentations.

Questions

Was it difficult to get help when you had a problem with the program?

Could your fellow learners help you with a problem?

Did you help some other learner with a problem?

Response**Table 4.27: Collaboration between computer users**

Help was readily available	70
Help was difficult to get	30
Sometimes obtained help from a fellow learner	73
Always obtained help from a fellow learner	21
Helped somebody else a couple of times	51
Helped somebody else once	21
Never helped anyone	27

Three questions were asked to determine whether learners helped one another with problems. 70% said that help was readily available when encountering a problem while 30% said that help was difficult to get. 73% of users sometimes and 21% always obtained help from a fellow user while 51% of respondents helped somebody else a couple of times and 21% helped somebody else once. 27% never helped anyone.

■ Evaluation – What as the interface like?

The questions under this topic are listed under “Question” in the table below. The percentages indicated comprise those respondents that answered the questions.

Table 4.28: Questions and responses on aspects of the interface

Question	Always %	Sometimes %	No %	Did not answer
Acceptability of colours	87		9	73
Acceptability of font type and size	94		6	74
Text readable and easy to follow	66	32	2	73
Pictures and text well laid out	70	29	1	75
Pictures used effectively	78	22	1	74
Is the program easy to use	92		8	76
Instructions clear and easy	72	28		75
Is the navigation easy	79	20	1	79

Questions concerning the interface were grouped together in a table 4.28. On the whole the response to these questions was good, with 73 to 79 respondents who did not answer the questions.

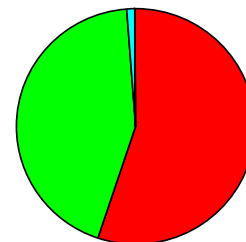
Question

Were there many errors in the programs that you could identify?

Response

Table 4.29: Errors in the multimedia computer presentations

Errors in the programs	%
No errors	55
Few errors	44
Many errors	1



As far as errors in the multimedia computer presentations were concerned 55% of users found no errors while 44% found a few and 1% found many.

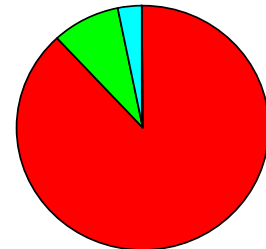
Question

Does using the program get easier as you use the program more and more?

Response

Table 4.30: Ease of use of the multimedia computer presentations

Does using the program get easier as you use the program more and more?	%
Yes, it gets easier	89
No, it is clear from the beginning	9
No, it is still complicated after having used it a couple of times	3



The response to this question consisted of 89% respondents saying yes, while 9% said that it was easy from the start. Only 3% mentioned that the programs were complicated and remained complicated even after regular use. 78 respondents did not answer this question.

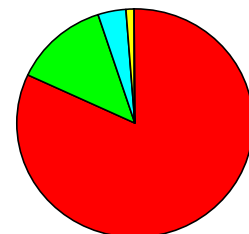
Question

Is the use of speech helpful/necessary?

Response

Table 4.31: Multimedia computer presentations and vocal explanations

Is the use of speech helpful/necessary?	%
Speech is very important in the program	82%
Speech helps but is not that important	13%
I seldom used the sound	4%
Sound is not important and is unnecessary	1%



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The vocal explanations that could be selected were regarded by 82% of respondents as a very important part of the programs. 13% said that it helps but is not that important, 4% said that they seldom used the oral explanations while 1% said it is not a necessary part of the programs. 76 of the respondents did not answer this question.

Question

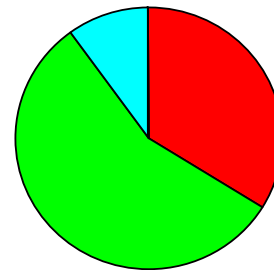
Is the work well explained and is the work systematically explained?

Response

The two questions received the following responses:

Table 4.32: Explanations in the multimedia computer presentations

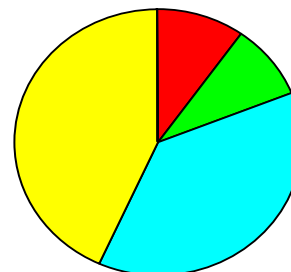
Well explained	%
Always	34
Most of the times	56
Only a few topics are well explained	10
No topic is well explained	0



76 respondents did not answer this question.

Table 4.33: Systematic explanations in the multimedia computer presentations

Systematically explained	%
The sequence is mixed up in all cases	10
The sequence is mixed up in some cases	9
The sequence is not bad but could be improved	37
The sequence is correct	43



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78 respondents did not answer this question.

34% of respondents experienced the work as always well explained and 43% experienced the work as systematically explained. 56% of learners that used the programs think that the work is well explained most of the time and 37 % think that the sequence could be improved. Some learners (10%) think that only a few topics are well explained while no learners think that no topics are well explained. 9% of the users experienced the sequence of some programs as mixed up while 10% think that all sequences in the programs are mixed up.

■ **Technical aspects – Were there navigational errors and technical problems?**

To test all the hyperlinks and technical aspects of programs like this is very time consuming and would delay the implementation of the programs. It is easier to implement the programs and to correct errors as they are discovered by the users.

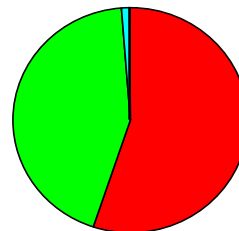
Question

Were there navigational errors in the programs that you can identify?

Response

Table 4.34: Navigational errors in the multimedia computer presentations

Navigational errors	%
No errors	55
Few errors	44
Many errors	1



Navigational errors were experienced by 40% (1% experienced many and 39% a few navigational errors). 60% did not find any navigational errors.

Question

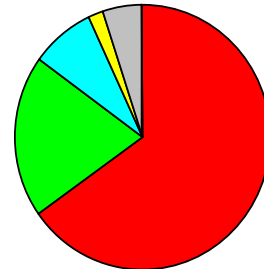
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Were there many technical problems when you used the programs?

Response

Table 4.35: Technical errors in the multimedia computer presentations

Were there technical errors in the programs?	%
No	65
Program wouldn't run	20
Sometimes a red cross was displayed.	8
The computer often crashed	2
The CD drive wouldn't read the CD.	5



Technical errors had no effect on 65% of the users, while 20% experienced a program that would not run, 8% sometimes came across a red cross displayed on the screen, 2% experienced computers that crashed and 5% of cases the CD drive would not read the CD.

■ Value

The following questions were asked to determine whether the learners see the multimedia computer presentations as a valuable asset in the learning process.

◆ Do learners feel presentations improved recollection?

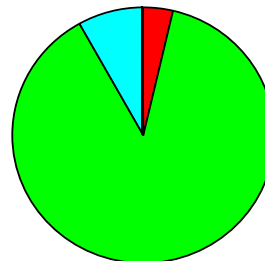
If learners have a perception that multimedia computer presentations improve their recollection it will be a big motivational factor to use the presentations.

Question

Do the programs make it easier to remember the work? (Is your recollection better?)

Response**Table 4.36: Multimedia computer presentations and recollection**

Did the multimedia computer presentations improve your recollection	%
No	4
Yes	88
There is no difference	8



Only 23 respondents did not answer this question. Of the respondents who answered this question 88% agreed that computer presentations improve recollection (88%). Only 8% said there is no difference while 4% indicated that their recollection is not better.

◆ Does the learner feel that his marks improved because of the presentations?

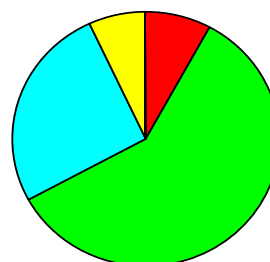
This question links to the previous question because if recollection improves marks should also improve.

Question

Did you do better in the topics where programs are available?

Response**Table 4.37: Multimedia computer presentations and marks obtained**

Did you do better in the topics where programs are available?	%
No	8
Yes	59
Some are better and others not	26
There is no difference	7



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Only 29 of the respondents did not answer this question. Of the respondents that did answer this question, most (59%) think that they did better in the topics where multimedia programs were available, while 26% think that they did better in some of the topics where multimedia programs were available. This means that 85% of the respondents felt that the multimedia programs influenced their performance positively. Only 8% think that they did not do better in the topics where multimedia programs were available while 7% think that the multimedia programs did not make a difference.

♦ **Is a computer presentation better than a lecture?**

The answer to this question depends on whether the multimedia computer presentations could convince the learners that they can acquire all the necessary knowledge by using the presentations.

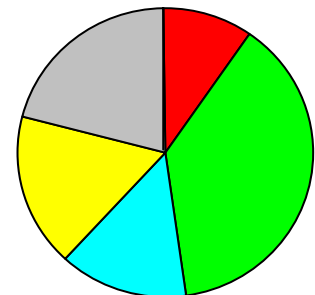
Question

A multimedia session done on a computer is better than a traditional lecture.

Response

Table 4.38: Multimedia computer presentation versus a lecture

A multimedia computer presentation is better than a traditional lecture.	%
No	10
Depends on the lecture	37
Depends on the computer presentation	14
A good computer presentation is better than any lecture	17
A computer presentation is for revision	21



The highest response (47%) here came from the group that feels a good lecture can be

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better than any computer presentation. 21% of the respondents feel that a computer presentation is for revision while 31% (17%+14%) feel that a good computer presentation is better than any lecture. 10% of respondents prefer a traditional lecture to a computer presentation. 28 of the respondents did not answer this question.

◆ Did presentations change the learner's attitude towards the subject?

If the claim that learners do not like histology is true this question will indicate whether there is a chance that multimedia computer presentations can change the negative feeling towards histology.

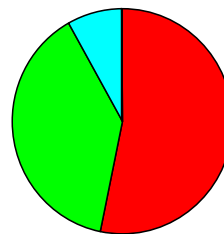
Question

Did the programs change your attitude (rating of) towards histology? Did it make you enjoy histology more?

Response

Table 4.39: Multimedia computer presentations and attitude

Did the programs change you attitude towards histology?	%
Yes, a little	53
Yes, a lot	39
No	8



Although histology was not the most popular of anatomy's subsections the ratings for histology was an improvement on the ratings before the study because when asked whether the multimedia programs influenced their attitude (rating) of histology, 92% of the respondents that answered the question replied with a yes of which 53% said a little and 39% said a lot.

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Of the respondents 8% were not influenced by the multimedia computer presentations at all in their attitude towards histology. 36 respondents did not answer this question.

□ Video

The questions under this heading enquire about the use and facilities for viewing the video.

◆ How many times did learners watch the video?

The response to this question will be compared with the marks obtained in the practical tests.

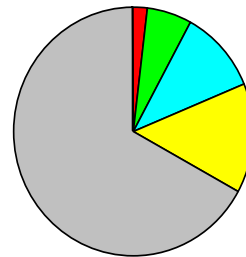
Question

How many times did you watch the video?

Response

Table 4.40: Number of times learners watched the video

How many times did you watch the video?	%
Once	2
Twice	6
Three times	11
Four times	14
More than four times	67



The majority of learners (67%) indicated that they watched the video more than four times. Only 2% of respondents watched the video only once while 6% watched it twice. 25% of respondents watched the video three or four times. Only four respondents did not answer this question.

□ What problems were encountered?

The results from this question will report on the facilities for viewing videos.

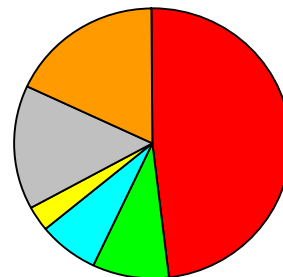
Question

When you watched the video in the library the following applied:

Response

Table 4.41: Video in the library

When you watched the video in the library the following applied:	%
I had problems finding a booking	48
I could easily find a booking	9
The video machines are always in working order	7
The video machines are not always in working order	3
The quality of the video is satisfactory	15
The quality of the video is not always good	18



The main frustration for learners that used the facilities in the library was getting a booking in the library (57%). For a number of respondents (18%) the video quality was a concern while for 15% the video quality was satisfactory. 75 out of 194 respondents did not answer this question. The learners that used their own video facilities are most likely the ones that did not answer this question.

◇ Favourite ways of studying

This question compares the traditional ways of studying with the use of new technology in learning.

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Question

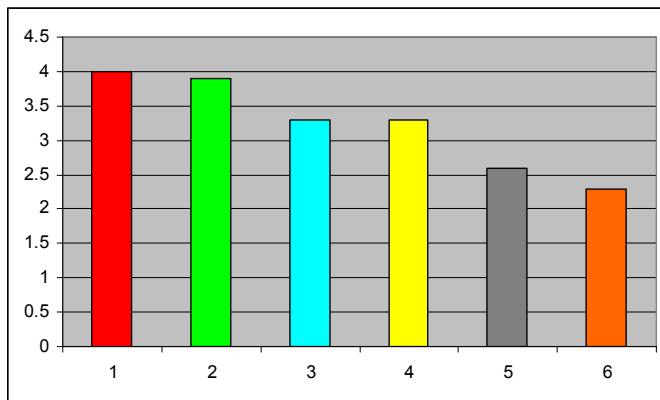
Rate the following from 1 to 6 in terms of your preferred methods of studying histology.

Response

Table 4.42: Favourite ways of studying

Method of studying	% First choice	Average rating	Frequency missing
Video	32	2,3	4
Attending lectures	16	2,6	11
Computer Multimedia	21	3,3	10
Notes	16	3,3	16
Practicals	6	3,9	12
Prescribed book	10	4,0	13

Average rating



The average rating calculation method was also applied to the results from this question. The responses of the learners indicated that the most popular way of studying histology is by watching the histology video. The second most popular choice of study method is attending lectures, while reading the histology notes and using the multimedia computer presentations are rated the third most popular way of studying histology. The fourth most popular way of studying histology is attending the histology practicals while reading the

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histology prescribed book is the least popular way of learning histology. The multimedia computer presentations was the second most popular first choice for studying histology but also the second most popular sixth choice.

◇ How would learners like their course?

The following questions request input from the learners as to how a future course should be presented.

◆ Can multimedia replace the traditional course?

This question tests the experiences the learners had with multimedia and whether they feel multimedia can replace the teaching done in the traditional way.

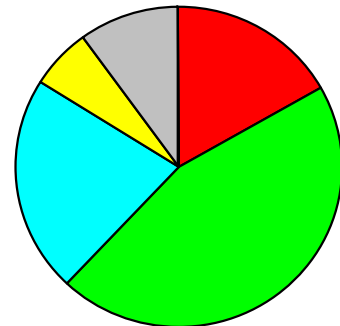
Question

What is your considered opinion on the histology course and the availability offerings of a multimedia environment?

