Student perceptions of problem topics/concepts in a traditional veterinary anatomy course

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ABSTRACT

While particular attention is paid to the nature and content of anatomy curricula, little has been published about the actual problem topics/concepts experienced by students of anatomy. This information is relevant to modifying existing courses and methods of teaching. The present study thus sought to identify, by means of a questionnaire administered to students of veterinary anatomy, perceived problem topics, the possible reasons for the problems, as well as student suggestions for solving the problems. A wide range of problem topics was identified by this survey, of which neuroanatomy, neurohistology and organogenesis recurred most frequently. A major reason given for the problems experienced was an inability to conceptualise 3-dimensional structures. Students requested more time, more lectures and appealed for a reduction in detail of textual information. Many of the problems experienced by this group of students are reflected in other studies of veterinary, medical and dental students, which suggests the existence of 'universal' problem topics in the various fields of anatomy. We believe that these universal problem topics exist in many anatomy courses, despite the application of innovative teaching methods and advanced audio-visual technologies. Only by identifying these topics can suitable strategies (within the constraints of the particular curriculum) be devised to resolve them.

Key words: anatomy, embryology, histology, problem topics/concepts, student perceptions.

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INTRODUCTION

The importance of anatomy as an essential component of veterinary and medical curricula has been emphasised in a number of studies[6,22]. In a recent survey of medical residency programmes in the USA, the majority of programmes rated gross anatomy as extremely important or very important. Gross anatomy was also ranked 'first' in order of importance by more programmes more often than any other basic science[6]. Although it is acknowledged that gross anatomy plays a pivotal role in the training of veterinary and medical professionals, a persistent and continuing erosion of the time available for teaching anatomy, together with concomitant loss of academic staff, has become an all too familiar reality[2,4,6,13,14,18]. This has led to an ongoing programme by many anatomy departments to modify their curricula and teaching methods, leading in some instances to the merging of gross anatomy with related subjects such as histology and embryology[6]. It is imperative, therefore, in view of the changes that have occurred, to carefully consider any factors that may adversely affect the efficient teaching and learning of anatomy, and as far as possible, to eliminate them.

Teachers of anatomy are well aware that certain topics/concepts within the fields of gross anatomy, histology and embryology regularly pose problems for students. These problems are believed to be chiefly of a conceptual nature. Students are required to visualise 3-dimensional (3D) structure in order to understand and learn the relevant information. In a subject such as embryology, this problem is often compounded when 3D changes occur across a 4th dimension, namely time. The perception among teaching staff that anatomy presents unique and challenging problems has been highlighted in a recent survey of medical students at the University of Natal, South Africa (D Manning, W Loening, D Sanders, University of Natal, unpubl. data, 1993), in which the students identified anatomy and physiology as the most difficult subjects to understand. Although there is a general awareness among academics that certain fields of anatomy pose problems for students, no data, as far as we are able to establish, are available to enable a meaningful assessment of the situation. This lack of data originates in part from a perception amongst some veterinary educators that the existence of problem topics in anatomy is 'common knowledge', an assertion that is not reflected in the literature.

Students who are admitted to the veterinary science course at the University of Pretoria are stringently selected, chiefly on the basis of their performance during the 1st year of university tuition. While these students have a high intellectual capacity, many experience difficulties in the basic sciences. It was thus the aim of this study to assess which topics/concepts in anatomy, histology and embryology were perceived as problematic by undergraduate students in veterinary science. The outcome of this study could then be used to address and alleviate the identified problems. A questionnaire was designed to gather information from students regarding which topics/concepts they found problematic, to give possible reasons for the problems experienced, and to suggest possible solutions.

Course description

Anatomy (including an embryology component) and histology courses are presented in the 2nd year of the veterinary science curriculum at the University of Pretoria, South Africa. The anatomy course is species-based and divided into 2 semesters of 15 weeks (160 hours) each. In the 1st semester, canine anatomy is studied in detail, while feline anatomy is offered as a comparative course. The focus during the 2nd semester is on important aspects of comparative anatomy, and the horse, bovine, pig and sheep are studied. Courses in avian and piscine anatomy are also presented during the 2nd semester. Students write 4 tests during each semester. A final examination is held at the end of each semester.

