

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.

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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.