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Improving Practical Instruction in Veterinary Gross Anatomy with Multimedia Based Preparation

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Abstract

This paper describes and discusses work towards the improvement of the teaching and learning of the regional anatomy of the dog in veterinary science classes. The study of this topic in many veterinary schools entails repeated use of preserved dog cadavers. While the use of preserved specimens is a conventional and widely adopted approach in the study of anatomy in many veterinary schools, it is a practice that has several inherent problems. These problems are related to the repeated use and storage of preserved tissue, and the artificial appearance and texture of such specimens. The work reported here sought to address these concerns with an approach to the teaching and learning of this topic with multimedia-based preparation materials and the use of non-preserved specimens for dissection. An evaluation of this effort was conducted with the help of a print-based questionnaire. Students reported that the use of fresh tissues encouraged them to learn anatomical details, and that the multimedia-based preparation materials were helpful in getting a clearer idea of what was to follow in the dissection sessions and in the surgical processes.

Instructional Context

In the initial years of the Bachelor in Veterinary Science course in most veterinary schools, the teaching of anatomy introduces students to the terminology and structures of most of the domestic animals. This knowledge base is enhanced later on in the course during their studies in general and systematic pathology, surgery, medicine, obstetrics and reproduction, and in diagnostic imaging. Instruction in veterinary anatomy has traditionally been provided with lectures and integrated practical classes utilising practical dissection of the dog as a type species for a regional focus. At The University of Melbourne, the regional dissection of the dog is a pivotal component of the Bachelor in Veterinary Science (B. V. Sc.) course since it provides the most coherent study of the structure of the animal body as a whole.

Until recently the regional dissection of the dog involved twenty-two practical sessions directly, and also shared some elements with a further three sessions. This activity totalled sixty-four hours altogether and spanned an entire semester (three months). It required that dog cadavers be preserved and then utilised repeatedly over the three-month period. Students performed the dissections on these preserved dog cadavers with the help of a commercially available dissection guide, supplemented by a small accompanying manual produced in-house by the Veterinary Anatomy Section which emphasised functional and applied aspects as well as specifying the

level of detailed knowledge required. Assessment of this component of the course is by practical examination using appropriate specimens in a ‘round robin’ type format at the end of the teaching year.

As indicated above, the timetabling of this practical component of the course had been traditionally confined to a single semester. This was more a reflection of technical and economic necessity (i.e., logistics of storing preserved cadavers, deterioration of these over time, and the expense of providing more than one cadaver per student group), rather than a reflection of the inherent academic value of the use of preserved cadavers in the exploration of dog anatomy. In addition the use of fixed dog cadavers necessitated that a somewhat semi-regional approach to dissection was adopted, for example, forelimb muscles were studied separately from forelimb vessels and nerves. This timetabling had also resulted in completion of the dog dissection prior to any theoretical instruction in some body systems and there was no possibility for formal integration of the dog dissection sessions with much of the systematic instruction.

Instructional Problem

While the dissection of the preserved dog is a conventional and widely utilised approach in the study of regional anatomy in many veterinary schools including that of The University of Melbourne, it has some inherent problems, such as:

- preserved tissues lack the texture, colour, and appearance of fresh tissues, and thus give an inappropriate impression of normal structures;
- handling and cutting of this preserved tissue is quite unlike cutting fresh material, so it does not adequately prepare the students for handling fresh tissue during surgery and autopsy examination;
- the concentrated focus on a single cadaver by each practical group does not necessarily prepare the students for the range of normal variations in anatomy that occur between animals;
- it has been noted that, over time, students become focussed on the processes of dissection rather than the exploration and investigation of structure and anatomical relations;
- undergraduate students are exposed to potentially toxic chemicals, such as formaldehyde used in tissue preservation; and
- adequate preservation of cadavers is inconsistent with a resultant wastage of both material and human resources.

A common approach to addressing such weaknesses in cadaver dissection courses is to use various ‘enhancements’ such as text or graphic-based supplements, audio-visual carousels or real-time demonstrations. These components are additional to the core dissection activity but they require ‘more of the same’ from the student in the form of reading and interpretation, or are relegated to acting as revision material to be used following the dissection session. Real-time demonstrations are much too dependent on teaching staff being uniformly energetic in providing consistently beneficial learning experiences. The initial approach in the Veterinary School at The University of Melbourne comprised a text-based enhancement as a supplement

to the commercial dissection guide. This approach was not consistently successful as the concurrent use of two 'texts' confused some students while others followed one and ignored the other. The teaching staff believed that it was important that a regional treatment was retained in the course as it relates readily to many of the functional and applied aspects of the discipline, such as clinical diagnostics and surgery. Obviously then, a more fundamental change was necessary to effectively address the shortcomings of the regional dissection course.

Solution Options

Our attention was drawn to the reconstruction of the human anatomy course in the Medical Faculty at The University of Melbourne in which pre-dissection preparation sessions preceded the dissection classes. A strength of this model was that this approach aimed at informing the students of the appropriate anatomy and providing them with a focus on the functionality and applicability of anatomy to the study of medicine before dissection. Students then approached the dissection session with a more informed and focused attitude, which had the potential to encourage learning. This comprised a sound model for teaching and learning in this area and we considered it to be just as applicable to Veterinary Anatomy. As such it formed the basis of this veterinary school's next attempt to improve the educational value of the dog dissection course.

However, the Medical School's preparation sessions were resource intensive in terms of both material resources and staffing, which could not be matched by the Veterinary School. It was considered that the most likely way to be able to remodel the dog dissection course was to utilise some computer-based elements in the preparation sessions which could be integrated with the limited amount of material resources available and also allay some of the staffing problems. Unfortunately lack of time and funds to engage in the creation of these computer-based resources basically kept this idea at the conceptual stages. This was the situation until The University of Melbourne embarked on a concerted effort to promote the integration of multimedia educational technologies in its teaching programs, and provided funds to enable projects such as this one to begin real development.

The adoption of multimedia-based technology in facilitating the teaching and learning processes in veterinary anatomy was considered very appropriate. This was because of the ability of the medium to demonstrate motion, display high quality graphics, incorporate sound, and most importantly, enable user interactivity, which could encourage an active learning approach to the material. In addition, it would take advantage of an increasingly computer-literate student population.