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The canine and comparative anatomy courses are presented in the traditional manner, *i.e.* by dissection and didactic lectures. In total, 320 hours are devoted to the study of gross anatomy. Approximately 10 % of the time allocated is dedicated to formal lectures, mainly at the beginning of the 1st semester, for teaching introductory anatomy, basic embryology and neuroanatomy. The students spend the rest of the time (90 %) in the dissection hall, where gross anatomy is studied by dissection and self-study. The dissection periods are structured and the students are issued with a formal study manual and dissection guide. Four students are assigned to the dissection of each animal. Four lecturers are present during the dissections to assist students (n = 100), resulting in a student: lecturer ratio of 25:1. Prosections are available for each section of the course and are permanently accessible in a study area adjacent to the dissection hall. A selection of appropriate videos in anatomy is available in the study area. Use is also made of wall charts, painted skeletons (to demonstrate muscular attachments) and appropriate radiographs. Each section of the course is concluded with a tutorial and the palpation of relevant anatomical structures on live animals.

The embryology component is presented as a series of lectures, using blackboard drawings, overhead transparencies and 35 mm slides, and is taught mainly during the 1st semester. A practical session involving dissection of bovine placentas is also presented. Aspects of organogenesis are presented as lectures before the relevant sections pertaining to gross anatomy. For example, the development of the heart and lungs and the pericardial and pleural cavities are presented before studying the anatomy of the thorax. A separate examination is not held in embryology, as it forms an integral part of the gross anatomy syllabus. Embryology questions are included in gross anatomy tests and examinations.

Histology constitutes a full-year course (30 weeks; 80 hours) that runs throughout both semesters. It comprises a series of lectures and practicals. Approximately 50 % of the allocated time is spent on lectures and 50 % on practicals. The lecturers use overhead transparencies, 35 mm slides and blackboard drawings. A comprehensive study manual drawn up by the department is supplied to the students at the beginning of the course. Each student is issued with a microscope and box of slides. The relevant tissue sections are studied during the practicals. Guidance regarding the cytological and histological features that the student should identify is given before and during the practical by the lecturer by closed-circuit television, supplemented with appropriate 35 mm slides. Four demonstrators are present during each practical session to assist students, giving a student: lecturer ratio of 25:1.

Recommended reference material for anatomy, embryology and histology is available in the faculty library.

MATERIALS AND METHODS

The open-ended questionnaire was administered to 2nd year students at the Faculty of Veterinary Science of the University of Pretoria, Onderstepoort. Since the amalgamation of this faculty with the veterinary faculty of the Medical University of Southern Africa (MEDUNSA), it represents the only institution in South Africa that trains veterinarians. The study and questionnaire were approved by the Ethics Committee of the Faculty of Veterinary Science, University of Pretoria and the Human Ethics Committee of the University of the Witwatersrand. The questionnaire was designed to elicit responses from the students and not to 'suggest' ideas. It was administered at the end of the academic year to ensure that all aspects of gross anatomy, histology and embryology had been dealt with before completion of the questionnaire.

The students were requested to give information on whether they were taking anatomy for the 1st time or whether they had completed a course in this subject previously. A student identification number was also requested so that responses could be correlated with a level of competence following their end-of-year examination in gross anatomy (which includes embryology) and in histology. The questionnaire was divided into 3 sections, 1 each for gross anatomy, histology and embryology. The student was requested to identify problem areas/topics, give reasons for the area/topic being problematic, and suggest a means of solving the problem. Students could list as many problem topics as they wished. Limited guidelines were given in the questionnaire, requesting the students to be specific regarding the identification of problem topics, e.g. autonomic nerve supply to the abdomen, rather than giving a broad area, e.g. the abdomen. We also explained this requirement verbally, as well as giving a brief overview of the reasons for the study, before administering the questionnaire.

Students were allowed to take the questionnaire away with them to ensure time for thought as to which areas had been problematic during the course. Questionnaires were retained by the students for a period of approximately 10 days.