Response

Table 4.43: Replacing the traditional histology course with a multimedia course

Should a multimedia course replace the histology course	%
Replace it completely	17
Lectures and practicals should support a multimedia course	45
Lectures should support a multimedia course	22
Practicals should support a multimedia course	6
Multimedia should only be additional for the ones interested	10



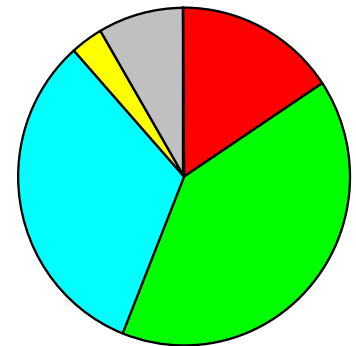
The majority of learners (45%) feel that histology multimedia should be supported by

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practicals and lectures. 22% would like histology multimedia to be supported by lectures and only 6% feel that multimedia should be supported by practicals. A group of 17% feel that histology can be changed into a multimedia course while 10% feel it should only be available to the ones interested. 28 respondents did not have an opinion on this issue.

Table 4.44: Response of learners that had used all the multimedia programs

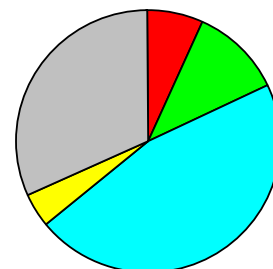
Should a multimedia course replace the histology course	/39	%
Replace it completely	6	15
Lectures and practicals should support a multimedia course	15	38
Lectures should support a multimedia course	12	31
Practicals should support a multimedia course	1	3
Multimedia should only be additional for the ones interested	3	8



The opinion of the 39 learners that used all the multimedia programs should therefore carry more weight. Their responses are however similar to the overall response. Only six (15% - 17% for the whole group) of the learners that used all the multimedia are of the opinion that multimedia can replace the histology course. The overwhelming opinion of this group is that multimedia should be supported by lectures and practicals (15 respondents out of the 39 = 38%, 45% in the whole group). The learners that want multimedia to be supported by only lectures are 12 (31%, 22% in the whole group). Only one of this group felt that the multimedia should be supported by practicals and three felt that multimedia should be additional only for the ones interested.

Table 4.45: Other responses of the learners that want the histology course to be replaced by a multimedia course

Multimedia should replace the histology course	/28	%
Did not reply on the use of multimedia	2	7
Did not use the programs at all	3	11
Started using the programs during block 2	13	46
Stopped using the multimedia after block 1	1	4
Used all the multimedia	9	32



What was the exposure of the learners that are in favour of replacing the histology course with a multimedia course? There were 28 respondents that indicated that they want a multimedia course to replace the traditional histology course completely. Of these 28 learners two did not answer the question on the use of the multimedia course while three did not use the programs at all. Most of these learners started using the programs during block two (13) while only one stopped using the programs after block one. Nine learners used the all the programs.

◇ Do learners think multimedia can replace the microscope?

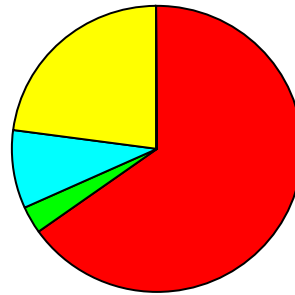
Many learners have already abandoned the microscope. The answer to this question should indicate if the general feeling is that the microscope has become obsolete.

Question

Is the multimedia on a computer better than using a microscope?

Response**Table 4.46: Multimedia computer presentations versus the microscope**

Is the multimedia on a computer better than using a microscope?	%
Much better	65
Not better	3
The same	9
The computer can completely replace the microscope	23



Of the respondents 87% felt that looking at histology slides on a computer screen is much better than looking at slides under a microscope. Only 3% felt that it is better to look at slides under the microscope and 9% felt that there is no difference. 22 respondents had no opinion on this question.

◇ Do learners prefer computer presentations or video?

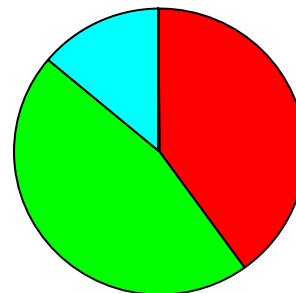
One would hope that the learners would choose the interactive computer presentations above the video that requires no effort but from the literature we know that learners choose the medium that requires the least effort (Heidger et al, 2002).

Question

Do you prefer a video to an interactive computer presentation?

Response**Table 4.47: The video versus the multimedia computer presentations**

Do you prefer a video to an interactive computer presentation?	%
Yes, I would prefer to use videos as an additional way of studying histology	40
I would like to watch the histology video in addition to computer presentations	46
Videos are not necessary when you have interactive computer presentations	14



The highest number of respondents (46%) would prefer to have computer presentations and videos available while 40% prefer videos to computer presentations. 14% feel that videos are no longer necessary if they have computer presentations available. 19 respondents did not answer this question.

❖ Tests – Is effort rewarded?

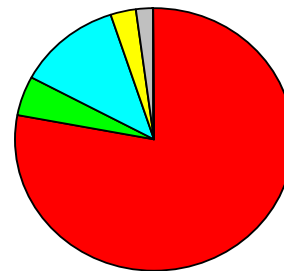
In a subject where subsections compete for the learner's study time, the answer to this question will indicate whether learners spend the necessary time studying histology.

Question

If I put in a big effort into practical histology:

Response**Table 4.48: Reward for effort in practical histology**

If I put in a big effort into practical histology:	%
I will do well	77
I may still fail	5
I will only get an average mark	12
I rather put in a big effort into the histology theory	3
I rather spend the time on gross or embryology	2



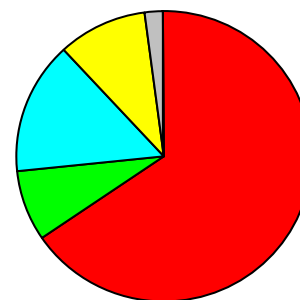
The perception of 77% of the learners is that a big effort in practical histology will result in good marks. Only 12% think that after a big effort you may only get an average mark, 5% think that you may still fail, 3% would rather spend time on histology theory and 2% would rather study gross anatomy instead of practical histology. Eight respondents did not answer this question.

Question

If I put a big effort into the theory of histology:

Response**Table 4.49: Reward for effort in the theory of histology**

If I put in a big effort into the theory of histology:	%
I will do well	66
I may still fail	8
I will only get an average mark	15
I rather put in a big effort into the practical histology	10
I rather spend the time on gross or embryology	2



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The learners (66%) felt that big effort in histology theory is rewarded with high marks. 15% felt that that this effort will only result in an average mark. 10% think that it is better to rather put an effort into studying practical histology than theory, 7% think that one can still fail in spite of a big effort in studying histology theory while 2% think it is better to spend the time studying another subsection of anatomy. 16 of the respondents did not answer this question.

4.1.1.2 Records

From the 194 respondents that answered the questionnaire 53 wanted to remain anonymous and did not fill in their identification (anatomy) number. Of the 141 respondents with whom the questionnaire could be linked to an individual only 75 had complete records (except for two for which we could not trace the SRS ratings). It was therefore decided to use only these 75 learners for the purpose of calculating averages and relating answers in the questionnaire to marks obtained in the different tests. Of these 75 learners, only six were dental (BDS II) learners and the rest were MBChB II learners. The parts of the courses that were used for this study were exactly the same for the two courses at the time of the study. The respondents from the two courses were therefore treated as one group.

➤ Tests results

The following table contains the test results obtained during the two tests that were written at the end of the two blocks that were included in this study. On the left are the particulars of the tests and concomitant marks and on the right the class average appears.

Table 4.50: Test averages

The test	Average %
Written histology /60 (multimedia computer presentations available)	38
Written histology /30 (multimedia computer presentations not available)	34
Practical histology /55 (multimedia computer presentations available)	48
Practical histology /25 (multimedia computer presentations not available)	56
Written – gross anatomy /210	63
Practical – gross anatomy /220	55

➤ Criteria for selecting learners

The different selection criteria that are used to select the learners for the medical and dental courses at MEDUNSA are given here.

❖ SRS

The SRS ratings of the different learners that were accepted into the medical and dental courses are provided here.

Result

Of the group of 75 learners three learners are from foreign countries and the SRS rating of two learners could not be traced.

The highest SRS rating is 16 which signals distinctions in mathematics and science. The lowest SRS rating with which a learner was selected for the course without additional credits is nine meaning a D for the one subject and an E for the other one. Learners with

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lower SRS ratings were also selected but they had to have additional credits. The average SRS rating is 10.

Result**Table 4.51: SRS points of learners**

SRS Rating	Number of learners with this rating	Number of learners with this rating without additional credits	Number of learners with this rating with additional credits
16	5	3	2
15	1	1	-
14	3	3	-
13	9	8	1
12	7	5	2
11	8	8	-
10	12	10	2
9	8	5	3
8	2	-	2
7	4	-	4
6	3	-	3
5	3	-	3
4	1	-	1
3	1	-	1
2	2	-	2
Averages	Total learners	From school	With additional credits
	10,48	10,16	8,5

❖ Additional credits

Courses or degrees passed or obtained from other institutions were also taken into account when selecting the candidates for the MBChB and BDS course.

Result

A field stating whether a learner has additional credits or not, was added to the data base. A value could not be given to the credits acquired because these credits are often subjectively awarded by the dean. A number of learners are foreign so they do not comply exactly with the requirements.

4.1.1.3 Relationships between responses and records

The statistical analyses done on the relationships between the responses from the questionnaire, the marks acquired in the tests and the information on selection that we have are discussed in this section.

❖ Statistical analysis

The following results were obtained from the comparisons that were analysed.

To determine whether there is a significant difference between the following groups of information the chi-square (X^2) test was used.

Babbie (1992) defines the chi-square (X^2) test as a frequently used test of significance. It is based on the null hypothesis which is the assumption that there is no relationship between the two variables in the total population.

The null hypothesis is not rejected at a 5% level of significance if $p < .05$. This means that there is no relationship between the two sets of values.

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The following comparisons were made:

- **SRS ratings correlated with the total histology mark.**

If the learners with high SRS ratings do better in histology than the learners with low SRS ratings it would mean that the null hypothesis is rejected at a 5% level of significance.

Result

Because $p=0,225418$ which is $>.05$ the null hypothesis is not rejected at a 5% level of significance which means that there is no significant relationship between the two sets of values, the SRS rating and the marks in anatomy.

- **Learners with additional credits compared to the rest of the learners.**

If learners with additional credits do better in histology than the learners without additional credits it would mean that the null hypothesis is rejected at a 5% level of significance.

If the null hypothesis is rejected at a 5% level of significance it would mean that more experienced learners with other previously obtained qualifications did better in the histology tests than a learner with no other academic qualifications.

Result

Because $P=0,8163$ which is $>.05$ the null hypothesis is not rejected at a 5% level of significance which means that there is no significant relationship between the marks of the learners with additional credits and the marks of the learners without additional credits.

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- **To determine whether the multimedia computer presentations resulted in higher marks for the users and lower marks for the non-users, the following three sets of marks were compared.**
 - Used none of the multimedia computer presentations
 - Used some of the multimedia computer presentations
 - Used all the multimedia computer presentations

If learners that used the multimedia computer presentations did better in the histology tests than the ones not using the presentations it would mean a rejection of the null hypothesis at a 5% level of significance.

The gross anatomy marks were used as a co-variant. This was done to prevent that the marks of learners who do well in all the anatomy subsections influence the comparison.

If the motivated hard working learners that usually do well were the ones using the multimedia and their marks were compared with the other learners it would give the false impression that it was the multimedia that was the reason for their high marks.

Result

The gross anatomy marks were used as a co-variant. Because $p=0,0797$ which is $>.05$ the null hypothesis is not rejected at a 5% level of significance which means that there is no significant relationship between the three groups of values. This means that the multimedia computer presentations did not influence the marks. Users of the programs did not have an advantage over the non-users.

- **The number of times a learner watched the histology video compared to the practical histology mark.**

If the number of times a learner watched the video is directly related to the practical histology mark that he/she gets, the null hypothesis is rejected at a 5% level of significance.

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The responses were divided into two groups.

Learners that watched the video one to four times

Learners that watched the video more than four times.

Result

When the marks of the two groups were compared and the gross anatomy mark was used as a co-variant a p value of 0.1264 was obtained. Because $p < .05$ the null hypothesis is not rejected at a 5% level of significance which means that there is no significant difference between the marks obtained in the practical test by learners that watched the video one to four times and the learners that watched the video more than four times. This means that watching the video more than four times will not result in a better mark.

- **The histology marks obtained by the learners that indicated histology as their favourite subject compared to their gross anatomy marks.**

If learners that favour histology do better in histology than the ones that do not like histology it would mean that the null hypothesis is rejection at a 5% level of significance.

Result

When the histology marks obtained by the learners that indicated histology as their favourite subject were compared with the marks of the other learners, with the gross anatomy mark as a co-variant a p value of 0.9692 was obtained. This value means that the null hypothesis is not rejected at a 5% level of significance which means that the learners who favours histology did not do better in histology than the learners that prefer the other subsections of anatomy.

- **Practical marks obtained by learners that did not attend the practicals.**

The marks of the learners that never attended a histology practical were traced to see whether learners could pass the histology practical test without doing practical histology, by relying on alternative study methods.

Result

16% (33 out of 194) of the respondents indicated that they never attended a histology practical. The marks for the practical part of histology of 10 of these learners could be traced back. Five of these learners passed the practical test but only one out of the ten passed the histology theory test.

4.1.2 Learner profiles

The responses from questions were used to put together the profile of the average MEDUNSA learner.

Subject preferences of the average MEDUNSA learner

- Prefers gross anatomy and does not like histology.

Study preferences of the average MEDUNSA learner

- Prefers to study histology by watching a histology video;
- Does not like to study from the prescribed histology book;
- Interacts with his/her fellow learners when using multimedia computer presentations;
- Believes that hard work in histology will be rewarded in the tests.

The average MEDUNSA learner and the internet

- Does not have access to the internet;
- Is not interested in histology on the internet.

The average MEDUNSA learner and lectures

- Has left lectures before the end;
- Has problems concentrating during lectures;
- Thinks histology lectures can be missed but not gross anatomy lectures;
- Attends lectures so that difficult concepts can be cleared up;

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- Likes lectures to be given with the aid of a data projector but does not think that lectures given in the traditional way are worse;
- Is satisfied with the quality of the histology lectures.

The average MEDUNSA learner and practicals

- Attended all the practicals.

How the average MEDUNSA learner would like his course

- Wants self study to be part of the histology course ;
- Wants a course where lectures are supported by multimedia computer presentations, videos and practicals.

The average MEDUNSA learner's financial situation.

- Cannot afford to buy his or her own computer;
- Has access to a video machine at home;
- Used a MEDUNSA computer.