Learning and Teaching Architecture

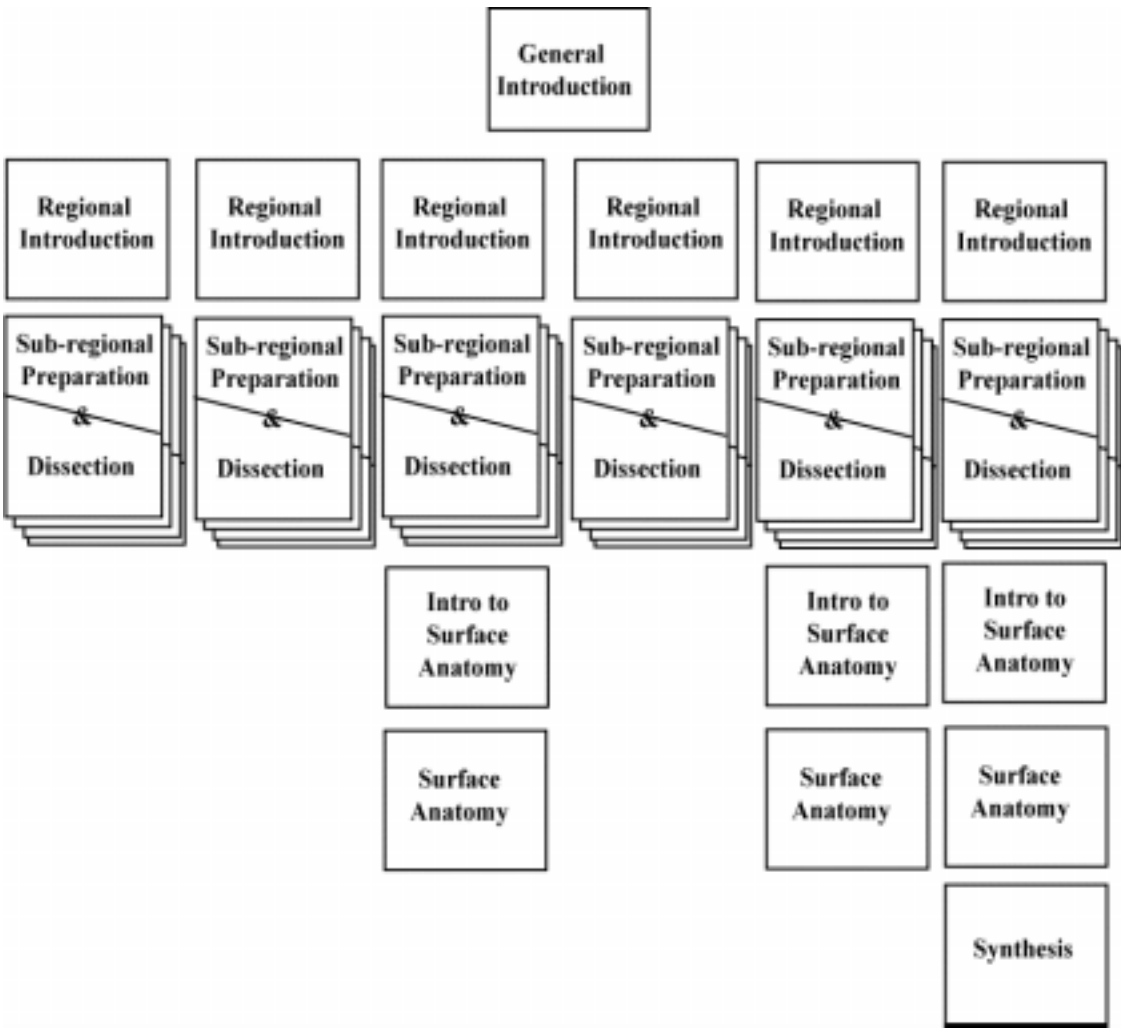
In 1998 major changes were made to the structure of the veterinary curriculum at The University of Melbourne which necessitated that the model of separate pre-dissection preparation sessions and dissection classes be introduced immediately. It was also decided to 'trial' the use of fresh dissection specimens instead of preserved cadavers. Use of fresh specimens for dissection would enable students to experience the real appearance, nature, and handling qualities of normal tissues *in situ*. It would also help them learn correct instrument handling techniques on natural tissues in preparation for later instruction in the course such as in pathology and surgery. This practice necessitated the development of revised dissection

procedures, as the commercial text used was no longer appropriate. Additional written material covering introductory, overview and surface anatomy sessions was also required.

The following instructional format was developed (see Figure 1). This comprised the following introductory sessions, preparation sessions, dissection classes and associated surface anatomy sessions.

- A general introductory session of 30 minutes (mini lecture),
- 6 regional introductory sessions of 40 minutes each (mini lectures),
- 24 sub-regional preparatory sessions of 1 hour each (4 sessions per body region – computer-based),
- 24 sub-regional dissection sessions of 1 hour each (laboratory dissection),
- 3 introduction to surface anatomy sessions of 30 minutes each (mini lectures),
- 3 regional surface anatomy sessions of 30 minutes each (live animal),
- A synthesis and discussion session of 1 hour.

Figure 1: The Revised Instructional Format



Whereas previously the time allocated to dissection was spent entirely in the dissection laboratory, it would now be more varied and 'modular' to some extent, which would also allow some flexibility in timetabling and delivery. This approach meant that body regions being

studied in the dog dissection course could be integrated more readily with some of the appropriate systems-based lecture topics, which would help to reinforce important anatomical concepts as well as information.

General Introductory Session

This is a half-hour lecture that describes the nature, content and organization of the various classes. It introduces students to the concept of 'regional anatomy' and how it relates to body systems. Body regions that will be studied in the course are specified. General instructions on laboratory procedures (e.g., instrument handling, dissection technique safety and cleanliness) and use of the computer modules are also outlined.

Regional Introductory Sessions

A half-hour lecture describes the body region and its boundaries including the sub-regions that will be encountered. With the help of simple graphics, the various body systems and their components are identified. This session also introduces students to the functional and applied themes that will be investigated in each of the sub-regions.

Sub-regional Preparation Session

This is a half-to one-hour computer-based preparation session for each sub-region that is studied in the course. In these sessions students work through a slide show/computer module which illustrates structures of the sub-region in a systematic way. Photographs are used to illustrate the relevant structures and features of sub-regional body systems. Some of the same photographs are used repeatedly with different system components identified to demonstrate different relationships. Orientation graphics and illustrations are used to assist the students in their understanding of these relationships. Components of sub-regions that are revisited are incorporated as self-test quiz slides.

Systematic instruction is accompanied by a list of references that students can consult while working through each module. Each sub-regional preparation module includes a functional theme illustrating the role of a particular system within the sub-region, encouraging students to think in terms of 'structure/function' relationships. Sub-regional preparation sessions conclude with a graphic sequence depicting the clinical procedure that is to be simulated at the commencement of the subsequent dissection class. A short digital video of this clinical procedure is also provided to assist the students in this particular activity.

Sub-regional Dissection Session

This is a typical dissection class of 1 to 2 hours duration which utilises a specifically written dissection procedure assisting the students to identify those structures/features presented in the preceding corresponding preparation module. The class commences with students performing a simulation of a clinical procedure relevant to the sub-region that is under study. During the dissection session students are led to investigate the structural mechanism relevant to the functional theme.

Introduction to Surface Anatomy Session

This is a half-hour lecture that describes and illustrates those surface landmarks or features pertaining to the previously studied region(s), which will be examined in the subsequent live-animal class. This session also includes other domestic species as well as the dog (e.g., cow and horse). These sessions cover between 1 and 3 body regions. This arrangement was essentially due to the surface anatomy classes being held off-site requiring transportation of students and accommodating a tight timetable.

Surface Anatomy Class

These are live-animal exercises using dogs, horses and cattle. Students perform these exercises in small groups rotating each half-hour through the different species. In these exercises students work through a list of surface features and attempt to locate and identify these with some input from staff who are there to assist and emphasise any functional or applied aspect of relevance to the regions studied.