On retrieval of the questionnaires, topics identified as problematic by the students were grouped by us, owing to the wide range of explanations/terminology used by the students in their replies. For example, 'nerve and arterial supply to the thoracic limb', 'course of nerves and vessels in the manus and pes' and 'innervation of the limbs' were grouped as one topic, namely nerve and blood supply of the limbs.

In order to determine which areas/topics students perceived as most or least difficult, the number of responses to a particular topic was calculated as a percentage of the total number of respondents to the questionnaire. Owing to the relatively high proportion of students (particularly in histology) who indicated that they had experienced no particular difficulties with the subject, the number of responses was also calculated as a percentage of only those students who had experienced problems.

RESULTS

Sixty-seven students of a total of 95 completed the questionnaire, giving a return rate of 70.5 %. Analysis of the results indicated no differences in the number or type of problem topics experienced by weaker (< 56 %), average (56–69 %) or stronger (> 69 %) students in both gross anatomy/embryology and histology (raw data not shown). These categories were based on the final marks obtained by the students and represented the average of the final examination mark and the student's year mark, which each carried equal weight.

Gross anatomy

Eleven students (repeat students) who responded to the questionnaire indicated that they had previously taken the gross anatomy/embryology course. Despite their previous exposure to the course, 8 of these students identified topics that had been problematic.

Of the 67 respondents, 19 (28 %) believed they had no specific problems with gross anatomy, while 48 respondents (72 %) identified a wide range of problem topics/concepts. In total, 41 problem topics were identified, of which those with the greatest student response are shown in Table 1a. Specific topics mentioned were neuroanatomy (30 %), the inguinal canal (22 %), reflections of the linings of body cavities (including omentum, mesenteries and pleural/pericardial/peritoneal membranes) (21 %), and the nerve and blood supply to the limbs (19 %) (Table 1a). A high proportion of the students indicated that the reasons

Table 1a: **Problem topics identified by students in gross anatomy.**

Problem topic/concept	Number of responses	% responses*	% responses**
Neuroanatomy	20	30	41.5
Inguinal canal	15	22	31.5
Reflections of the membranes of the body cavities (omentum/mesenteries, pleural/pericardial/peritoneal membranes)	14	21	29
Nerve and arterial supply to the limbs	13	19	27
Topography of abdominal/thoracic cavities and viscera	12	18	25
Splanchnology of head (e.g. paranasal sinuses)	6	9	12.5
Stay apparatus/limb mechanics	5	7.5	10.5
Perineum	5	7.5	10.5
Autonomic nervous system	4	6	8.5
Limb joints/synovial sheaths	4	6	8.5

Table 1b: **Student perceptions of reasons for problems in gross anatomy.**

Possible reasons for problems	Number of responses	% responses*	% responses**
Could not visualise (3D)	21	31	44
Inadequate explanation in notes	19	28	39.5
Too great volume/detail	18	27	37.5
Complex subject matter	15	22	31.5
Too little dissection time/vague instructions	10	15	21
Difficult to identify structures on specimens	7	10.5	14.5
Not taught/left for self study	7	10.5	14.5
None or inadequate illustrations	7	10.5	14.5
Poor demonstration specimens	5	7.5	10.5
Insufficient time	3	5	6.5
Difficulties with terminology	3	5	6.5

Table 1c: **Suggested solutions to problems in gross anatomy.**

Possible solutions for problems	Number of responses	% responses*	% responses**
Clearer lectures, instructions, explanations	22	33	46
Use more visual aids	22	33	46
Better/more illustrations	13	19.5	27
Highlight important (essential) information	7	10.5	14.5
Spend more time/give additional lectures	7	10.5	14.5
Simplify/summarise information	4	6	8.5
Study harder/more tests to motivate learning	4	6	8.5
Remove from curriculum/postgraduate work	4	6	8.5
Study problem topics in a functional context	3	5	6.5

*Number of responses expressed as a percentage of the total number of respondents.
**Number of responses expressed as a percentage of those respondents who identified problems.

for these problems were a failure to form a 3D picture of the specific area or that the area was difficult to visualise (31 %); that there had been insufficient or a complicated/confusing explanation in the study manual and dissection guide issued by the department (28 %); that there was too great a volume or too much detail required (27 %); or that the subject was too complicated or difficult to understand (22 %) (Table 1b). The students suggested as possible solutions: clearer explanations/instructions (33 %), tutorials using more 3D-aids such as models, computer programs, videos and prepared specimens (33 %), more diagrams and illustrations (19.5 %), highlighting of important/relevant detail (10.5 %) and more time for particular topics, dissections and tutorials (10.5 %) (Table 1c).