The average MEDUNSA learner and multimedia

- Has the perception that multimedia computer presentations improves: his/her recollection and marks;
- Multimedia changed his/her perception of histology;
- Found the multimedia enjoyable to use;
- Spent more time on histology than he or she would have because of the multimedia programs;
- Watched the video more than four times;
- Prefers to look at tissues on a computer screen rather than under a microscope.

Academic background

- Has a SRS rating of ten (D in science and a D in Mathematics).

CHAPTER 5

DISCUSSION AND RECOMMENDATIONS

The following table gives an outline of the contents of this chapter. The table is divided into four columns. The first column contains the 5 main topics that are discussed in this chapter namely the development, the research, the recommendations, the conclusion and suggestions for further study. The second column contains two subheadings under development – multimedia and tests. Under multimedia the advantages and disadvantages for the lecturer, how to deliver, design and implement multimedia are discussed. Under research the instruments, that is questionnaire and records and relationships are discussed as well as the profiles of a learners. The discussion of the questionnaire is divided into development and distribution and a discussion of the responses of the learners.

Table 5.1: Layout of Chapter 5

Development (From the developer's perspective)	Multimedia	What are the advantages for the lecturer?	
		What are the disadvantages for the lecturer?	
		How to deliver multimedia	
		Designing multimedia	
		How to implement multimedia	
	Tests		
Research	Instruments	Questionnaire	Development and distribution
			Discussion of the responses of the questionnaire
	Records and Relationships		
	Learner profiles		
Recommendations			
Conclusion - How should histology be presented in future?			
Suggestions for further research			

5.1 Development (from the developer's perspective)

This section will discuss development from the developer's perspective.

5.1.1 Multimedia

The lessons learned during development will be discussed here.

5.1.1.1 What are the advantages for the lecturer?

The multimedia that was developed for this study succeeded in making the task of the lecturer easier in the following ways:

- Relieved the lecturers from some of their earlier duties like presenting revision practicals;
- Relieved lecturers from learners that have missed lectures or practicals that want to borrow transparencies or notes to catch up;
- Provided learners with an alternative way to solve problems without having to ask the lecturer;
- Provided the lecturer with a presentation that can be used for lecturing purposes.

The multimedia helped to alleviate some of the tasks of the lecturer. New developments and improved features of the multimedia will bring about different duties and responsibilities for the lecturer in future.

5.1.1.2 What are the disadvantages for the lecturer?

From a lecturer's perspective the multimedia that was developed for this study failed in that it did not provide lecturers with feedback of learner's progress.

The multimedia is not yet at a stage of development where a learner can rely solely on the multimedia for acquiring the necessary knowledge of histology. Some further developments will have to be implemented to assure that learners do not fall behind without the lecturers realizing it.

5.1.1.3 How to deliver multimedia?

The multimedia in this study was delivered in the form of a video and in the form of multimedia computer presentations.

This study demonstrated that a successful video can be made by making a standalone *PowerPoint* presentation and video taping it. One of the limitations of a video is that the standard video tape only allows for a three hour video. The quality of the video that was available to the learners was not very good. This was due to the fact that there was no computer available from which to tape first generation videos. A master copy had to be made from which second generation copies were made.

The sound quality of the video was not good due to a lack of proper recording facilities and lack of a professional presenter. The sound files that were made for the presentations and the video are recordings made with the *Windows* sound recorder. The sound file is a vocal explanation of the different features of the tissue in the slide. No script was written for the sound files. This often resulted in many retakes before a satisfactory result could be obtained.

PowerPoint is a program that is usually used for presentations. This study showed that *PowerPoint* can be used as an authoring tool for developing standalone programs for CBL.

During this study the following advantages of *PowerPoint* as a program to develop multimedia in were experienced:

- User advantages
 - *PowerPoint* is a widely used program and although *PowerPoint* has to be installed on a computer before a presentation will run on that computer a reader can be downloaded for free and supplied with a presentation;

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- No installing of a presentation is required;
- Programs can be copied from the CD to the hard drive to make running the program easier and faster;
- *PowerPoint* adapts to the size of the screen.

- Editing advantages
 - It is an ideal program to develop standalone presentations for video taping;
 - Animations can be made by changing subsequent screens;
 - Menus with hyperlinks can be created;
 - *Web CT* provides a compressing feature that makes the file sizes of *PowerPoint* presentations small enough so that the presentations can be run from a website;
 - Easy to adapt and to change;
 - Easy to transfer slides, images or text from one presentation into another one.

A number of features that are available in other authoring programs are not available in *PowerPoint*.

The following are disadvantages of *PowerPoint* as an authoring program for multimedia that were experienced during development:

- Lacks some of the tools that the more advanced authoring programs have; (e.g. more control over the hiding and displaying of objects and to be able to calculate marks for a test).
- Incorporating sound files into the multimedia file which makes the file bulky;
- Screen tips can be made but the screen tip text box cannot be formatted;
- No pull down or pop up menus are available in *PowerPoint*;

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- Testing options are limited to a hyperlink that links to a slide that indicates right or wrong with feedback, no total test score can be calculated.

5.1.1.4 Designing multimedia

When designing multimedia there are many different options available to the developer. A design is never really right or wrong, some designs are just better than others. A lot of thinking must go into the initial planning stages of a project like this. An interface must be developed and the designer must then stay with that interface. To try and change the interface halfway through the project is almost impossible. Other people, peers and learners must be consulted before a final decision on an interface is made.

5.1.1.5 How to implement multimedia

Once a project like this is started it is important to implement the first program as soon as possible, so that any major error in the design or the program can be discovered and corrected before the rest of the development is done.

When there are multiple links in a program it is almost impossible for the developer to test all the links because this will take hours of time. An easier option is to make the programs available and to ask users to report any links that do not work.

5.1.2 Tests

The way of testing that was available to us was not the way we would have chosen if at all possible but we were limited by the facilities available. A computer centre will provide more options for testing learners. A problem in the histology curriculum is that practical histology and theoretical histology are almost treated as two separate subjects since there are different tests for the theory and the practical part of histology.

5.2 Research

Under this topic the instruments used for the research and the profiles of a typical MEDUNSA learner will be discussed.

5.2.1 Instruments

The two instruments namely the questionnaire and the records and relationships will be discussed here.

5.2.1.1 Questionnaire

The development of the questionnaire as well as the responses received by the respondents will be discussed here.

➤ Development and distribution

Putting together a questionnaire is a cumbersome process. Errors, questions that should have been asked or ambiguity is often discovered when the results are being processed. When it is a once off questionnaire this can have an influence on the results.

In this study the questionnaire was handed out to the learners that were present at the last lecture of the second of four blocks. Because attending lectures is not compulsory not all the learners were present when the questionnaire was handed out. Just more than half of the learners were in class on that particular day and were included in the study.

➤ Discussion of the responses of the questionnaire

The following table gives an outline of the responses received. The table is divided into three main columns: **Questions on**, **Question groups** and **Discussed under**. The first two main columns are the same as Table 3.3 in Chapter 3 and Table 4.2 in Chapter 4. The third main column is the same as the first two main columns except that all the

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different aspects of multimedia computer presentations are discussed under one heading.

Table 5.2: Layout of the topics discussed

Questions on:		Question Groups		Discussed under:		
Subject preferences		Favourites subsection?		Subject preferences		
		Reasons for selection?				
Facilities		Video facilities at home?		Facilities		
		Computer facilities at home?				
		Can learners afford computers?				
T U T O R E D	Lectures	Ratings –How do learners rate their lectures		Ratings	Lectures	
		Attendance	Why not attend?			Attendance
			Why left a lecture?			
			Concentration?			
			Too many?			
			Are certain lectures more important?			
	Presentation - Which is the best way to present?		Presentation			
	Practicals Why do learners not attend or leave practicals		Practicals			
	Prescribed book – To what extent is the prescribed book used?		Prescribed book			
	Internet- To what extent is the internet used?		Internet			
L E A R N I N G	Multi-media computer presentations	Use	To what extent used?	How Successful	Multimedia computer presentations	
			Why not used?			
			Why used only by some?			
			Time spent?			
			Were they enjoyable?			
			Did learners spend more time on histology because of?			
			Did learners help one another with the presentations?			
			Evaluation- What was the interface like?			
		Technical aspects- Were there navigational errors and technical problems?				
		Value	Do the learners feel presentations improved recollection?			
	Does the learner feel that his marks improved because of?					
	Is a presentation better than a lecture?					
	Did presentations change the learner's attitude towards the subject?					
	Video	How many times?		How successful	Video	
What problems were there?						
Favourite ways of studying						
How would learners like their course?		Can multimedia replace the traditional course?		How would learners like their course?		
		Do learners think multimedia can replace the microscope?				
		Do learners prefer - computer presentations or video?				
Testing						

❖ Subject preferences

Anatomy is a subject that consists of four subsections namely:

- Gross anatomy
- Neuroanatomy
- Embryology
- Histology

The time spent (lecturing and practicals) on each subsection is more or less related to the allocated marks for that subsection in the tests and the final exam. Each subsection is of equal clinical importance. The knowledge that the learners obtain in each of the subsections becomes important at some stage or another during the rest of the medical course. As the course is presented now this may apply in the fourth or fifth year. A sound knowledge of gross anatomy for instance becomes important when the learners eventually do surgery. Knowledge of histology is vital for the understanding of physiology, which again forms a basis for the understanding of such subjects as internal medicine. All the disciplines that learners encounter during the rest of the medical and dental course at some stage or other refer back to the basic knowledge obtained in anatomy. Therefore it is important that a good basic anatomy knowledge foundation is secured in the second year.

The first problem that emerged from the questionnaire is the fact that histology is the least popular subject amongst learners doing the second year anatomy course. The fact that learners are antagonistic against histology must have an influence on their motivation to study histology.

The way in which the subject is presented only plays a small role in determining the popularity of a subject. The biggest reason for the popularity of gross anatomy is that the learners find gross anatomy more interesting and secondly more relevant to the

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medical course. When learners do gross anatomy they can already see the clinical relevance of the subject. This according to the learners is not the case in histology. Although histology is narrowly linked to physiology and plays an important role in the understanding of physiology, the clinical relevance of histology may only become apparent when learners do certain subjects in their later years. There is in other words little that a lecturer can do to improve the popularity of his subject unless if he can convince the learners that his subject is clinically just as relevant to the medical course as any of the other subsections.

This problem should be solved with the new outcomes-based course that starts in 2003 for the dental students and in 2004 for the medical students. In the new outcomes based course the subjects will be more integrated. Histology will be integrated with subjects like physiology, pathology and pharmacology. The clinical relevance of knowledge will thus immediately become clear to the learner.

❖ Facilities

From the response to this question it is clear that the responsibility to supply computer facilities lies with the university. The majority of learners admitted at MEDUNSA do not come from affluent homes and study with bursaries that only pay for fees and books and learners can therefore not afford computers of their own. At this stage there is also not enough reason to buy a computer. The multimedia computer presentations that were developed for this study are all that are available for anatomy. Apart from the histology video, video study material exists for some of the other subsections of anatomy.

Almost all of the learners have access to video machines. So any video material that becomes available can be used at home by most of the learners and is therefore very popular. The learners that do not have video facilities at home experienced some frustration with the facilities in the library in that they sometimes found it difficult to secure a booking.

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The fact that few learners have their own computers means that the responsibility lies with the university to supply computer facilities to the learners. At the time of the study it was inadequate. The mission of the university is to empower the educationally disadvantaged section of the community which also forms part of the community that cannot afford luxuries like computers.

❖ Learning

The responses on the issues regarding the different ways in which learners learn namely tutored and self learning will be discussed next.

◇ Tutored learning

The learning that takes place while a learner is instructed by a lecturer or a demonstrator is discussed.

□ Lectures

Issues regarding the official lectures that form part of the histology course will be discussed.

■ Ratings

According to the literature lectures can be assessed in the following ways:

- rating lecturers by using a questionnaire;
- assessing the marks obtained by the learners;
- evaluating the quality of the professional (the doctor in our case) produced .

The second way of assessing lectures can easily be manipulated by lecturers by setting substandard papers or by training learners for the test or exam while the third way is a

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long term assessment and impractical for quick results. This leaves only the first way of assessing the teaching. According to March and Roche (1997), rating lecturers by using a questionnaire is influenced by factors that have nothing to do with the quality of the lecture. Factors that influence the results obtained from a questionnaire:

- Prior interest in the subject which in our case we know is not very high;
- Leniency in the allocation of marks (Greenwald and Gillmore, 1997). Learners usually do well in our practical test but not in the theoretical written papers;
- There is also a relationship (although weak) between class size and ratings (small and large classes give the best ratings) which in our case would have a positive influence on the ratings because of the large size of the class (Fernández et al., 1998);
- The social view and the charisma of the lecturer will also have an effect on the ratings (Shelvin and Banyard, 2001). In our case this factor is unknown.

All histology lectures that were given were rated as good by the respondents irrespective of which of the two lecturers gave the lectures. In almost all cases the good rating that was chosen by the students was by far the most popular rating, much more popular than the second most chosen option.

Assessment by colleagues or experts in the same academic field is not mentioned in the literature cited but may also be a good way of assessing lecturers.

The lectures were given by two different lecturers, the one used a data projector and the other one used an overhead projector, blackboard and slides. The way in which the lecture was presented played no role in the rating obtained. So the use of a data projector did not give the one lecturer an advantage above the one using the traditional slides, blackboard and overhead transparencies. Therefore according to the learners a lecture given in the traditional way can be just as good as a lecture making use of the newest technology.

■ Attendance

Attendance of the lectures given by the lecturers in the anatomy department is not compulsory. However learners not attending histology lectures is a problem. At the time of the study the anatomy class consisted of 345 learners. We do not take roll call but the lecture hall that we use can only accommodate 300 learners and the class was never full. At most of the lectures only about half of the class was present. On the day when the questionnaires were handed out, only 201 learners were present. Another disturbing tendency amongst learners is that they get up and leave the lecture while it is in progress. More than half of the learners have left a lecture or lectures before the end. Why they do not attend or leave has always been a matter of concern to the lecturers.

The reasons learners gave for not attending or leaving the lectures are loss of concentration, becoming bored with the lecture or that the lecture was too long. All of these answers point to loss of concentration. Either learners lose concentration and leave the lecture or because they know they are going to lose concentration they do not attend. This problem with keeping focused on the lecture concurs with the research by Stuart (1978) who found that learners reach their peak concentration levels after ten minutes and that concentration deteriorates afterwards. If a learner attends a lecture and loses concentration he or she is not benefiting by attending and may just as well leave the lecture. From the research done by the National Training Laboratories (1998, Online) we know that only 5% of knowledge conveyed during a lecture is retained. Loss of concentration may be a reason why lectures are so ineffective.