Synthesis Session

This is a half to one-hour graphics intensive group lecture session which is focussed on presenting the structure of the animal body as a whole and the integration of the various body systems as well their functions. The applicability of the regional approach is re-emphasised as an introduction to clinical studies that follow the completion of this dissection course.

Printed Manual

A printed manual is available for student's use during the preparation and the dissection sessions as well as the surface anatomy classes. This manual includes notes relevant to all the introductory and synthesis sessions. Anatomical structures and features are included with reference to descriptions and illustrations to supplement the preparatory modules. Brief outlines are included of functional themes with illustrations similar to those presented in the related preparatory module, along with descriptions of the simulated clinical procedures with accompanying photographs (as available in the computer-based modules). The manual also carries the dissection procedures for each sub-region.

Rationale of this Architecture

For the general, regional and surface anatomy introductory sessions, as well as the synthesis session, the mini-lecture format was considered the most suitable approach for presenting this material to students. The photographs and illustrations that are used in these mini lectures are reproduced in the printed manual to enable students to focus on the emphasis placed on these images during these sessions.

For the sub-regional preparation sessions, however, computer-based instruction was adopted as a presentation medium for the following reasons:

- the possibility of achieving high graphic clarity;
- economic reproduction and distribution of high quality graphics;

- potential for incorporation of motion and sound (important in presenting functional and some applied aspects of anatomy and giving emphasis to selected material);
- flexibility in delivery – accessible outside scheduled classes/potential for self pacing; and
- the production of readily and economically updateable material.

The utilisation of the classic 'hands-on' approach in the dissection sessions, using non-formalised specimens was essential in enabling students to not only appreciate normal animal structure but be able to investigate the 'structural/functional' relationships in the sub-regions. The use of non-preserved specimens is designed to enable students to become familiar with the nature of 'natural animal tissue' including its handling characteristics. In such a learning environment students are also able to gain the relevant experience in the use of instruments and their actions on 'natural' tissues. The use of simulated clinical procedures emphasised the relevance and applicability of anatomy to their future clinical studies. These components hopefully act as a motivational strategy in encouraging students to want to pursue study in a traditionally rather 'dry' and fact-dominant subject.

For the surface anatomy sessions, it is imperative that live-animal classes are used to introduce students to the appearance and nature of the animal body in its normal state, and also demonstrate the real world applicability of their anatomical knowledge.

Development

Once the instructional format was defined, the development of the instructional materials was an apparent process, although, not without its own problems. The adoption of the sequence of separate but integrated preparation and dissection sessions is an idea that has been tried and tested before in the teaching of human anatomy and physiology. Therefore, although this was a novel approach in the teaching of veterinary anatomy in this school, it was not entirely a new concept. First, the supporting modules (i.e., introductory, surface anatomy and synthesis sessions) had to be formulated. Next the regions and sub-regions were to be defined including the identification of functional and applied themes for each sub-region. The dissection of each sub-region was performed, recorded and photographed. The dissection procedure was refined, and the structures, features, organs and systems of relevance were identified and listed. Introductory outlines and the functional theme outlines could be written now and appropriate graphics selected and produced. The writing of the clinical procedure simulation followed with the selection and/or production of appropriate graphics and video. Finally the construction of the computer-based instructional modules followed -- incorporating relevant graphics and appropriate quizzes.

The Development Team

The instructional materials development team comprised the following personnel: two academics (who were anatomy teachers and veterinarians with clinical experience); two ancillary academics (veterinary systematic content experts); one dissector/resource producer (veterinary graduate with teaching experience); one technical assistant (with general laboratory and preparatory skills); one graphic artist/designer; and one digital imaging consultant.

Implementation

The sessions which comprise the various components of any given body region are loosely integrated into the systematic anatomy course of lectures and practical classes. Particular sub-regions are studied along with relevant systemic topics (e.g., thoracic region with cardiovascular system, forelimb region with musculo-skeletal system). The 'general' introductory session is followed immediately by a 'regional' introductory session, which is followed by a sub-regional preparatory session and then the relevant dissection session. Three regions are completed before the introduction to surface anatomy session, which covered all of these regions. The whole class of 70 students in this cohort receive the group lecture-based sessions at the same time. Students work in pairs through the preparatory modules during scheduled classes with input from staff when required. Groups of between two and six students carry out the dissections with the help of written procedures with assistance from demonstrators if and when requested. These group sizes vary depending on particular sub-regions. Some sub-regions require whole bodies while others use only portions and in this case multiple specimens can be accommodated on each dissection table. Students work in groups of six during the surface anatomy classes. This number was felt appropriate for the students and the animals being examined.

Evaluation

Evaluation of the impact of the multimedia-based preparation materials was focussed on its use and utility to undergraduate students in the practical sections of the study of regional anatomy of the dog course. By *use* and *utility*, we meant the extent to which the multimedia-based preparation materials helped this group of students perform particular dissection procedures; recognise features of the dog's anatomy and how these features (bones and muscles) worked. It also inquired into why students were able or unable to experience these outcomes.

Instrumentation

A questionnaire with structured and open-ended response items was used to gather this data towards the end of the semester. A two-phased procedure was adopted in the design and development of this questionnaire. In the first phase, subject matter experts (there were two of them in this case) were presented with a semi-structured *proforma*, which they were asked to use to identify the focus of the evaluation. The questions posed in this *proforma* focussed on the following areas: learning goals/outcomes, design architecture, delivery attributes, and the learning process (See Appendix A). The subject matter experts were asked to respond to several questions on each one of these areas. For example, on 'learning goals/outcomes' they were asked to identify 'what are the learning goals or outcomes for your students? What is unique about these learning goals? What are your instructional goals? And what is unique about these instructional goals?' For each one of these questions they were also required to reflect on what evaluation strategy/instrumentation they could, or might like to use to gather the necessary data and also to find out whether, and to what extent these goals had been achieved.

The purpose of this activity was to focus the subject matter experts' thinking on issues of critical importance from the learning and teaching perspective, and there were several advantages in adopting this design and development strategy for the evaluation phase of this project. Firstly, it offered a structure for the subject matter experts to focus their thinking.

Their thoughts captured in this manner provided material for negotiation amongst the team on areas that we needed to concentrate (issues that we needed to evaluate) on and those that were either not relevant for this project or not so important. This activity in itself served to validate not only the focus and content of the evaluation but also the instrumentation for gathering such data. It was important that we collect data on the most essential features and with the most appropriate instrumentation and this procedure enabled us to facilitate this process.

This developmental process led to the identification by us of the precise areas and issues on which we agreed to focus our evaluation. It is interesting to note that this final set of areas and issues were not all of those that we initially thought we needed to evaluate. This is to suggest that without a systematic process for identifying the areas of real interest, chances are that a great deal of time and effort could be (and often has been) wasted in collecting data of no real interest to anyone. This set of issues became the focus of our evaluation. Since we were interested in students' individual perceptions of the computer-based learning exercises, we developed question items which required students to provide both a quantitative response as well an explanation of their response (See Appendix B: Evaluation Questionnaire). An external evaluator administered this questionnaire in one of the special sessions of the class towards the end of the semester. Names of respondents were not required on the returned questionnaires.