The duty of the lecturer is to give the lecture and to make sure that all the information is conveyed to the learners. According to Steyn (2001), lecturers like to believe that learners remember everything they are being told in a lecture. This is definitely not true if learners are not concentrating.

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The sheer volume of information that the learners are confronted with and the length of the lectures definitely play a role in the concentration problems that learners have. Provision for catching up missed lectures or parts of lectures missed when learners suffered from lapses in concentration is thus of the utmost importance. The amount of work that has to be covered during each lecture does not allow for innovative lecturing. Lectures can easily become information sessions where facts are being regurgitated boring the learners in the process. At this stage there is no assurance that the learner is served with a quality lecture.

The work that Stuart (1978) did on loss of concentration during lectures was done in one lecture. What is not known is what happens during the following lectures. How long a break do learners need to get their concentration levels back to the original level? One can only assume that learners will lose their concentration quicker during the follow up lectures. In our case learners often attend lectures from 8h00 to 11h00.

When asked, most learners suggested a reduction of lectures. Most learners however reduced the number of lectures they attended by simply staying away.

Their main reason for attending lectures is because the lecturer clears up difficult concepts. This means that most learners (74%) imply that there are higher cognitive concepts in histology which they want the lecturer to explain to them. Some of the learners indicated that they attend lectures because they enjoy lectures while others attend lectures for tips for the test or exam that the lecturer may give. A response by 21% of the respondents is that they attend lectures because their sense of duty does not allow them to stay away. These learners attend the lectures whether they benefit or not.

Few students say that the information given in the lecture cannot be found somewhere else. This means that students attend lectures so that the lecturer can clear up the higher cognitive information (difficult concepts). The learners that took part in this survey

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feel that difficult concepts can only be cleared up by being directly in contact with the lecturer. They do not trust supplementary instruction with this function.

Histology is seen by most learners as the subject whose lectures can be missed. This response may have to do with the fact that histology is also the subsection of anatomy with the most comprehensive supplementary instruction available. Much of the work can be caught up by looking at the video or using the multimedia computer presentations.

A number of learners (18%) also said that they do not attend lectures because they use the video instead and another group (19%) stated that they used the multimedia computer presentations instead of going to the lecture.

The learners that chose to watch the video instead of attending the lecture did not use a suitable alternative as the video was specifically made as supplementary instruction for the practicals with a bit of theory added. On the other hand the multimedia computer presentations contain all the information conveyed in the lectures and is therefore a valid substitution for the lecture.

In spite of the serious problems most learners (96%) have with the system of lecturing, learners are strongly in favour of attending lectures. Many learners feel that some lectures should be replaced by self study. If a learner does not attend a lecture he/she replaces the lecture with self study. Many have done that already. The lecturers should evaluate the lectures and decide which lectures have a higher and which have a lower cognitive content. Multimedia should be available for the whole course but lectures should only be given on the topics with a higher cognitive content.

Although the learners have already been exposed to the new technology in teaching, more convincing will be needed to win the trust of the learners before they will fully accept technology taking over all aspects of the course.

■ Presentation

Although the learners were not influenced by the technology used to present the lecture most of them acknowledge that using a data projector is a better way of lecturing than using the traditional way (blackboard, slide and overhead projector).

Preparing a lecture on a computer and presenting it with the aid of a data projector has a number of advantages over the traditional way of presenting a lecture, such as:

- Lectures can be better structured;
- The sequence in which the information is presented can be kept the same;
- It is easier to improve your lecture by adding better examples;
- The lecture can be more colourful;
- Animations and video can be used in the lecture;
- Lectures can be made available on the university's intranet, internet or on CD rom;
- Graphics from the Internet can easily be incorporated into lectures.

□ Practicals

During practicals two things happen, namely:

- A tutorial is presented where the best visual material the lecturer can find is displayed on overhead monitors accompanied by a thorough explanation of the tissues and structures of the specific topic;
- Learners use a microscope to look at specific tissues and cells.

It is difficult to determine whether the learner remembers the image that he has seen under the microscope or the image that he has seen on the monitor. The image on the monitor is mostly clearer and is also a better example of what must be identified. Finding and identifying cells and tissues on a microscope slide is time consuming. Learners

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often waste time looking for structures and cells under the microscope which they may not even find or often identify incorrectly. We know that many learners do not even look for the tissues and structures under the microscope but attend the practicals purely for the sake of the accompanying tutorial.

The practical work in histology is aimed at teaching learners to identify different cells and tissues. The reasoning behind this is that learners must know what normal tissues and cells look like so that they can recognize pathological cells or tissues. We thought we were teaching learners by means of the microscope to prepare them for the pathology course in third year. In the past the pathology course involved a lot of microscope work. Pathology has however scaled down on the use of the microscope as a teaching tool. At MEDUNSA the third year medical students look at (according to the pathology department) only eight pathology slides during the year. These 8 slides are slides of basic pathological conditions.

This is happening at other universities as well. Because of this limited use of the microscope in pathology, universities are phasing out the microscope as a teaching tool for histology. At the University of the Orange Free State this is happening while at the University of Pretoria students are given the option of using either a microscope or a computer program to learn practical histology. Students mostly prefer to use the computer only.

In the oral pathology course for dental students at MEDUNSA students do not do any microscope work. It is not expected of dental students to be able to identify the various pathological conditions from microscope slides under a microscope. The emphasis in oral pathology has shifted to identifying pathology from macroscopic appearance.

Why must the histologists teach a learner to use a microscope if most of them are never going to use a microscope again? The question therefore arises, can the microscope be replaced by images displayed on a monitor?

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Although the majority of students indicated attending practicals as their least favourite way of studying histology, 60% of the students said that they attended all the practicals. This means that 40% of the learners missed all or some of the practicals.

The histology practicals start in February and the practical exam is in October. No learners use a microscope to do revision before any test or exam. If a learner looks at a tissue or structure in February for two or three minutes it is doubtful whether the learner will recognize that structure in the October practical exam if no reinforcement had taken place in the mean time.

Using the microscope is a constructivist way of learning. The problem is that the lecturer does not know what knowledge is constructed. If the slide does not contain the relevant structures the learner cannot construct the appropriate knowledge. A constructivist way of learning should not be replaced by a way of learning that is only instructivist (videos and multimedia computer presentations) but by a way that is both instructivist and constructivist.

◇ Self learning

The results of learning that takes place when a learner utilizes books, the internet, multimedia computer presentations and videos are discussed here.

□ Prescribed book

Learners were forced to use the prescribed book or another histology book because the notes given to the students do not include drawings and drawings are essential in understanding the morphology of tissues. The slides viewed in the practicals and the micrographs in the video only supply the learners with two dimensional information. It is impossible to build a three dimensional image from only one two dimensional image. This is the reason why 45% of the respondents used the book for reference purposes. A

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group of learners (38% of respondents) either did not use the book, found it too complicated or gave up using the book quickly.

The prescribed book contains a lot of additional information and the learners may find it difficult to decide what is necessary to know and what is beyond the scope of the course. According to Snodgrass (2000) learners may fail to read the textbook when most of the study material from the textbook is not included in the learning objectives.

 Internet

At this stage the Internet as a source of information for histology is not utilized by the majority of learners. It is also doubtful if learners will use the internet if not forced to do so. To encourage learners to use the Internet, questions can be asked on information available from certain websites or learners can be given assignments for which information must be gathered from the Internet. Learners are confronted with a massive volume of information to be mastered, and as such very few learners will voluntarily go and look for additional information on for instance the internet.

 Multimedia computer presentations

Most learners indicated that the lack of facilities (the computers were always occupied) gave them limited opportunities in using the multimedia computer presentations was the main reason why 30% of respondents did not use the presentations at all, while others indicated that they did not use the presentations as much as they would have liked to. The computers that were made available to the learners were often all occupied and were used to study the presentations while other anatomy lectures were in progress.

The majority of learners only spent two to four hours on the presentations. All in all the presentations consists of ± 560 pages of information which means that a learner that spent three hours using the presentations had to go through three pages of information

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every minute. Only 13% of the respondents spent more than eight hours using the programs, which was probably the minimum time required to master the work.

A positive response regarding the multimedia computer presentations is that once learners started using the presentations they kept on using them. Very few learners did not use the presentations of the second block after having used them in the first block.

The interface that was used for the experimental part of the study was decided upon and used throughout. *PowerPoint* is not an advanced authoring program but through hyperlinks much interactivity could be built into the programs. Advanced authoring programs have many more options as far as the interface is concerned. The interface that was used for this study was thus limited to what *PowerPoint* allows. This study however indicated that by incorporating menus with hyperlinks and sound files, *PowerPoint* presentations can also be used for self study.

According to the responses from the questionnaire the elements of the interface, instructions, colours, font type and size, the layout, the use of graphics, ease of use and navigation system were all acceptable to the users. The element that rates the lowest of all (66% were satisfied) was the text used in the presentations. The text was taken from the notes and linked to the appropriate graphics. The reason why the text from the notes was incorporated into the presentations was so that users could keep track of their progress.

From observations, when learners were using the multimedia computer presentations, it was clear that the learners could master the way the programs work very quickly and could almost immediately start with effective learning.

The vocal explanations that are part of the programs are considered by the majority of learners as a very important part of the programs. Sound is one of the things that separate multimedia from electronic books. Many developers ignore the potential of computers to play sound.

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One factor that has to be taken into account is that most of the learners that answered the questionnaires have never seen similar programs. Their frame of reference for judging computer-based teaching programs is very limited. Some favourable feedback was received from colleagues and fellow histologists.

According to the users the multimedia programs contain no (55%) to a few errors (44%). Technical problems were limited (65% did not encounter any) but a few hiccups were experienced by learners which had to do with the computer that was used.

The vast majority of learners (88%) have the perception that multimedia computer presentations improve their recollection. Because of this it could also be expected that the majority of learners would also indicate that they think they did better in the topics where multimedia computer presentations were available. This could not be proven by comparisons between the marks of the learners that used none of the presentations, learners that used some of the presentations and learners that used all the presentations. In the comparisons the null hypothesis was tested, with the learners' gross anatomy mark as a co-variant. The results showed that learners that do well in the histology section are the ones that also do well in the gross anatomy section of the course. As a result no improvement of marks could be attributed to the multimedia computer presentations. This is in line with what was described by researchers like Clark and Craig (1992).

The believe that multimedia computer presentations improve recollection is however a very important motivational factor. If learners believe that they can master the work quicker and better if it is presented in a multimedia format they will be motivated to use such programs.

This was illustrated when most learners indicated that the multimedia computer presentations made them spend more time on histology than they would have without

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the programs. This response relates to the response where learners indicated that the multimedia computer presentations as enjoyable to use. Learning that is enjoyed will have a positive influence on outcomes (Reeves and Harmon, 1994). In the first of the four levels of evaluation suggested by Kirkpatrick (1959a, 1959b, 1960a, 1960b) the feelings of the user about the program is evaluated. It is said that people learn better when they feel positive about their learning environment.

The majority of learners did not think the work was always well explained although most felt that it was well explained most of the times (but not always). This indicates that what some learners experience as well explained, others may feel is not well explained.

Interaction between users was tested by asking whether they helped one another. Most (73%) obtained help from another user which indicated interaction to some extent. The lack of facilities also forced users to work together on the same computer as was seen during visits to the computer centre where the multimedia computer presentations were available. According to the National Training Laboratories (1998, Online), learners have a knowledge retention rate of 90% when they teach one another. The multimedia computer presentations were not designed with interaction in mind, interaction is however desirable.

Most of the learners do not prefer multimedia computer presentation above lectures. A large number (47%) feel that a good lecture is better than a computer presentation while an additional 21% feel that a multimedia computer presentation is only for revision. This means that 68% of learners want to retain lectures because they think that attending a lecture is a better way to learn than using a multimedia computer presentation. This opinion of the respondents is also clear when asked about replacing the traditional histology course with an e-learning course where 83% said no.

A high number of respondents (93%) indicated that the multimedia computer presentations changed their attitude towards histology.

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The following principles were adhered to during the development of the multimedia computer presentations and may have played a part in the success of the presentations:

- Reduce text (reading on the screen) to a minimum;
- Text should be repeated as a vocal explanation;
- Make sure that the interface is acceptable;
- Work out the navigation system of the program before development starts;
- As soon as something has been developed test it on the learners;
- Make the graphic images as large as possible;
- If a complicated drawing is used reduce it to a simple drawing and add on to build the drawing.

During the study the following factors which could result in a multimedia computer presentation failing were identified:

- Too much text;
- Graphics that are too small;
- Graphics that have too many annotations;
- Arrows and annotations that cover too much of an image;
- Programs with no sound;
- Too much information on a screen.

■ How successful were the multimedia computer presentations?

The multimedia computer presentations succeeded in some aspects but also failed in some aspects. The multimedia computer presentations succeeded in the following aspects:

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- Changed learner's attitude towards the subject by providing a study medium that was enjoyable to use;
- Made the learners spend more time studying histology than they would have without the programs;
- Provided the learners with all the required information in one medium;
- Provided the learners with an interface that:
 - was user friendly and easy to navigate;
 - had clear instructions;
 - had readable fonts;
 - had text that was easy to follow;
 - used acceptable colours;
 - Included images that were used effectively for explanation;
 - Included vocal explanations which were regarded as a very important part of the program.
- Created the perception that:
 - Multimedia computer presentations improve recollection;
 - By studying multimedia computer presentations your marks will improve.
- When learners started to use the multimedia computer presentations they kept on using it;
- When using the programs learners interacted to some extent;
- Gave up lectures just to get a chance to use the multimedia computer presentations.

The multimedia computer presentations failed with respect to the following:

- Was not accessible enough for learners that wanted to use the programs because of lack of facilities;
- Could not replace the video as the learner's favourite way of studying;
- The majority of learners did not think the work was always well explained although most felt that it was well explained most of the times;

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- The programs did not spark their interest in E-learning. Very few went to look for similar study material;
- Could not convince the majority of learners to accept multimedia computer presentations as a replacement for the histology course;
- The learners that used the programs did not do better than the ones that did not use the programs;
- The multimedia computer presentations that were developed are not yet a software cognitive tool for teaching and learning histology because it did not provide a constructivist way of learning histology.

□ Video

The video that was available to the learners was made specifically for revision of the practical part of the histology course from the tutorials shown in the practicals.

The response received when asked about their favourite way of studying can be explained by what is reported in the literature where it is stated (Oliver,1998) that learners associate watching a video with a pleasant and relaxing experience. Very little effort is involved and it is seen as an easy way to acquire knowledge. Presenting knowledge by means of a video is especially suited for the conveying of facts (low cognitive information) that must be memorized (rote learning).