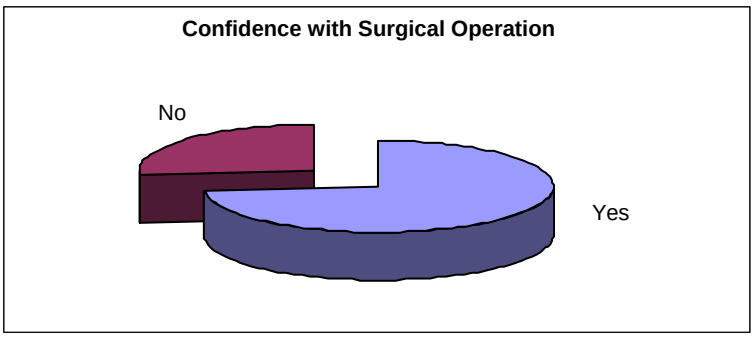
Data Analysis and Discussion

The quantitative data derived from the questionnaire was summarised using Microsoft Excel^{TM}. The qualitative comments of the respondents have been used in this paper to explain their quantitative judgements.

Confidence with Surgical Processes

Foremost, as part of our evaluation, we were interested in knowing if the computer-based preparation had any impact on the confidence levels of students with the surgical approach, and the dissection session that followed, and if it helped them readily identify the structures and features in the sub-region under study.

Figure 2: Confidence With Surgical Operation



On the whole students felt that being able to watch a demonstration gave them a 'visual idea' of what was to follow. Seventy five percent of the respondents felt that the multimedia-based preparation sessions did help their confidence levels as it enabled them get 'some idea of what they were about to do, and see clear pictures of what it should look like', and also 'become aware of the anatomical landmarks'. Twenty-five percent of the group didn't find the multimedia preparation materials of any use in improving their confidence levels.

The disappointments that students had with the utility of the multimedia preparation in the dissection sessions had to do mostly with the technical quality of the video and some of the computer generated images.

"The video (the times that I saw it) did not have sound and focussed only on the surgery site so finding it during the dissection relative to other structures wasn't possible. The video was often of poor quality. The surgical film is very small with very little resolution on the MAC Screens."

It also seems that many students found the treatment of the content for dissection somewhat insufficient.

"Not detailed enough especially with respect to blood vessels and nerves. No transverse or cross-sections were provided with labels. Because the surgery on the computer was only for the initial incision and did not include deeper structures. It had no bearing on how to do the dissection. The digital video was not very clear either."

Given these observations, it is not surprising that some of the students did not experience substantially improved levels of confidence with the surgical procedures that followed the multimedia preparations sessions.

Some students found the multimedia preparation session 'helpful in the surgical approach' and others felt that 'knowing where the major muscles, arteries, veins were before starting, enabled them to proceed with confidence.' A majority (seventy-one percent) of the student group found that the multimedia-based preparation materials actually helped them proceed with the dissection more confidently. It is important to recognise that twenty-four percent of the group did not think this was so for them.

Figure 3: Confidence With Dissection

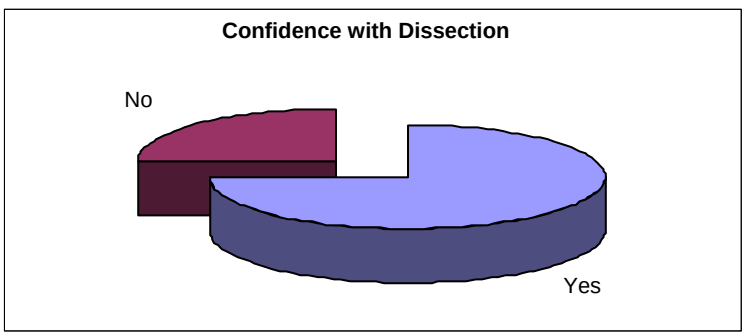


Figure 3. Confidence with dissection.

Several problems were identified with the multimedia-based preparation material that can help explain this outcome.

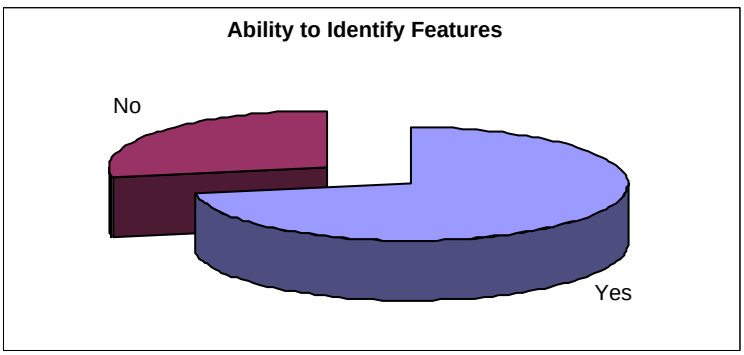
“The multimedia preparation was especially helpful for the initial surgical approach but ultimately we fell back on the written/typed sheets. Only a fraction of material was covered by multimedia. The slides were no good for that. The digital video was not very clear either. The session on the computer was often not directly related to the dissection (i.e., it was in the wrong sequence). It did not help with the actual dissection.’

‘Not detailed enough especially with respect to blood vessels and nerves. No transverse or cross-sections were provided with labels. These are needed. The RAD is not always clear if the picture we are shown is too close up—meaning that it is hard for us to orientate ourselves in some of the pictures given.’

‘In some of the slides presented, it was hard to get my bearings, i.e., what end was up? Hard to tell on the small screen. Easy to identify, but hard to find exact areas of insertion/origin.’

There was one thing that the multimedia-based preparation materials were useful for, and that was in enabling students readily identify the structures and features in the sub-region under study. Many (seventy percent of the group) claimed that ‘although nothing beats getting in there and correctly orienting yourself…the multimedia preparation materials was very useful for orientating in a new area’.

Figure 4: Ability to Identify Features



Still there were many problems with orientation for some of the students (at least twenty-seven percent). Most of these problems had to do with the manner in which the material was presented (zoomed in or out, step-by-step etc.) and the quality of some of the pictures.

‘Sometimes the view was too close-up so didn’t even know what you are looking at. Needed to zoom out, then zoom in. Close up shots need to be accompanied, at all times, with a wider view first.’

‘The diagrams/slides were too complicated to follow after muscles have been removed from their origins. Should show step by step removal of muscle one by one.’

‘Pictures in the RAD multimedia did not identify clearly or label clearly some of the more obscure structures. Hard to tell on the small screen. Some of the pictures on the computer were really hard to make out. Often the photographs in the presentation were difficult to orient and so made finding the structures while dissecting difficult. The pictures were often unidentifiable

(red and bloody mess)----need to indicate cranial/caudal, dorsal/ventral orientation, say which muscles have been removed. Sometimes photographs were unclear (but overall very good).'