All learners that missed any practical or part of a practical had to fall back on the video and or the multimedia computer presentations to catch up the missed practical work. These 40% of learners have already, to a lesser or larger extent, replaced the microscope as a teaching tool with the video or the computer. The learners that attended the practicals only to watch the tutorial and the ones that failed to find the appropriate tissues or cells can also be added to this group.

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Some of the learners that did not attend the practicals could be identified and their performances could be compared. Of the ten learners that never attended a practical and whose marks could be traced back five failed the practical tests. This is slightly more than the 44% of the respondents who could be identified and failed the practical histology test. The five out of ten learners that passed the histology practical test demonstrated that enough knowledge could be acquired from the video and or the multimedia computer presentations to pass the histology practical test.

Of these ten learners who never attended a practical and whose marks could be traced back only one passed the histology theory tests. This may be an indication that not attending the practicals may have more to do with dedication than finding alternative study material more effective.

We know that almost all of the learners watched the video before practical tests or exams (only four respondents did not answer the question on the number of times that they watched the video). A few might have used the histology atlas to prepare for the tests or exam.

One can assume that no learner could rely solely on the histology practical to pass the histology practical exams since most in fact learners write the practical exam in which they are required to identify tissues and cells that many of them have never seen in a real slide.

The fact that no learners used the microscope for revision purposes indicates that the computer but mostly the video has completely replaced the microscope for revision purposes.

Most of the learners indicated that they watched the video more than four times before the test. This points to a perception amongst learners that if one watches the video several times one will pass the histology practical test. When the results from the test

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were compared with the number of times a learner has watched the video it was found that there is no relation between the marks obtained and the number of times a learner has watched the video. The more than four timers did not do better than the rest thus indicating that it is not necessary to watch the video more than four times.

Some learners were not satisfied with the quality of the video. This may be a valid complaint as the videos that are used in the library are second-generation videos copied from a master. The quality may also deteriorate because of the many times the videos are played in the library.

■ How successful was the video

The video succeeded in the following ways:

- Was the most popular way of studying histology;
- Replaced the need to do revision on the microscope;
- Supplied enough information to learners to pass their practical histology test;
- Provided the learners with a study aid that was easily accessible;
- Provided the learners with a study aid that all learners could utilize;
- Provided the learners with a way of repetition learning to memorize the images of tissues and cells;
- Was except for the notes the only histology study aid that all the learners used.

The video failed in the following aspects:

- Failed to convince learners to accept it as a complete replacement for the practicals;
- The quality of the video failed to satisfy everybody;
- The video was not a constructivist way of learning but only instructional.

◇ Favourite ways of studying

The learners learn their histology by attending and using some or all of the following six ways:

Table 5.3: Popularity of different study material

Way of study	Popularity rating
• Video	1
• Lectures,	2
• Notes	3
• multimedia computer presentations	3
• Practicals	4
• Prescribed book	5

The notes and the video are the only histology study aids that all the learners use.

When asked to choose their favourite way of studying histology the most popular selection amongst respondents was watching the histology video. Attending lectures came in second while the multimedia computer presentations and reading the notes shared third place. Attending histology practical sessions involving the use of a microscope was the second least popular and reading the prescribed histology book was the least popular way of acquiring histology knowledge.

The findings given in table 5.3 confirm the results obtained by Heidger et al (2002) that found that learners, when given the option of how they want to learn, will choose whatever requires the least effort, the way that they consider the easiest and fastest. In the study done by Heidger et al, (2002) it was the histology multimedia CD while in our case it was the video. Some elements of the virtual microscope like a high magnification (zooming in) of a particular tissue is included in the video if necessary. This way of learning requires no participation from the learner except concentration. Heidger et al

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(2002) did not include a video in their study but included a virtual microscope which is more user friendly than the microscope but retains some of the disadvantages of the light microscope in that it does not tell the learner anything about the tissue he or she is looking at, plus the learner has to spend time looking for structures while consulting a histology atlas.

Considering the large amount of information learners are confronted with in their second year anatomy course it is understandable that they would choose the easiest way or the way they perceive as the easiest to master the work. Histology accounts for one third of the marks in anatomy. Therefore learners should spend no more than a third of their study time on histology. Any study method that requires more than that will according to the principle of easiest and fastest, be discarded in favour of another method which they consider easier and faster.

◇ How would learners like their course?

The question is, can the histology course be replaced by a multimedia (E-learning) course? The answer obtained from the respondents is “no” (83% said no). What role should multimedia then play in the histology course? Most of the respondents (45%) want a course that includes lectures and practicals while 22% want multimedia computer presentations that are supported by lectures. Very few of the respondents (13%) feel that histology is better under the microscope than on a computer screen so we can assume that when learners indicated that they want to attend practicals they referred to the tutorials that were presented during the practicals.

It was thought that the learners that used all the multimedia computer presentations may have a different opinion on replacing the histology course with multimedia course but their opinion was the same as that of the group as a whole.

Steyn (2001) says that teachers are reluctant to change trusted ways. Learners may feel the same. Learners may also feel that changes in the curriculum may lower the standard of the course and so reduce the value of their qualification. If they know that other

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universities are already using teaching methods where the microscope is not used any more they may change their opinion about the matter.

Major problems with the lectures were exposed in the questionnaire. Most of the respondents indicated that they have a problem with the present system of lectures and that they want some lectures to be replaced by multimedia. Almost all learners have concentration problems. Many do not attend lectures, or leave the lecture before the end. To force learners to attend lectures will simply mean more learners in class not concentrating.

The following changes to the lectures were suggested by the learners:

- Longer breaks between lectures;
- Shorter lectures with less information;
- Fewer lectures;
- Parts of the work should be left for self-study;
- Lectures should be given with the aid of a data projector.

According to feedback learners attend lectures so that difficult concepts can be cleared up. This means that learners want lectures with a higher cognitive content (difficult concepts) to be presented and lectures with a lower cognitive content to be assigned for self study. Learners also indicated that in the ideal course lectures will be presented by means of computers using a data projector.

What becomes clear from the questionnaire is that there are many different preferences amongst the learners. No newly designed course would satisfy all the learners. Learners are ready for E-learning to various extents.

❖ Testing

An important factor in testing is whether learners are rewarded for the effort they put in. If learners feel that they do not get good marks even if they put a lot of effort into studying a subject they may sideline the subject and rather spend time on a subject where they will be rewarded for their effort. In the cases of histology theory and practicals the majority of students felt that the effort they put in is reflected in the marks they obtain. This also means that the students see the amount of work as manageable.

When a subject has different subsections, like anatomy, and there is no sub minimum for each subsection, like in anatomy, the relationship between amount of work and the marks allocated to that subsection in the test or the exam is very important. If a subsection covers too much work and does not count enough, learners will rather spend their time on another subsection where the relationship is more advantageous.

5.2.1.2 Records and relationships

Before comparing marks one must keep in mind that few learners could use the multimedia computer presentations as much as they would have liked, because of inadequate facilities. The majority (71%) of the users spent only two to four hours on the multimedia computer presentations which is not nearly enough to master the work. These learners had to use other studying options in conjunction with the multimedia computer presentations. When the marks of the three groups of users (used none, used some and used all) of the multimedia computer presentations were compared with the gross anatomy mark as a co-variant no significant correlation could be found. This means that users do not have an advantage over non-users but it also means that users do not have a disadvantage because they used the programs. As long as we are sure that users of multimedia computer presentations are not being disadvantaged it is save for learners to use these programs, and with improvements to the programs that would inevitably be made because of the feedback that was gathered and continuous development, using the programs may be to the advantage of the learners if not already the case.

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When the averages are compared there is a difference between the theoretical test results of the work on which multimedia computer presentations were available (38%) and work on which multimedia computer presentations were not available (34%). This difference however cannot be contributed to the multimedia computer presentation because:

- Only 22% of learners used all the multimedia computer presentations;
- 71% of the learners that used the multimedia computer presentations spent only two to four hours using them.

What is more important than this difference is that both these averages are failing averages. This indicates that there is a problem with the learners' theoretical knowledge of histology. These low marks may have much to do with the following facts:

- Histology is the learner's least favourite subsections of anatomy;
- 66% of learners left lectures or did not attend lectures;
- Only 3% did not have concentration problems during lectures;
- 38% of learners did not use the prescribed book or gave up using it;
- The learners rated most of the lectures they attended as average;
- Facilities for using multimedia computer presentations were inadequate.

An important component of acquiring theoretical knowledge in histology is to study drawings of the structure of tissues and cells. These drawings are shown to the learners during the lectures and are also available in the prescribed book as well as in the multimedia computer presentations. It is doubtful whether a learner can look at a drawing once during a lecture and remember it sufficiently to recall the knowledge in a test or exam. A learner should study the drawings again before a test. The problem is that many learners do not attend classes and if they attend they either leave early or do not concentrate. Reviewing the drawings should take place by either using the

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prescribed book or by studying the multimedia computer presentations which many did not do or did not do sufficiently.

The fact that the learners rate almost all lectures as good (not very good) may also have an effect on the knowledge gained during lectures.

Learners performed much better in the practical tests. In the practical tests the better average was obtained in the section where multimedia computer presentations were not available (56% versus 48%). However, the video was made specifically for revision of the practical histology and we know that almost all the learners (only four respondents did not answer the question on number of times that they watched the video and 92% of respondents watched the video three or more times) used the video for revision.

The marks obtained by the learners in the gross anatomy part of the two blocks were 63% for the written section and 55% for the practical section.

What emerges is that learners do not put in a big effort to master the theory part of histology but rather make up their marks by spending time preparing for the gross anatomy and the practical histology (by watching the video). This means that many learners finish their anatomy course without a sound knowledge of histology. This means that there is a huge shortcoming in the present system that allows for this to happen. The question arises why present a course that many learners do not care about and eventually have little knowledge about?

The learners that study at MEDUNSA come almost exclusively from disadvantaged communities as can be seen by the response on affordability of computers (only 8% said they can afford a computer). All the records of 67 learners could be traced. The average SRS rating of these 67 learners (including learners from school and learners with additional credits) was 10,48. The average SRS rating of the learners that had no additional credits was 10,24 while the average SRS rating of the learners with additional credits was 8,5. A SRS rating of 10 means a D for mathematics and a D for science.

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With a mark like that a learner could only get into the medical course at the University of Pretoria after proving himself by getting another qualification. This means that the average MEDUNSA learner could not get into most other medical schools. When the marks obtained for the two tests that were used in this study were compared with the SRS rating there was however no relationship between the two. This poses the question, is using the mathematics and science marks the right way to select learners for the medical course, are there not other subjects that will give a better indication of a learner's potential to master the medical course? The marks that the learners obtain in anatomy should be correlated with the marks the learners obtain in the different subjects in the subsequent years. The marks obtained by the learners in other school subjects should be correlated with the anatomy marks to see whether the marks of other subjects could also be used as selection criteria.

The results indicate that there is no significant difference between the learners with additional credits and the learners without additional credits although the former has a lower average SRS rating (8,5) than the learners without an additional credit (10,48). It is impossible to say whether the learners with additional credits improved during their efforts to obtain their additional credit so that they could compete with the higher SRS learners without additional credits or whether they would have performed the same earlier without their additional credits. Are they not just learners with potential that did not perform well in school?

When the marks of the learners that used none, some and all the multimedia computer presentations were compared there was no significant difference in marks confirming what many authors like McKenna (1995) have shown. However McKenna (1995) states that "most" research concluded that CBL does not enhance learning which means that some found enhancement and others found no enhancement. The quality of the CBL material that was used for the research is not mentioned. According to Cairncross and Manion (2003) interactive multimedia can create a high quality learning environment that promotes deeper learning but this potential may not be fulfilled in many programs. This indicates that the quality of CBL material will have a huge influence on the outcome of such a study. Studies tend to treat all CBL material alike, which is not the case.

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Another research finding that may be of importance is the one of Haddon et al (1996) who did a study on two groups of learners, one was taught in the conventional way and the other with the use of multimedia. No significant difference in exam results was obtained but there was a significant correlation between learner ability and degree of improvement for the multimedia group. The lower the ability the bigger the improvement. This means that multimedia is more successful than conventional methods for learners of below average ability. With our lower selection criteria some of our learners may fall in this group.

What was not investigated and could be of importance is whether the learners that used the multimedia computer presentations acquired their knowledge in a shorter time than the learners that used the traditional way of studying.

Another comparison that was made showed that the learners that indicated that histology is their favourite subject did not do better than the ones that indicated gross anatomy as their favourite subject. Favouring histology did not serve as motivation to do better than the rest of the learners.

The complete records of ten of the 33 respondents that never attended a histology practical could be traced. Five of these learners passed the practical test but only one passed the histology theory test. Not attending the histology practicals may have more to do with lack of responsibility than with finding other ways of learning more satisfactory.

5.2.2 Learner profiles

The average MEDUNSA learner was accepted into university with a SRS of ten which means a D for mathematics and a D for Science. This learner does not come from an affluent home as can be seen from the fact that the learner cannot afford a computer

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and is possibly the reason why the learner did not have internet access because at the time of the study a learner had to pay a monthly subscription for internet access. The learner however had access to a video machine at home.

Lack of concentration is the main issue when it comes to attending lectures. Loss of concentration is the main reason why learners often left lectures before the end. Learners attended the lectures to have difficult concepts cleared up by the lecturer. Learners prefer their lectures to be presented with the use of a data projector but the lectures given by one of the lecturers using conventional lecture aids like transparencies and slides were not worse than the ones presented with the aid of the data projector. The standard of lecturing was experienced as good, not very good but also not bad. Learners were very conscientious when it came to the histology practicals but preferred to look at histological slides on a screen rather than through a microscope. The learners did not use the prescribed handbook but preferred to study histology with the aid of a video which the average learner watched more than four times. Learners however want the histology course to include practicals, self study, videos, lectures and multimedia computer presentations.

MEDUNSA learners enjoyed using the multimedia and spent more time on histology than they would have without the multimedia. Learners have the perception that the multimedia improved recollection and marks and that hard work in histology will result in good marks. Learners are of the opinion that they can miss histology without serious consequences probably because of the video and multimedia computer presentations that were available.

The multimedia changed the learners' attitude towards histology a little but they still do not like histology.

5.3 Recommendations

The clinical relevance of the histology course content should be explained and emphasised so that learners can understand why they need a sound knowledge of histology. This will also mean that the course content must be evaluated and all information that cannot be defended as clinically important must be omitted from the new course. If learners understand the importance and relevance of the subject it will hopefully motivate them to change their attitude towards histology.

If enough multimedia computer study material is made available to the learners it will put pressure on the university to upgrade its computer facilities. Because little computer-based study material has been developed by lecturers at MEDUNSA little pressure for a computer centre exists at the moment.