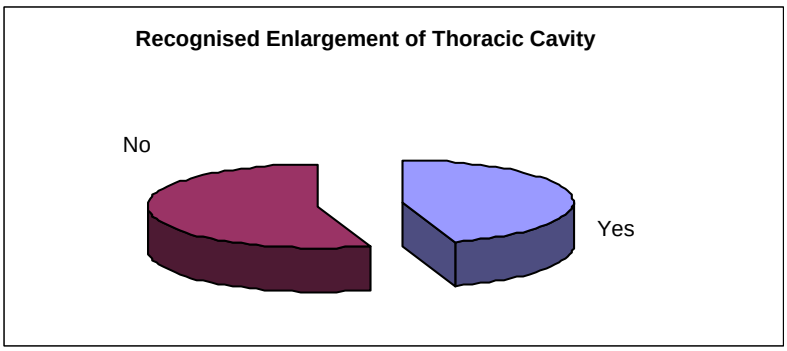
'Orientation was sometimes not clear on the slides. In some of the slides presented, it was hard to get my bearings, i.e., what end was up?'

Recognising Body Functions

Next, we wanted to find out if the multimedia preparation materials enabled students to recognise particular body functions. The two body functions we focussed on were: how enlargement of the thoracic cavity results in expansion of the lungs; and how irritation of the phrenic nerve might result in synchronous diaphragmatic flutter.

So, did the multimedia preparation materials enable this group of students to recognise how 'enlargement of the thoracic cavity results in expansion of the lungs'? Well, not quite. This student group seemed fairly evenly divided on this one. In fact, a little more of them thought that multimedia preparation materials did not enable them to recognise how enlargement of the thoracic cavity resulted in expansion of the lungs (44 percent no, to 37 yes).

Figure 5: Recognised Enlargement of Thoracic Cavity



From those who had found the multimedia preparation materials helpful in recognising how the enlargement of the thoracic cavity resulted in expansion of the lungs (thirty-seven percent of them in this case), we wanted to know what specific feature(s) of the preparation session had enabled them to achieve that? So we asked them to identify those specific features and this is what they identified and said.

- 'Clear labelling.'
- 'The balloon in syringe demonstration.'
- 'The talk before the actual dissection and the computer slides.'
- 'Showing the way that the units move, external and internal intercostal muscles.'
- 'The details on the relevant muscles and describing their alignment in relation to their operation.'
- "Just seeing how all of the thoracic components come together relative to one another and get an appreciation of the sizes and location of things tangibly helped."

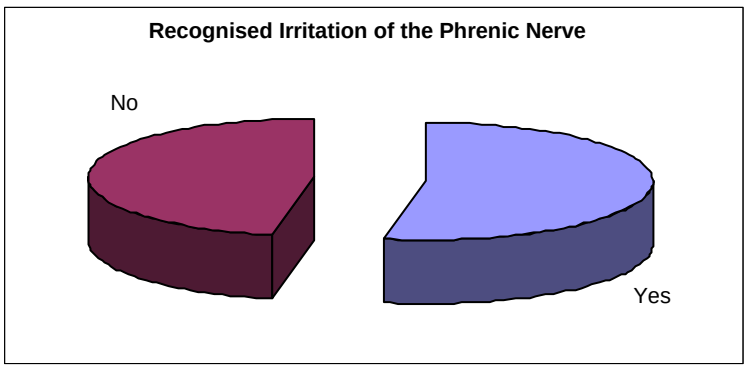
- "I knew how it happened already, but this showed how the direction of muscle fibres for expiration and inspiration, and their contraction contributed to movement of thoracic wall."

From those who had *not* found the multimedia preparation materials helpful in recognising how the enlargement of the thoracic cavity resulted in expansion of the lungs (forty-four percent of them in this case), we wanted to know, what they thought was the problem? This is what they pointed at:

- 'It was hard to determine actual extent of thoracic cavity and how structures were used to expand it. This was easier to understand/observe in the dissection class.'
- 'There was only the structures involved, the expansion wasn't clear.'
- '3-D maybe, to look from a different angle.'
- 'The movement of muscles is not demonstrated.'
- 'No diagrammatic drawing of how this occurs, just photos of gross anatomy.'
- 'Not really explained at all.'

Now onto the second body function…did the multimedia preparation materials enable this group of students recognise how 'irritation of the phrenic nerve might result in synchronous diaphragmatic flutter'? Once again, a similar experience was recorded. This student group seemed fairly evenly divided on this one too. A little more of them thought the multimedia preparation materials enabled them to recognise how irritation of the phrenic nerve might result in synchronous diaphragmatic flutter (43 percent yes, to 38 percent no).

Figure 6: Recognised Irritation of the Phrenic Nerve



From those who found the multimedia preparation materials helpful in recognising how 'irritation of the phrenic nerve might result in synchronous diaphragmatic flutter' (forty-three percent in this case), we wanted to know what specific feature(s) of the materials had enabled them to achieve that? This is what they identified and said:

- 'Clear nerve passing over the heart and contracting the diaphragm. Great slide!!!'
- 'When following the nerve passing over the heart, it could be seen joining the diaphragm. Shown where it crosses over heart clearly and labelled.'
- 'Because the surrounding tissue was cleared from the heart and phrenic nerve. It was very easy to see the relationship between the nerve and the diaphragm.'
- 'Good clear pictures with accompanying description.'
- 'Good description of the processes that occur to cause thumps.'

And from those who had *not* found the multimedia preparation materials helpful in recognising how 'irritation of the phrenic nerve might result in synchronous diaphragmatic flutter' (thirty-eight percent of them in this case), we wanted to know, what they thought was the problem? This is what they pointed at:

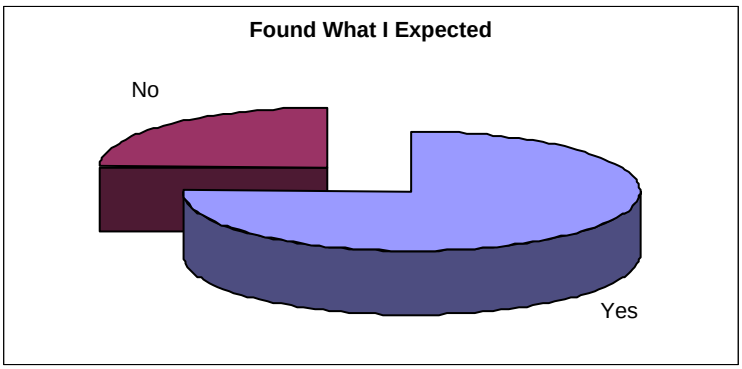
- 'Unclear.'
- 'Seemed to show just where the nerve ran and not what it did.'
- 'Not much written details supplied on the computer programs. It is more useful for the location and relative location of structures grossly.'

From the Dissection Session

Next, we wanted to know if, from the dissection session, students were able to see, do and achieve certain types of understanding that we expected to occur. These were: being able to find what they expected to find; being able to develop a mental picture of the course of the *vagus* nerve through the thorax; being able to palpate the third intercostal space; and finally, being able to insert a needle into the right ventricle of the heart.

First, during the dissection session, were the students able to find what they expected? The majority (seventy-three percent) of the group found what they expected to find. A smaller number (twenty-four percent) of the group were unable to do this.