Most learners have access to a video machine and although a video is only instructional it is still very valuable. This should be exploited by supplying the learners with video study material.

Although, according to The National Training laboratories (1998, Online), retention of knowledge from lectures is the lowest of all the ways of learning (5%) lectures will still be an important part of the learning process for the foreseeable future. Every effort must therefore be made to improve the standard of lecturing. Efforts must also be made to try and make the lectures as relevant and effective as possible.

With a conventional lecture what is said in class is between the lecturer and the learners. When a lecturer makes his lectures available on a CD or on the web he exposes himself to criticism from everybody. Some lecturers may need to be convinced to do so. If a lecturer prepares his or her lectures as proper presentations on computer and makes them available either on the web or on CD, peers, senior members of staff or faculty can evaluate these lectures and suggest improvements. In that way learners can

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constantly improve their lectures to eventually own a set of very good lectures. A system like this can serve as quality assurance to make sure that all lectures are up to standard.

If lecturers prepare their lectures as computer presentations the university should provide data projectors in all lecture halls so that lecturers can present their lectures with the aid of a projector. Once facilities are available lecturers should be encouraged to present their lectures using a data projector.

When preparing a lecture on a computer one must be careful not to get carried away by the technology. Preparing a lecture with lots of images, text that flies around as well as other gimmicks may look very impressive but will confuse the learner instead of clarifying the topic.

The evaluation of lecturers should be done in another way than asking the learners to evaluate the performance of the lecturers. From both the literature (March and Roche, 1997; Shelvin and Banyard , 2001; Greenwald and Gillmore, 1997 and Fernández et al., 1998) and this study, it is clear that evaluation of lecturers by learners is not reliable and very often produces a result that rates lectures as average. The idea behind evaluation of lectures and study material is to improve the standard of lecturing. If one assumes that there is always room for improvement, and there always is, one can replace the evaluation by learners with a suggestion box, perhaps on the web where learners can suggest how a lecturer can improve his lectures.

Learners have made it clear that they do not like learning from a textbook. Imported textbooks are also becoming very expensive and are already out of reach of most of the learners. Therefore, notes which include drawings and micrographs should be developed. Notes should include the images and drawings from the multimedia computer presentations. Learners will never be able to do all their learning from either a computer or a video. A book or notes will always be important to supplement the multimedia computer presentations and videos, something a learner can take home to read during the holiday.

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Because the Internet is going to be a very important source of information for the learners once they qualify as doctors every effort must be made to introduce them to the Internet as early as possible in the course. Again the university must make sure that the facilities are available and the learners should be encouraged to use the internet and even forced to do so by asking test or exam questions based on recommended websites or they must be given assignments forcing them to go and find information on the internet.

The interface that was developed for this study can be used as a starting point for new multimedia computer presentations that will be developed in an advanced authoring program. The information on colours, fonts, navigation etc. can be used in the new program. More advanced authoring systems have features available that will make the multimedia programs better in many aspects.

Some features that will be an improvement but were not available in *PowerPoint* are:

- Pop up boxes;
- Indicators that can be hidden or displayed;
- Better animations than the crude screen changes that were used in *PowerPoint*;
- Text that can be hidden or displayed.

In the interface that was used for this study the indicators (arrows, circles or lines) appeared on the images as part of the image. An improvement would be one where the arrows or other indicators could be hidden and only shown on request. This would give the learners the option of testing themselves on the features of a particular slide before requesting help from the program in the form of pop up indicators with pop up boxes and sound files attached to them.

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The multimedia computer presentations should include all the information that is in the video. The video should be used as a quick way to revise the practical aspects of the work.

Because of the popularity of the video, a video option, a presentation that runs just like a video, could be added to the presentations where learners could just sit and watch a presentation that runs automatically. This will save the learners with computers the trouble of using a computer and a video machine. The resolution is also much better on a computer screen than on a television.

Many learners indicated that they have problems with the explanations given in the programs. Lesewski and Settle (1996) state that a computer cannot rephrase an explanation like a lecturer can. This statement does not have to be true. For certain topics more than one explanation could be included into the presentation so that learners could choose a second explanation if the first one is not satisfactory. This approach could work well with topics like bone or tooth development which involve long complicated explanations. In class the lecturer usually has to explain these topics more than once using different angles. The same could be done in a multimedia computer presentation.

Histology is a very visual subject. Drawings and images, instead of text, should be used as much as possible to explain concepts and facts. The drawings and images should be accompanied by a vocal explanation as this was appreciated by the respondents in this study as well as those in the study done by Mars and McLean (1996). The text that is used in the computer presentations should be concise.

When developing multimedia one must make sure that the new programs work on computers with limited memory as well as slow processors (100MHz).

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Programs should be implemented as they are developed so that errors could be exposed and corrected and not be repeated. Evaluation should be an ongoing process; every perceived improvement should be evaluated by the users to determine if it really is an improvement.

Learners should be encouraged to visit histology websites to get a different perspective on what they must master. If some information is not clear to them they must know that it can be cleared up by getting a different perspective from information on the internet.

Questions for self evaluation should be added at the end of each section. The results of these tests should be forwarded to the lecturer. This information will keep the lecturer up to date on the progress of learners.

According to researchers like Clark and Craig (1992), multimedia is not the factor that influences learning. It is the instructional methods that influence learning. Oliver (1998) mentions that effectiveness of technology depends on how it is used. This means that there is always room for improvement. By constantly improving the instructional methods used in one's multimedia computer presentations one may come closer to the point where computer presentations enhance learning. Efforts should be made to change the multimedia computer presentations into a cognitive tool.

Bad multimedia makes it difficult to convince sceptics to incorporate multimedia in their teaching. Learners and lecturers may come to rely on multimedia that is not up to standard which may have negative consequences for learning. To prevent multimedia that is not up to standard from reaching the learners an evaluation system is necessary. The function of this system should be to help developers improve their multimedia.

From the responses it is clear that there was much interaction between learners while using the multimedia computer presentations. 70% of the users indicated that they received help or helped their fellow users. This interaction between learners should be

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encouraged and innovative ways like group assignments should be implemented to increase interaction.

Video is a strong favourite of our learners. Instead of trying to replace the video with multimedia computer presentations efforts must be made to improve the video. The quality of the tapes can be improved by dedicating a computer for this purpose and making first generation copies directly from the computer.

The sound on the video should be improved. This can be done by acquiring better recording equipment, like a good quality sound card and a decent microphone. The visual quality of the images and the vocal explanations should constantly be evaluated and efforts must be made to improve them. Better examples should replace the images that are not very good.

The video should also be put on DVD. DVD players have recently become much cheaper and have therefore become an alternative for a video player. When a video is often played such as in the library the quality of the video deteriorates. Using a DVD will solve the problem. The quality of a DVD is also much better.

Efforts must be made to get other histologists from other universities involved in the production of multimedia.

An important point to keep in mind is that all the learners are exposed to the video. Care must be taken that the important parts of the work are well covered in the video or DVD.

Because the video was so popular the production of a second video tape containing questions in the same format as in the tests and the exams should be considered. A video tape like this could be used for self testing and should provide the answers of the questions at the end of each test.

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The course should be structured in such a way that there is a direct relation between time spent, amount of work and marks that each section counts in the tests and the exam.

The practical and theory histology tests should be integrated into one test. Both these tests are in the form of multiple choice questions. A large bank of practical and theoretical multiple choice questions already exists. This would make it easy to switch to a computer-based test. A practical question could be asked followed by a related theoretical question.

Self tests as well as tests of which the results are sent to the lecturer to keep track of learners' progress should be included in the multimedia computer presentations.

Interaction between learners is desirable, therefore features that encourage interaction should be included in the multimedia computer presentations, such as a test where two learners compete with one another.

The images that are used in the tests should not be the same as the ones used in the presentations and in the video. The learners should be exposed to as many examples of the different tissues as possible.

In future doctors will make many of their diagnoses on a computer screen. Already diagnostic tools like X rays, CT scans, magnetic resonance, arthroscopy and sonar are becoming digital. With telemedicine doctors will have to diagnose diseases like skin conditions and pathology from digital images. The sooner a medical learner learns to become accustomed to and at ease with a computer screen the better.

5.4 Conclusion – How should histology be presented in future

Histology is currently taught with the aid of the following:

- Lectures – all topics are covered
- Practicals - consisting of a tutorial and practical microscopy
- CD – slightly more than half the course is available
- Video – made for revision of all the practical work
- Notes – no drawings are included
- Prescribed book – source for viewing drawings

The only ways that are utilised by all the learners are the notes and the video.

Because the retention of knowledge from attending a lecture is so low (The National Training laboratories, 1998., Online) ways of replacing lectures or some lectures should be investigated. If the lecturing time is used to cover fewer topics more thoroughly during shorter lectures, the retention of knowledge may improve. For a start some lectures (the ones with a lower cognitive content) can be replaced by multimedia computer presentations. Lecture time can then be used for the more difficult topics (topics with a higher cognitive content). This will also solve the problem, that was indicated by the learners, of too many lectures. Shorter lectures will also make it possible to concentrate during the whole lecture. Lecture topics will have to be evaluated by the lecturers or the learners or both to decide which lectures have a higher cognitive and which a lower cognitive content. Previous test results could also be used to identify more and less difficult topics. The lectures with a lower cognitive content should be replaced by computer presentations first.

To promote interaction (questions, suggestions) between learner and lecturer (which does not happen in the lecture hall at present) could be done through a chat room or by E mail. Compulsory tests can be included. In this way the lecturer will know who utilised

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the study material and who did not. The tests will also indicate the level of knowledge acquired by the learner while using the study material.

Because the current computer facilities at MEDUNSA available to learners cannot be used for group learning sessions or computer testing, it was decided to put up a new computer laboratory. To obtain a venue for this computer laboratory a new building will have to be built or one of the existing venues has to be changed into a computer facility (the cheapest option). For an institution that has difficulties in securing enough money to buy the computers for such a laboratory, building a new building is not an option. The histology laboratory in our department was identified as a venue for such a lab. At this stage the laboratory houses the microscopes that are used for the histology practicals. One of two options exists, such as:

- Keep the microscopes and install the computers with them in the same lab;
- Get rid of the microscopes and install the computers in the lab.

The first option is the more expensive option and would make the lab more cramped with a microscope and a computer sharing a desk. One of the aims of this study is to convince the stakeholders to take the second option. This would mean that the microscopes in the practical histology course will have to be replaced by computers.

The case against the time consuming way of teaching histology with the aid of a microscope is strong because there will be less time available in the new curriculum to teach learners histology and microscope skills are not required in the rest of the medical or dental course. This would not mean that medical doctors and dentists that qualify at MEDUNSA will have no microscope skills because learners use microscopes in their first year during their biology course. A number of the microscopes from the histology laboratory can be moved to a smaller venue (that exists) where learners that feel that they benefit from using the microscope can still use microscopes to study practical histology.

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If the learners that do their histology without the microscope are successful it will very soon convince the learners that are still using the microscope (if any) that the microscope is not a requirement for success in histology. Again the rule of choosing the easiest way of study should come into play.

Some histologists feel strongly about retaining the light microscope and may well see abandoning the light microscope in favour of the computer as a lowering of standards. If this transformation process from microscope to computer is properly executed with mechanisms in place to intercept and to deal with learners that fall behind, sceptics could be convinced of the merits and potential of presenting histology as an E-learning course.

A feature that will be included in the histology presentations of the future is the virtual microscope. The following table was drawn up comparing the features of the virtual microscope (Heidger et al, 2002), the light microscope, the CD and the video.

A comparison between the features of the light microscope, the virtual microscope, the CD and the video.

Table 5.4: Features of the light microscope and virtual microscope compared to the video and CD

Features	Light microscope		Virtual microscope		CD		Video	
	Yes	No	Yes	No	Yes	No	Yes	No
Shows the whole slide		X	X		X		X	
Needs to be focused	X			X		X		X
Can zoom in		X	X		X		X	
Light and condenser need to be adjusted	X			X		X		X
Only available in a histology laboratory	X			X		X		X
Must search to find appropriate objects	X		X			X		X
Tell the user what he is looking at		X		X	X		X	
Allows more than one person at a time to observe		X	X		X		X	
Interactive	X		X		X			X

Zooming in can be added in the program on CD and video if the developer feels that it is necessary.

A virtual microscope can be constructed by taking successive overlapping digital images through the microscope. From these images a montage can be made which links through “Hot spots” to the different images that were taken to get a “zoom in” effect.

The biggest drawback of the virtual microscope according to the users in the study done by Heidger et al (2002) is the fact that users are not told what they are looking at (as with the light microscope), when using the virtual microscope learners must still use a histology atlas to figure out what they are looking at.

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The development of a teaching tool like the virtual microscope which involves a huge effort would be futile if learners do not use it (Heidger et al, 2002). To make the virtual microscope more acceptable to learners, instructivist features will have to be included.

There is no question that the virtual microscope can be a very useful lecturing as well as teaching aid providing an innovative way can be found to force or convince learners to use it. Sitting in front of a microscope figuring out a histology slide is a constructivist process. The virtual microscope can change the new way of teaching into a constructivist way. The virtual microscope alone will not fill the gap left by the traditional light microscope but the clever use of the virtual microscope could replace the light microscope.

An option will be to take digital photographs of the slides that learners usually study during histology practicals, supply them to the learners who then have to annotate them. Figuring out the different cells and structures with the aid of a histology atlas and or the internet will be a constructivist exercise just like using the microscope. Adding this feature to the software will change it into a cognitive tool.

To promote collaborative learning through small group interaction, groups of learners could work together on the same assignment. The assignment can then be “handed in” by pasting the assignment on a bulletin board. This method will give insight into the learning that has taken place, something that is unknown when learners study using the microscope. A certain number of exam questions could be asked from these assignments.

If the alternatives are put into place one can safely recommend that the use of the light microscope as a tool for teaching practical histology can be removed from the curriculum for second year medical and dental learners. The time wasted sitting behind a microscope looking for cells and tissues can be utilised in a much more productive way.

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New histology multimedia computer presentations will be developed in a more advanced authoring tool like *Toolbook*. The existing *PowerPoint* multimedia computer presentations will be used as a basis.

Histology teaching programs are image intensive and vocal explanations are also important. Both these features increase file sizes. The sizes of the multimedia files and because few of our learners have internet access (most of our learners come from disadvantaged communities) do not make the internet an alternative for delivering the histology multimedia. Multimedia computer presentations should be delivered on CD Rom to our learners. This however does not exclude the web as a tool for communication between learners and lecturers. Efforts should be put into sparking the learners' interest in using the internet as a source of information because the internet will definitely play a major role in the medical practice of the future.

A website should be developed to convey additional or new information to learners as well as getting feedback. The following information should be available on such a website:

- Links to useful websites;
- Better examples of tissues (images);
- New theoretical information;
- A suggestion box to allow learners to give an input into the course and study material;
- Notification of errors in the study material by the lecturer;
- A chat room for learner interaction (collaboration) as well as learner lecturer interaction;
- A notice board for announcements;
- Self tests.

The challenge will be to develop a histology course that makes use of constructivist methods as well as collaborative learning. Collaborative learning is achieved when a group of learners book a TV room in the library to watch the video. Learners watching a video on histology together forms an ideal environment for discussion and collaborative learning.

The university should consider including a course in one or other multimedia authoring program (like *PowerPoint*) into the curriculum of all the courses.

Continuous evaluation and improvement of multimedia programs (computer presentations and videos) should take place. A system where a programmer and a designer are involved makes the process difficult while if the teacher performs all these functions this process is much more effective because any error in the program that comes to light can be corrected immediately. This ensures that new improved versions of the programs or videos become available all the time. This is however not always possible because not all lecturers will be either interested in or capable of performing all of these functions. Therefore the university should make facilities available where programmers and designers can assist lecturers in making multimedia programs.

The big advantage of instructional technology is the flexibility of the system. Why not give the learners an option to design their own course? Many learners want to attend classes and also want to attend practicals. Learners could be supplied with a practical replacement video and computer presentations but still be given the option to come and review some or all the slides under the microscope. This may also give learners a chance to become familiar with E-learning and may well have the effect that all learners will eventually only make use of the E-learning facilities.

5.5 Suggestions for further research and development

The following questions arose during this study:

Chapter 5 – Discussion and recommendations

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- The first suggestion for further research is to conduct a knowledge audit for histology. Masses of knowledge is added almost daily to the pool of knowledge in the medical field. Much of this knowledge must be added to the medical curriculum. Therefore some of the content that used to be taught must be sacrificed to make way for new, more important, knowledge. We must make sure that we equip learners with histology knowledge that they really need. A knowledge audit should be done by compiling a questionnaire and sending it to medical practitioners in the various fields of medicine.
- Does a good presentation on computer automatically mean a good lecture? More and more lecturers are lecturing with the aid of a data projector. With the aid of what is available on the internet and in textbooks it is not difficult to compile a very good presentation. When these presentations are shown to learners in many instances the lecturer becomes just a voice telling learners what they see on screen. This voice can even be added to the presentation. So at what point does the presence of the lecturer become unnecessary?
- This should be an ongoing study. During this study most learners spend only a limited time using the multimedia presentations. The questions raised during this study should be asked again to new learners who have used the multimedia more extensively. The questions should be divided into groups of a few questions each that could be added to a multiple choice test. This will prevent the tedious process of reading the results into a database. In this way questions that turn out to be ambiguous or questions that yield inconclusive results could be rephrased and asked again.
- Is achievement in mathematics and science the best criterion to select learners for the medical course? Will other school subjects not give a better indication of potential to study medicine?

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- Determine how the ideal standalone teaching program for histology should function. Most authors in the field of teaching histology with the aid of a computer give examples of what their programs look like. It seems that these teachers are all still experimenting with histology teaching programs and that nobody has yet determined how the ideal teaching program for histology should function.
- Animations may be very useful in explaining conceptual content of histology. A study could be done to determine the effectiveness of animations.
- A study to look into ways of teaching histology in a more constructivist way should be conducted. This could be done by supplying learners with only some of the information that they need which will then force them to construct knowledge by utilizing different sources.
- A study should be conducted into the role that culture plays in learning. At Medunsa we have learners coming from different cultural backgrounds and yet we treat them all exactly the same.
- Ways to improve multimedia presentations should be investigated. At Medunsa very few learners are English first language speakers. When conducting an oral examination one often becomes aware of learners that have problems expressing themselves properly in English. A poor command of the English language will have an influence on learners' ability to learn. A solution to this problem may be to offer learners alternative explanations for a topic and also to give learners the option of listening to explanations in a language of their choice. This may help learners that are studying in a second language to understand concepts and also help to improve their English.

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- The role that the internet can play in delivering the Histology course should also be investigated. As the internet gets faster and faster its ability to handle bigger files increases. The interaction that the internet provides between learner and lecturer can be very useful. If ways can be found to exploit this potential fully, histology can be developed into a distance training course.
- A lot of money and effort is going into developing and refining the virtual microscope. The value of some of the features that are build into the virtual microscope should be investigated. Is it really necessary to digitize a whole slide or does one only need to digitize a representative section of the slide? Some developers even build in a focusing option into the virtual microscope. This means that a huge number of out of focus images have to be taken which make the file sizes of the virtual microscope large as well as slower. Is it really necessary to build a shortcoming of the light microscope, manual focusing, into the virtual microscope?
- Many of the drawings that are found in histology textbooks were drawn originally by studying serial sections. It is possible to include serial sections in a multimedia computer presentation. A study should be done to see whether this will not bring constructivism into the learning process. Serial sections will allow learners to discover the three dimensional morphology of tissues for themselves.
- A study should also be done to see whether it is worth the effort to develop ones own programs or would it be better to buy a course that has already been developed. The cost for the learner as well as for the university should be investigated for both these approaches.
- Computer testing for histology should also be investigated. The computer opens a rich new variety of testing possibilities. Using the conventional written way of testing limits the lecturer to theoretical question and black and white images. The

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system that was used in this study for testing practical histology only allowed for identifying tissues and structures and answering by way of multiple choice. If the test is conducted on computer learners can for example be asked to identify structures by clicking on them. Many other creative ways of asking questions are also possible. A system of allowing learners to write the test when they are ready should also be investigated.

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APPENDIX

QUESTIONNAIRE ON THE HISTOLOGY COURSE

Please answer each question by **circling** an appropriate number in a **shaded box** or writing your answer in the **shaded space** provided

1. Which subsection of anatomy do you prefer most: 1 for most preferred and 4 for least favorite.

Gross		V2	<input type="text"/>	5
Embryology		V3	<input type="text"/>	6
Histology		V4	<input type="text"/>	7
Neuroanatomy		V5	<input type="text"/>	8

2. Why do you enjoy this subsection most? Rate the options by numbering from 1 to 4.

It is more relevant to the course		V6	<input type="text"/>	9
It is better presented		V7	<input type="text"/>	10
It is easier		V8	<input type="text"/>	11
More interesting		V9	<input type="text"/>	12

3. Rate the following from 1 to 6 in terms of your preferred methods of studying histology.

Notes		V10	<input type="text"/>	13
Prescribed book		V11	<input type="text"/>	14
Video		V12	<input type="text"/>	15
Multimedia		V13	<input type="text"/>	16
Attending lectures		V14	<input type="text"/>	17
Practicals		V15	<input type="text"/>	18

4. Which ONE of the following is true with regard to the prescribed histology book?

No I have not read the prescribed book	1	V16	<input type="text"/>	19
I have just looked up a few things.	2			
I have studied from the book	3			
I have started to study from the book, but gave it up	4			
The book is too complicated.	5			

5. Do you have access to the internet? (You may choose more than one answer)

No		V17	<input type="checkbox"/>	20
Yes – at Medunsa		V18	<input type="checkbox"/>	21
Yes - at home		V19	<input type="checkbox"/>	22
Yes – from a friend's computer.		V20	<input type="checkbox"/>	23

6. If your answer to Question 5 is YES then answer this Question

I looked for histology on the Internet	1	V21	<input type="checkbox"/>	24
I found histology websites on the Internet	2	V22	<input type="checkbox"/>	25
I found histology of the same standard as our course	3	V23	<input type="checkbox"/>	26
The histology that I found on the Internet was as good as the presentations that are available to us	4	V24	<input type="checkbox"/>	27
I found histology that was better than the Presentations that are available to us	5	V25	<input type="checkbox"/>	28
The histology that I found is not applicable to our course	6	V26	<input type="checkbox"/>	29

7. Can you afford a computer of R5000

Yes	1
No	2
If it is really worth it I will make a plan	3

V27 30

8. Rate the presentation of the **LECTURER** for each course component below.

Use the scale:

- 1** = Outstanding (O)
2 = Very good (VG)
3 = Good (G)
4 = Not good (NG)
5 = Bad (B)
6 = Very bad (VB)
7 = No comment – I did not attend (NC)

Block 1	O	VG	G	NG	B	VB	NC			
Epitheliums	1	2	3	4	5	6	7	V28	<input type="text"/>	31
Connective tissues	1	2	3	4	5	6	7	V29	<input type="text"/>	32
Cartilage	1	2	3	4	5	6	7	V30	<input type="text"/>	33
Bone	1	2	3	4	5	6	7	V31	<input type="text"/>	34
Lymphoid system	1	2	3	4	5	6	7	V32	<input type="text"/>	35
Muscle	1	2	3	4	5	6	7	V33	<input type="text"/>	36
Respiration	1	2	3	4	5	6	7	V34	<input type="text"/>	37
Vascular system	1	2	3	4	5	6	7	V35	<input type="text"/>	38

Block 2	O	VG	G	NG	B	VB	NC			
Neurohistology	1	2	3	4	5	6	7	V36	<input type="text"/>	39
Soft tissues of the mouth	1	2	3	4	5	6	7	V37	<input type="text"/>	40
Tooth development	1	2	3	4	5	6	7	V38	<input type="text"/>	41
Eye histology	1	2	3	4	5	6	7	V39	<input type="text"/>	42
Ear & olfactory epithelium	1	2	3	4	5	6	7	V40	<input type="text"/>	43

9a. If you **DID NOT ATTEND** or **LEFT** any histology lectures below, please give your **MAIN** reason

Epitheliums	
I find it difficult to concentrate in class	1
I did not like the way the lecture was presented	2
I have too many lectures to attend	3
I do not like the topic	4
I would rather put effort into reading gross anatomy	5
Personal reasons	6
I study the notes	7
I study the prescribed book	8
I watch the video	9
I use the histology multimedia programs	10

V41 44

9b. If you **DID NOT ATTEND** or **LEFT** any histology lectures below, please give your **MAIN** reason

Connective tissues	
I find it difficult to concentrate in class	1
I did not like the way the lecture was presented	2
I have too many lectures to attend	3
I do not like the topic	4
I would rather put effort into reading gross anatomy	5
Personal reasons	6
I study the notes	7
I study the prescribed book	8
I watch the video	9
I use the histology multimedia programs	10

V42 45

9c. If you **DID NOT ATTEND** or **LEFT** any histology lectures below, please give your **MAIN** reason

Cartilage	
I find it difficult to concentrate in class	1
I did not like the way the lecture was presented	2
I have too many lectures to attend	3
I do not like the topic	4
I would rather put effort into reading gross anatomy	5
Personal reasons	6
I study the notes	7
I study the prescribed book	8
I watch the video	9
I use the histology multimedia programs	10

V43 46

9d. If you **DID NOT ATTEND** or **LEFT** any histology lectures below, please give your **MAIN** reason

Bone	
I find it difficult to concentrate in class	1
I did not like the way the lecture was presented	2
I have too many lectures to attend	3
I do not like the topic	4
I would rather put effort into reading gross anatomy	5
Personal reasons	6
I study the notes	7
I study the prescribed book	8
I watch the video	9
I use the histology multimedia programs	10

V44 47

9e. If you **DID NOT ATTEND** or **LEFT** any histology lectures below, please give your **MAIN** reason

Lymphoid system	
I find it difficult to concentrate in class	1
I did not like the way the lecture was presented	2
I have too many lectures to attend	3
I do not like the topic	4
I would rather put effort into reading gross anatomy	5
Personal reasons	6
I study the notes	7
I study the prescribed book	8
I watch the video	9
I use the histology multimedia programs	10

V45 48

9f. If you **DID NOT ATTEND** or **LEFT** any histology lectures below, please give your **MAIN** reason

Muscle	
I find it difficult to concentrate in class	1
I did not like the way the lecture was presented	2
I have too many lectures to attend	3
I do not like the topic	4
I would rather put effort into reading gross anatomy	5
Personal reasons	6
I study the notes	7
I study the prescribed book	8
I watch the video	9
I use the histology multimedia programs	10

V46 49

9g. If you **DID NOT ATTEND** or **LEFT** any histology lectures below, please give your **MAIN** reason

Respiration	
I find it difficult to concentrate in class	1
I did not like the way the lecture was presented	2
I have too many lectures to attend	3
I do not like the topic	4
I would rather put effort into reading gross anatomy	5
Personal reasons	6
I study the notes	7
I study the prescribed book	8
I watch the video	9
I use the histology multimedia programs	10

V47 50

9h. If you **DID NOT ATTEND** or **LEFT** any histology lectures below, please give your **MAIN** reason

Vascular system	
I find it difficult to concentrate in class	1
I did not like the way the lecture was presented	2
I have too many lectures to attend	3
I do not like the topic	4
I would rather put effort into reading gross anatomy	5
Personal reasons	6
I study the notes	7
I study the prescribed book	8
I watch the video	9
I use the histology multimedia programs	10

V48 51

9i. If you **DID NOT ATTEND** or **LEFT** any histology lectures below, please give your **MAIN** reason

Neurohistology	
I find it difficult to concentrate in class	1
I did not like the way the lecture was presented	2
I have too many lectures to attend	3
I do not like the topic	4
I would rather put effort into reading gross anatomy	5
Personal reasons	6
I study the notes	7
I study the prescribed book	8
I watch the video	9
I use the histology multimedia programs	10

V49 52

- 9j. If you **DID NOT ATTEND** or **LEFT** any histology lectures below, please give your **MAIN** reason

Soft tissues of the mouth	
I find it difficult to concentrate in class	1
I did not like the way the lecture was presented	2
I have too many lectures to attend	3
I do not like the topic	4
I would rather put effort into reading gross anatomy	5
Personal reasons	6
I study the notes	7
I study the prescribed book	8
I watch the video	9
I use the histology multimedia programs	10

V50 53

- 9k. If you **DID NOT ATTEND** or **LEFT** any histology lectures below, please give your **MAIN** reason

Tooth development	
I find it difficult to concentrate in class	1
I did not like the way the lecture was presented	2
I have too many lectures to attend	3
I do not like the topic	4
I would rather put effort into reading gross anatomy	5
Personal reasons	6
I study the notes	7
I study the prescribed book	8
I watch the video	9
I use the histology multimedia programs	10

V51 54

- 9l. If you **DID NOT ATTEND** or **LEFT** any histology lectures below, please give your **MAIN** reason

Eye histology	
I find it difficult to concentrate in class	1
I did not like the way the lecture was presented	2
I have too many lectures to attend	3
I do not like the topic	4
I would rather put effort into reading gross anatomy	5
Personal reasons	6
I study the notes	7
I study the prescribed book	8
I watch the video	9
I use the histology multimedia programs	10