Figure 7: Found What I Expected



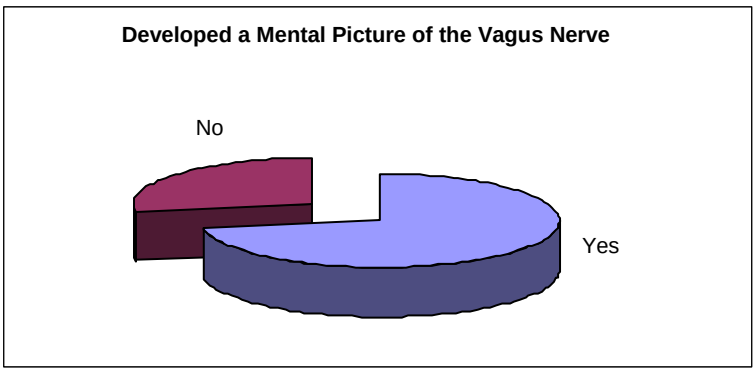
Why some of the students were unable to find what they expected was a concern for us. So we asked students if that was the case for them, then what did they think was the problem? The problems they identified related to the manner, in which the task was attempted, some level of haste and carelessness on their own part, and sometimes the quality of specimen as well was a problem. Here is a selection of the problems identified by students, in no special order of importance or frequency.

- 'Often I was lost when I got to the detail because the program didn't show it well.'
- 'Often we manage to sever, remove or damage material before we came to looking at it.'
- 'Sometimes the dogs were in relatively poor condition and we would mess up the dissection.'

- ‘Making nervous incisions into muscles.’
- ‘Sometimes it was bit difficult especially when starting and a few of the practicals there was too little time.’
- ‘It is sometimes hard to identify small vessels and nerves. Many are in close proximity and look the same. It can be difficult to differentiate these.’
- ‘Stubborn group members and too many people per dog. Practical too stressful. Dissection procedure not detailed/specific enough. Could not pre-read for practical since notes were not given out until in practical room.’
- ‘The problem of not seeing certain structures were, at times, due to the illogical way the dissection procedures was written (shifting from one region to another without being notified in the notes).’
- ‘Some of the structures can be found theoretically but practically it is very hard to find.’

As teachers of this subject matter, we have often had difficulty with getting students to develop a mental picture of the course of various nerves and muscles in a dog’s anatomy. So we asked students if from the dissection session, they were able to achieve such a mental picture of the course of the *vagus* nerve passing through the thorax. The bulk of the student group (sixty-eight percent) had no problems developing such a mental image.

Figure 8: Developed Metal Picture of Passage of the Vagus Nerve



We were interested in knowing if there were specific features of the dissection session that enabled them to develop this mental picture. We asked them that and most of their responses suggested learning by doing, or being explained the path of the nerve either via the multimedia-based preparation session or by a demonstrator.

- ‘Opening of thoraxis cavity helped me.’
- ‘Actually seeing the nerve made it stick in my mind.’
- ‘Dissecting and following it. Do it and see it rather than imagine it.’
- ‘Basically going through it with demonstrator.’
- ‘You could actually follow the nerve and see where it went.’
- ‘Preparation session.’

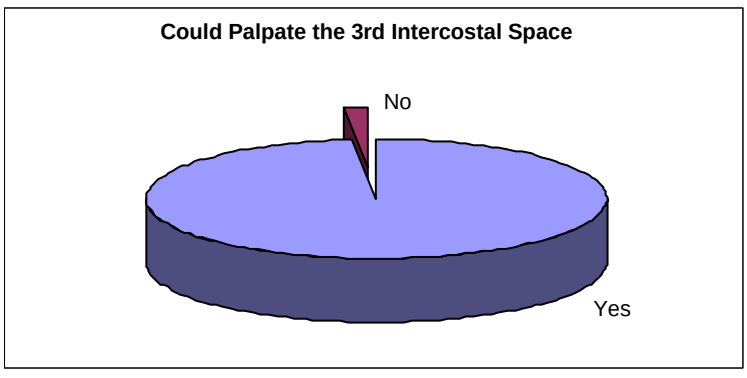
- 'The *vagus* nerve within our dog was very clear especially after the multimedia session. This was true for most structures (esp. vessels and nerves).'
- 'Being able to move around objects in the thoracic cavity and seeing how the nerve sat relative to these.'
- 'RAD presentation was very helpful. It would have been harder if we relied just on the dissection.'

Twenty-five percent of this student group was unable to achieve this mental image. So what did they think was the problem? Some of their problems were concerned with the multimedia-based preparation session, and others with the nature and amount of information that was provided.

- 'Holes in the pathway and found them difficult to visualise.'
- 'I needed to look at the specimen in order to orientate myself and picture what is where.'
- 'More explanation in the notes is needed regarding exactly where we are looking and where it runs.'
- 'Would be good if had 'maps' of vessels on the multimedia program because nerves and vessels etc. are hard to picture and track their course.'
- 'RAD failed to give overall picture centred on specific bits. If you could have a general revision slide showing how everything fits together.'
- 'It wasn't clear exactly how long the nerve ran from. It would have been better to place indicators to where it ran even if you couldn't see the parts on the multimedia session.'

As shown in Figure 9, almost all of the students in this cohort (ninety-four percent) were able to 'palpate the third intercostal space'.

Figure 9: Palpate the 3rd Intercostal Space



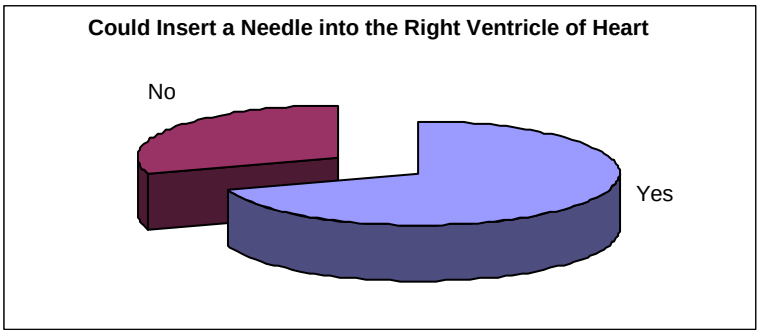
What specific feature(s) of the dissection session enabled them to be able to do this was of interest to us, so we inquired into that. Many of the comments pointed to the usefulness of the multimedia-based preparation session.

- 'This was shown on the multimedia (video) and was easy to find.'

- 'By feeling along the rib cage and the visual picture that was given in the multimedia sessions.'
- 'But only after reading (was not in procedure) text as to its position, cardial to scapula.'
- 'Feel the ribs and count from backward i.e. Cardial to cranial to find the third space.'
- 'From the RAD I got an idea where the space was, although I wasn't certain that it was correct until I took the leg off and saw it was the correct ribs.'
- 'Clear image from multimedia presentation of where to locate 3rd intercostal space.'
- 'The video gave a clear dissection procedure and exactly where the third intercostal space was.'
- 'The dissection note and knowledge gained from lectures.'

Interestingly though, not as many of the students could "insert a needle into the right ventricle of the heart'. Only sixty-seven percent of the student group was able to do this task.

Figure 10: Could Insert Needle into Right Ventricle



These students identified a number of features that enabled them to achieve this task. Some of the most commonly mentioned ones are cited in the following.