V52 55

9m. If you **DID NOT ATTEND** or **LEFT** any histology lectures below, please give your **MAIN** reason

Ear and olfactory epithelium	
I find it difficult to concentrate in class	1
I did not like the way the lecture was presented	2
I have too many lectures to attend	3
I do not like the topic	4
I would rather put effort into reading gross anatomy	5
Personal reasons	6
I study the notes	7
I study the prescribed book	8
I watch the video	9
I use the histology multimedia programs	10

V53 56

10a If you **DID NOT ATTEND** or **LEFT** any practicals below, please give your **MAIN** reason

Epitheliums	
I don't need to attend the practical I watch the video	1
I don't need to attend the practical I study the Multimedia programs on histology	2
The practicals are not necessary	3
I have difficulties with the microscope	4
I histology slides are confusing, I would rather put effort into gross anatomy	5
Personal reasons	6

V54 57

10b If you **DID NOT ATTEND** or **LEFT** any practicals below, please give your **MAIN** reason

Epitheliums	
I don't need to attend the practical I watch the video	1
I don't need to attend the practical I study the Multimedia programs on histology	2
The practicals are not necessary	3
I have difficulties with the microscope	4
I histology slides are confusing, I would rather put effort into gross anatomy	5
Personal reasons	6

V55 58

10c If you **DID NOT ATTEND** or **LEFT** any practicals below, please give your **MAIN** reason

Connective tissues	
I don't need to attend the practical I watch the video	1
I don't need to attend the practical I study the Multimedia programs on histology	2
The practicals are not necessary	3
I have difficulties with the microscope	4
I histology slides are confusing, I would rather put effort into gross anatomy	5
Personal reasons	6

V56 59

10d If you **DID NOT ATTEND** or **LEFT** any practicals below, please give your **MAIN** reason

Cartilage	
I don't need to attend the practical I watch the video	1
I don't need to attend the practical I study the Multimedia programs on histology	2
The practicals are not necessary	3
I have difficulties with the microscope	4
I histology slides are confusing, I would rather put effort into gross anatomy	5
Personal reasons	6

V57 60

10e If you **DID NOT ATTEND** or **LEFT** any practicals below, please give your **MAIN** reason

Bone	
I don't need to attend the practical I watch the video	1
I don't need to attend the practical I study the Multimedia programs on histology	2
The practicals are not necessary	3
I have difficulties with the microscope	4
I histology slides are confusing, I would rather put effort into gross anatomy	5
Personal reasons	6

V58 61

10f If you **DID NOT ATTEND** or **LEFT** any practicals below, please give your **MAIN** reason

Lymphoid system	
I don't need to attend the practical I watch the video	1
I don't need to attend the practical I study the Multimedia programs on histology	2
The practicals are not necessary	3
I have difficulties with the microscope	4
I histology slides are confusing, I would rather put effort into gross anatomy	5
Personal reasons	6

V59 62

10g If you **DID NOT ATTEND** or **LEFT** any practicals below, please give your **MAIN** reason

Muscle	
I don't need to attend the practical I watch the video	1
I don't need to attend the practical I study the Multimedia programs on histology	2
The practicals are not necessary	3
I have difficulties with the microscope	4
I histology slides are confusing, I would rather put effort into gross anatomy	5
Personal reasons	6

V60 63

10h If you **DID NOT ATTEND** or **LEFT** any practicals below, please give your **MAIN** reason

Respiration	
I don't need to attend the practical I watch the video	1
I don't need to attend the practical I study the Multimedia programs on histology	2
The practicals are not necessary	3
I have difficulties with the microscope	4
I histology slides are confusing, I would rather put effort into gross anatomy	5
Personal reasons	6

V61 64

10i If you **DID NOT ATTEND** or **LEFT** any practicals below, please give your **MAIN** reason

Vascular system	
I don't need to attend the practical I watch the video	1
I don't need to attend the practical I study the Multimedia programs on histology	2
The practicals are not necessary	3
I have difficulties with the microscope	4
I histology slides are confusing, I would rather put effort into gross anatomy	5
Personal reasons	6

V62 65

10j If you **DID NOT ATTEND** or **LEFT** any practicals below, please give your **MAIN** reason

Neurohistology	
I don't need to attend the practical I watch the video	1
I don't need to attend the practical I study the Multimedia programs on histology	2
The practicals are not necessary	3
I have difficulties with the microscope	4
I histology slides are confusing, I would rather put effort into gross anatomy	5
Personal reasons	6

V63 66

10k If you **DID NOT ATTEND** or **LEFT** any practicals below, please give your **MAIN** reason

Soft tissues of the mouth	
I don't need to attend the practical I watch the video	1
I don't need to attend the practical I study the Multimedia programs on histology	2
The practicals are not necessary	3
I have difficulties with the microscope	4
I histology slides are confusing, I would rather put effort into gross anatomy	5
Personal reasons	6

V64 67

10l If you **DID NOT ATTEND** or **LEFT** any practicals below, please give your **MAIN** reason

Eye histology	
I don't need to attend the practical I watch the video	1
I don't need to attend the practical I study the Multimedia programs on histology	2
The practicals are not necessary	3
I have difficulties with the microscope	4
I histology slides are confusing, I would rather put effort into gross anatomy	5
Personal reasons	6

V65 68

10m. If you **DID NOT ATTEND** or **LEFT** any practicals below, please give your **MAIN** reason

Ear and olfactory epithelium	
I don't need to attend the practical I watch the video	1
I don't need to attend the practical I study the Multimedia programs on histology	2
The practicals are not necessary	3
I have difficulties with the microscope	4
I histology slides are confusing, I would rather put effort into gross anatomy	5
Personal reasons	6

V66 69

11. Have you ever left a histology lecture before the end? (Choose only one)

Never	1
Once	2
Regularly	3
Everytime	4

V67 70

12. If you did leave a histology lecture, or lectures, before the end which of the following is/are applicable?

It was during the same lecturer/s lecture/s	1	V68	<input type="text"/>	71
I could no long concentrate	2	V69	<input type="text"/>	72
The lecture was too long	3	V70	<input type="text"/>	73
I could study the work on my own from the notes or textbook	4	V71	<input type="text"/>	74
The lecture was boring	5	V72	<input type="text"/>	75
I decided rather to look at the video or computer presentation	6	V73	<input type="text"/>	76
I was tired because I had not had enough sleep	7	V74	<input type="text"/>	77

13. Are you unable to concentrate during lectures?
(Choose only one)

Never	1	V75	<input type="text"/>	78
Sometimes	2			
Only when listening to certain lecturers	3			
When the lecture gets too long	4			
Never during the first lecture	5			
Only when I have not had enough sleep	6			

14. Do you think you have to attend to many lectures?

Yes, because there is too much to absorb	1	V76	<input type="text"/>	79
No, but I would prefer longer breaks inbetween	2			
No, I can sit through the lectures and concentrate all the time	3			
The lectures should be shorter and certain topics should be left for self-study	4			
Some lectures should be replaced by computer presentations	5			
All lectures should be replaced by computer presentations	6			

15. Which lectures do you think are vital and cannot be missed? (Choose the ones applicable)

Gross anatomy	1	V77	<input type="checkbox"/>	80
Embryology	2	V78	<input type="checkbox"/>	81
Histology	3	V79	<input type="checkbox"/>	82
Neuroanatomy	4	V80	<input type="checkbox"/>	83
Lecture can be caught up later	5	V81	<input type="checkbox"/>	84

16. For what reason(s) should these lectures not be missed? (Choose the appropriate one/s)

The information cannot be found anywhere else	1	V82	<input type="checkbox"/>	85
The lecturer clears up difficult concepts	2	V83	<input type="checkbox"/>	86
The lecturer gives useful tips for the test	3	V84	<input type="checkbox"/>	87
The lectures are enjoyable	4	V85	<input type="checkbox"/>	88
My sense of duty doesn't allow me to stay away	5	V86	<input type="checkbox"/>	89

17. How would you rate a lecture given with the aid of a computer and a data projector?

Better than a traditional lecture (Using the chalk board, slides and overhead projector)	1	V87	<input type="checkbox"/>	90
Not as good as a traditional lectures	2			
The same as a traditional lecture	3			
Some are better, while others are not	4			
I wish all my lectures were given in this way	5			

18. Did you use the multimedia material that was available?

Did not use it	1	V88	<input type="checkbox"/>	91
Used some of it during Block 1	2			
Used some of it during Block 2	3			
Used only the multimedia for Block 1	4			
Used only the multimedia for Block 2	5			
Used it all	6			

19. I did not make use of the multimedia programs available because: (Choose the primary reason)

Don't know about computers	1
Did not know about the programs	2
Did not have time	3
Looked at it but decided it was not worth it (don't need it)	4
The computers were always occupied	5

V89 92

Non computer users go to Question 34 and carry on from there!

20. I used some of the multimedia programs available because: (Choose the primary reason)

I struggled with the computer	1
The computer programs were too difficult to use	2
Some of the programs were good and other were not good	3
I decided it was not worth it (don't need it) after I started to use it	4
The computers were always occupied	5

V90 93

21. How much time did you spend on the histology multimedia? (Choose the appropriate one)

2 – 4 hours	1
4 – 6 hours	2
6 – 8 hours	3
More than 8 hours	4

V91 94

22. Are the colours used in the programs clear and pleasing to the eye?

Yes	1
No	2
Did not notice the colors	3

V92 95

23. Are the font type and letter size easy to read?

Yes	1
No	2

V93 96

24. Is the text simple, readable and easy to follow?

Yes, always	1
Not always	2
No	3

V94 97

25. **Layout:** Are the pictures and text well laid out?

Yes, always	1
Not always	2
No	3

V95 98

26. Are the pictures used effectively?

Yes, always	1
Not always	2
No	3

V96 99

27. Is it easy to use the program?

Yes	1
No	2

V97 100

28. Are the instructions clear and easy to understand?

Yes, all instructions are clear	1
Not all the instructions are clear	2
Instructions are not clear at all	3

V98 101

29. Is it easy to move through the programs i.e. find specific topics available in the program?

Yes, it is simple to navigate	1
Not everything is clear	2
Instruction are not clear at all	3

V99 102

30. Does using the program get easier as you use the program more and more?

Yes, it gets easier	1	V100 <input type="text"/> 103
No, it is clear from the beginning	2	
No, it is still complicated after having used it a couple of times	3	

31. Is the use of speech helpful/necessary?

Speech is very important in the program	1	V101 <input type="text"/> 104
Speech helps but is not that important	2	
I seldom used the sound	3	
Sound is not important and is unnecessary	4	

32. Is the work well explained?

Always	1	V102 <input type="text"/> 105
Most of the times	2	
Only a few topics are well explained	3	
No topic is well explained	4	

33. Is the work systematically explained?

The sequence is mixed up in all cases	1	V103 <input type="text"/> 106
The sequence is mixed up in some cases	2	
The sequence is not bad but could be improved	3	
The sequence is correct	4	

34. How many times did you watch the video?
(Choose the applicable one)

Once	1	V104 <input type="text"/> 107
Twice	2	
Three times	3	
Four times	4	
More than four times	5	

35. If you watch the video where do you normally watch the video? (Choose the applicable response)

In the library	1
In the residence	2
On you own video machine	3
On a friend's video machine	4
On a borrowed video machine	5

V105 108

36. When you watched the video in the library the following applied:

I had problems finding a booking	1
I could easily find a booking	2
The video machines are always in working order	3
The video machines are not always in working order	4
The quality of the video is satisfactory	5
The quality of the video is not always good	6

V106 109

37. Is the multimedia on a computer better than using a microscope? (Choose the appropriate one)

Much better	1
Not better	2
The same	3
The computer can completely replace the microscope	3

V107 110

38. Does the programs make it easier to remember the work? (Is your recollection better?)

No	1
Yes	2
There is no difference	3

V108 111

39. Are the programs enjoyable to use?

Yes	1
No, I prefer to read the notes	2
No, I prefer to watch the video	3
No, I prefer to read the prescribed book	4
No, but it is better than reading the notes	5

V109 112

40. Did you do better in the topics where programs are available?

No	1
Yes	2
Some are better and other not	3
There is no difference	4

V110 113

41. Did you spend more time on histology than you would have if there were not computer programs available?

No	1
Yes	2
The programs make no difference	3

V111 114

42. Was it difficult to get help when you had a problem with the program?

Yes	1
No	2

V112 115

43. Could your fellow students help you with a problem?

Sometimes	1
Always	2
Sometimes we could not solve the problem	3

V113 116

44. Did you help some other student with a problem?

Never	1
Once	2
A couple of times	3
Never	4

V114 117

45. Were there many errors in the programs that you can identify?

Many	1
A few	2
I couldn't find any	3

V115 118

46. Were there navigational errors in the programs that you can identify?

Many	1
A few	2
Couldn't find any	3

V116 119

47. Were there many technical problems when you used the programs?

Never	1
Program wouldn't run	2
A red cross was displayed sometimes	3
Computers crashed	4
CD rom wouldn't read the CD	5

V117 120

48. What is your considered opinion on the histology course and the availability offerings of a multimedia environment? (Choose only one answer)

Multimedia can completely replace the histology course	1
Multimedia histology should be supported by practicals and lectures	2
Multimedia histology should be supported by lectures	3
Multimedia histology should be supported by practicals	4
Multimedia should only be additional, for those interested	5

V118 121

49. A multimedia session done on a computer is better than a traditional lecture: (Choose only one)

No	1
Depends on the lecture	2
Depends on the computer presentation	3
A good computer presentation is better than any lecture	4
A computer presentation is for revision	5

V119 122

50. Do you prefer a video more than an interactive computer presentation? (Choose only one)

Yes, I would prefer to use videos as an additional way of studying histology	1	V120	<input type="text"/>	123
I would like to watch the histology video in addition to computer presentations	2			
Videos are not necessary when you have interactive computer presentations	3			

51. Did the programs change you attitude (rating of) towards histology? Did it make you enjoy histology more?

Yes, a little	1	V121	<input type="text"/>	124
Yes, a lot	2			
No	3			

52. What computer did you use the program on? Write in the mHz.

Medunsa's computer	1	V122	<input type="text"/>	125
My own Pentium I ...	2			
My own Pentium II ...	3			
My own Pentium III ...	4			

53. If I put a big effort into the theory of Histology:

I will do well	1	V123	<input type="text"/>	126
I may still fail	2			
I will only get an average mark	3			
I rather put in a big effort into practical histology	4			
I rather spend the time on gross or embryology	5			

54. If I put in a big effort into practical Histology:

I will do well	1	V124	<input type="text"/>	127
I may still fail	2			
I will only get an average mark	3			
I rather put in a big effort into the histology theory	4			
I rather spend the time on gross or embryology	5			