- 'It was really the lectures which helped me do this.'
- 'It took a few goes, but with help I was able to withdraw some blood.'
- 'Instructions on dissection procedure sheet.'
- 'Used the intercostal space as landmarks.'
- 'Being able to appreciate location of Right Ventricle in relation to the rest of the body."
- 'We were able to identify specific portions of the heart from knowledge on landmarks on the external (pericardial) surface.'
- 'Videos, 3rd and 4th intercostal space. Demonstrator help.'

Why were twenty-nine percent of the students unable to do that? Here is selection of some of the commonly cited reasons, many of which had to do with the specimen itself.

- 'The dog was too frozen.'

- ‘Fat dog, heart shifted position.’
- ‘Our dog was too big for the needle.’
- ‘The heart had tipped backwards due to damage of the diaphragm.’
- ‘The directions in the presentation were clear, however, the heart of the dog we were dissecting had moved in relation to its normal position, so we were unable to locate it where it should have been.’
- ‘The heart had moved back further into the thoracic-cavity. It may have hit the heart but no blood could be drawn out. It may have coagulated or possibly hit the wrong part of the heart.’

Use of Fresh Tissues and Specimens

A major impetus of this project was the inherent problems we have faced in the practical dissection of the dog as a type species in the study of its regional anatomy. This component of the course (comprising a total of 64 hours of study spanning a period of 3 months) requires that dog cadavers be preserved and then utilised repetitively during this time. While this is a traditional and widely utilised approach, it has inherent problems.

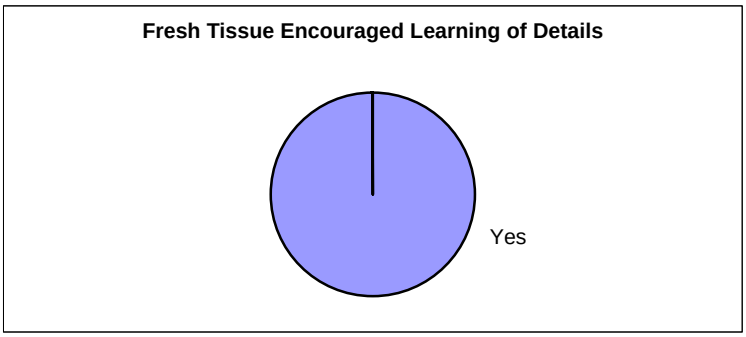
The preserved tissues lack the texture, colour, and appearance of fresh tissues, and thus give an inappropriate impression of normal structures. The handling and cutting of this preserved tissue is quite unlike cutting fresh material, so it does not adequately prepare the students for handling fresh tissue during surgery and autopsy examination. And the concentrated focus on a single cadaver by each practical group does not necessarily prepare the students for the range of normal variations in anatomy that occur between animals. These are only some of the problems with using preserved tissues and specimens in teaching the subject.

The use of fresh tissue and specimens for these dissection classes would allow students to experience the appearance, nature, and handling qualities of normal tissues *in situ*, as well as to begin to learn correct instrument handling techniques on natural tissues in preparation for later instruction in the course, in particular Pathology and Surgery.

As part of our evaluation we asked students a couple of questions about the use of fresh tissues and specimens in this project. These were concerned with whether the use of fresh tissue and specimens encouraged them to ‘want to learn anatomical details’; if it encouraged them to ‘try to remember anatomical details’; and finally if ‘being able to manipulate fresh specimens enabled them to clearly see how muscles act on bones to move them’?

So, did the use of fresh tissues and specimens ‘encourage students to want to learn anatomical details’. There was resounding yes to this question and no doubt about it at all.

Figure 11: Fresh Tissue Encouraged Learning of Details

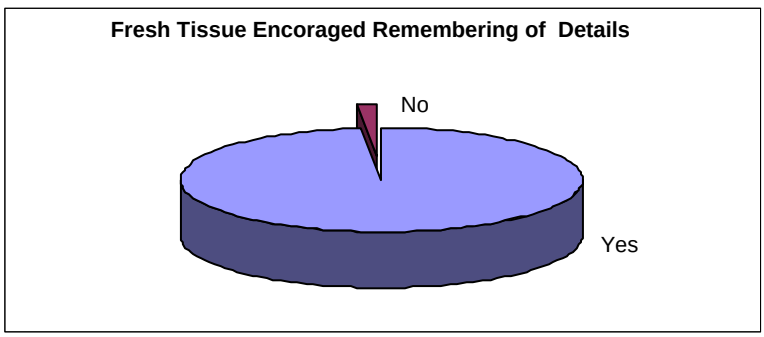


The reasons for this were quite obvious and unanimous.

- 'The use of fresh specimens is much more pleasant and realistic.'
- 'It was certainly much more 'inviting' to be working on fresh dogs. We also saw a lot which is not visible on dog which has been preserved/treated with Formaldehyde.'

Next, did the use of fresh tissues and specimens encourage them 'to try to remember anatomical details'? Again there was a resounding yes to this question.

Figure 12: Fresh Tissue Encouraged Remembering of Details

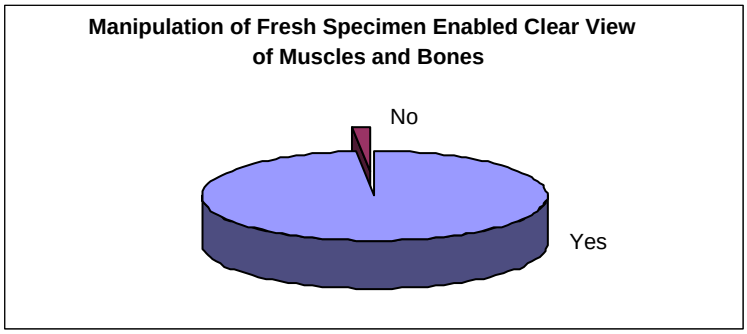


What were the reasons for this? Quite simple.

- 'Fresh specimens are really good. Details (e.g. Muscle definition) easier to see, not as smelly.'
- 'I liked fresh tissues very much, also good getting different dog each time. Starting from fresh helped in revision.'

Finally, we asked students if being able to manipulate fresh specimens enabled them to clearly 'see how muscles act on bones to move them'? Once again their answers were a resounding yes.

Figure 13: Manipulation of Fresh Specimen enabled clear view of Muscles and Bones



We asked students, if this were the case then, could they specify the specific feature(s) of the dissection session that enabled them to see that? Many of their comments had to do with the use of fresh tissue and specimen, a selection of which are produced below:

- 'I could see tendon attachments working.'
- 'Palpation of specific sites. When pulling tendons and muscles it was possible to see how the bones responded/acted and how joints moved etc.'
- 'Use of fresh specimen each week. Also revision dogs can look at different groups of muscles working together and hence gain a better understanding of how they all fit.'
- 'Use of fresh specimens i.e. before the tendons had become hard and crusty was useful.'
- 'Able to see the real colour of the tissues without the formalin smell. The fresh muscle still had the rigid strength as if it were a dissection in surgery.'

Conclusion

Much of what is taught and learned in the early stages of veterinary anatomy is of a factual and procedural nature. All students are expected to know this declarative information (i.e., the structural/functional relationships in sub-regional dog anatomy, dissection instrument handling, dissection technique safety and cleanliness). This information does not change over several years with a change in the instructors or even veterinary schools. To have instructors of this subject matter produce their own materials is not only time and resource intensive, but could be unethical as the chances of variation in the content increases with each version, and depending on the choices made by individual instructors, possibly advantaging or disadvantaging different student cohorts. It makes good sense then to prepare and produce these materials in a manner such that the same material forms the basis of the teaching of this subject by different instructors over a number of offers (no doubt with their own individual idiosyncrasies). This was one of the principal motivations of the work that is reported on in this paper.

The advantages of developing a set of instructional materials that is considered by a team of professionals as consistent and valid in the profession and in the subject matter domain has many advantages. Firstly, in being delivered in an electronic form, these materials can be more readily and economically updated. Moreover, these instructional materials are a product of a team effort which comprises not only more than one subject matter or content expert, but

several other professionals who bring to this working environment skills and expertise in message design, and the communication of that message to novices. By its very nature, such a collaborative working environment has the built-in mechanisms to ensure a high quality process, as well as product. The instructional materials developed in this environment will necessarily reflect a collective and negotiated view by professional veterinarians and veterinary science teachers of what is necessary and acceptable during study at that level in the domain. This is important not only for certification in the profession but ensuring reliability of service and practice in it.

The work reported in this paper is about improving the teaching and learning of the 'regional anatomy' of the dog in veterinary science classes at The University of Melbourne. In the past the study of this subject entailed repeated use of preserved dog cadavers. While the dissection of the preserved specimens is a conventional and widely utilised approach in the study of the regional anatomy of the dog in many veterinary schools, this practice has several problems which are related to the repeated use and storage of preserved tissue. Attempts at helping this situation with the use of text- and graphic-based enhancements have not been too successful.

Clearly a fundamental change in the approach to the teaching and learning of this subject was necessary to address its shortcomings. This change needed to focus on the structure/function relationships in sub-regional anatomy in the preparation sessions of the course. To ensure that the preparation sessions didn't turn out to consume too much of staff time, multimedia-based materials were considered most appropriate as it had the capacity to incorporate high quality graphics, visuals, and also demonstrate motion and sound. Along with this change, fresh specimens began to be used.

An evaluation of this effort (with external input) was carried out. This exercise focussed on the use and utility by students of the multimedia-based preparation materials, as well as their experience with fresh specimens. A print-based questionnaire with structured and open-ended response items was used for this purpose. Its focus was on ascertaining the effects on students of the revised instructional format on such things as their confidence with surgical processes, ability to recognise body parts and functions, and of the use of fresh tissues and specimens.

On the whole students felt that multimedia-based materials with its attendant visuals and moving images gave them a clearer idea of what was to follow in the dissection sessions. The few disappointments they had with the utility of the multimedia preparation materials in the dissection sessions had to do mostly with the technical quality of the videos and the images. Students found that the multimedia preparation materials helpful in the surgical approaches. They also said that knowing where the major muscles, arteries and veins were before starting dissection, enabled them to proceed with confidence. Finally, nearly all students felt that the use of fresh tissues and specimens had a positive impact on their motivation to learn anatomical details. For the instructors, this was the most interesting and satisfying outcome of all.

Acknowledgment

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Appendix A:Focusing the Evaluation

Focusing the Evaluation *Proforma*		
Learning Goals/Outcomes	**Evaluation Strategy**	**Instrumentation**
1. What are the 'learning goals or outcomes' for your students?		
2. What is unique about these learning goals (e.g. in comparison with conventional practices)?		
3. What are your 'instructional goals' (as teachers of this subject)?		
4. What is unique about these instructional goals (e.g. in comparison with conventional practices)?		
Design Architecture	**Evaluation Strategy**	**Instrumentation**
1. List attributes of this approach to the study of dog dissection that are of particular interest to you?		
2. Why are these of particular interest?		
3. What problem or weakness in the teaching of dog anatomy is this curriculum addressing/changing?		
4. How is this curriculum changing or addressing this perceived weakness?		
Delivery Attributes	**Evaluation Strategy**	**Instrumentation**
1. What is unique about the delivery mode of this curriculum? (i.e., as self-instructional mode, interaction, just-in-time access)		
2. What is unique about the selected delivery mode?		
3. How is this delivery mode addressing a need in existing methods of teaching dog anatomy and dissection?		

Learning Process	**Evaluation Strategy**	**Instrumentation**
1. What about the learning process is this curriculum changing?		
2. How is this curriculum changing that learning process?		
3. What about the current practices in the teaching of dog anatomy and dissection is this curriculum changing?		
4. How is this curriculum changing these practices/processes?		

Appendix B:Evaluation Questionnaire

RADog Multimedia Dissection Preparation Session Evaluation Questionnaire

Instructions: *We are interested in your experience with the RADog multimedia assisted dissection course. The information you provide here will have no bearing at all on your assessment in this course. Please respond to all the questions in the spaces provided and if you give us your name, we will be able to help you with your concerns later on.*

Your Name (OPTIONAL*)*:

1. The multimedia preparation session enabled me to:

	Yes	No	If no, why not?
• perform the surgical approach with confidence.			
• proceed with the dissection confidently.			
• readily identify the structures and features in the sub-region under study.			

2a. The multimedia preparation session enabled me to recognize how:

- enlargement of the thoracic cavity results in expansion of the lungs.

☐ Yes

if yes – What specific feature(s) of the preparation session enabled you to achieve that?

.....

.....

if no – What do you think was the problem?

☐ No

. .....

... .

2b.The multimedia preparation session enabled me to recognize how:

- irritation of the phrenic nerve might result in synchronous diaphragmatic flutter (thumps).

☐ Yes

if yes – What specific feature(s) of the preparation session enabled you to achieve that?

.....

.....

☐ No

if no – What do you think was the problem?

.....

.....

3. During the dissection session I found what I expected to find.

☐ Yes

.....

.....

☐ No

if no – What do you think was the problem?

.....

.....

4a. From the dissection session:

- I developed a mental picture of the course of the vagus nerve through the thorax.

☐ Yes

if yes – What specific feature(s) of the dissection session enabled you to do that?

.....

.....

☐ No

if no – Why do you think you were unable to achieve that?

.....

.....

4b. From the dissection session:

- I could palpate the third intercostal space.

☐ Yes

if yes – What specific feature(s) of the dissection session enabled you to do that?

.....

.....

☐ No

if no – Why were you unable to do that?

.....

.....

4c. From the dissection session:

- I could insert a needle into the right ventricle of the heart.

☐ Yes

if yes – What specific feature(s) of the dissection session enabled you to do that?

.....

.....

☐ No

if no – Why were you unable to do that?

.....

.....

5. The use of fresh tissues and specimens:

	Yes	No	If no, why not
encouraged me to want to learn anatomical details.			
encouraged me to try to remember anatomical details.			

6. Being able to manipulate fresh specimens enabled me to clearly see how muscles act on bones to move them.

☐ Yes

if yes - What specific feature(s) of the dissection session enabled you to see that?

.....

.....

☐ No

if no – Why were you unable to see that?

.....

.....