Embryology

Twenty-five of the 67 (37 %) respondents experienced no specific problems in embryology. The remaining respondents (63 %) identified a total of 14 problem topics. Thirteen percent of respondents cited organogenesis in general as problematic. The urogenital tract (including the development of the external genitalia) (13 %), the heart and circulatory system (10.5 %) and the development of the liver (9 %) were also identified as problem topics (Table 2a). One third of the students (33 %) indicated that these problems stemmed from an inability to visualise or comprehend the sequence of events that characterise these developmental processes, particularly in 3D. The embryology notes (included in the gross anatomy manual) were also considered to be too comprehensive, detailed and difficult to understand (30 %) (Table 2b). Scheduling more time for embryology, extra tutorials and reduction of detail (28.5 %), the use of more visual aids (videos, computer graphics, slides, and 3D models) (22.5 %) and improving the quality of the lectures or changing their format by including physical specimens to demonstrate structural changes (10.5 %) were perceived by the students as possible solutions to the problems (Table 2c).

Histology

A relatively high proportion of students (58 %) believed that they had no specific problems in histology, with only 42 % of the respondents indicating difficulties with the subject. Of the 11 students who indicated that they had previously com-

Table 2a: **Problem topics identified by students in embryology.**

Problem topic/concept	Number of responses	% responses*	% responses**
Organogenesis	9	13	21.5
Urogenital tract (including external genitalia)	9	13	21.5
Development of heart and cardiovascular system	7	10.5	16.5
Development of liver	6	9	14.5
Pharyngeal arches, pouches and grooves	6	9	14.5
Foetal membranes/placentation, particularly 3D picture	6	9	14.5
Gastrulation	5	7.5	12
Development of body form	5	7.5	12
Development of face/head	4	6	9.5
Formation of body cavities/mesenteries	3	4.5	7

Table 2b: **Student perceptions of reasons for problems in embryology.**

Possible reasons for problems	Number of responses	% responses*	% responses**
Difficult to visualise/orientate, particularly 3D	22	33	52.5
Notes inadequate – too detailed/confusing	20	30	47.5
Lack of 3D sketches and simple sketches	4	6	9.5
Insufficient time	3	4.5	7
Not properly integrated with anatomy and histology	2	3	4.5

Table 2c: **Suggested solutions to problems in embryology.**

Possible solutions for problems	Number of responses	% responses*	% responses**
Simplify, cut detail/spend more time	19	28.5	45
Use more visual aids, particularly 3D models	15	22.5	35.5
Improve lectures/change format of lectures	7	10.5	16.5
More diagrams/simple sketches	5	7.5	12

*Number of responses expressed as a percentage of the total number of respondents.
**Number of responses expressed as a percentage of those respondents who identified problems.

pleted a course in histology, 5 identified problem topics. Fourteen problem topics were identified. The students listed the hippocampus (21 %), nervous tissue in general (9 %) and the eye (7.5 %) as problem topics (Table 3a). Respondents indicated the following reasons for the perceived problems: difficult and confusing concepts (19.5 %), difficulties in identifying tissues and cells (16.5 %), insufficient time, particularly for practicals (10.5 %) and a failure to visualise 3D structure (7.5 %) (Table 3b). Proposed solutions to the problems were: scheduling more lectures to provide additional time to better assimilate the work (12 %), simplifying the work by including summaries or tables and removing unnecessary detail (10.5 %) and using more visual aids (photographs, slides, diagrams and 3D models) (9 %) (Table 3c).

DISCUSSION

The respondents who completed the questionnaire identified a wide range of perceived problem topics in all 3 divisions of anatomy, the greatest number of problem topics being identified in gross anatomy followed by embryology and then histology. While the number of problem topics was numerically greater in gross anatomy, this could possibly be related to the greater volume of work covered by this course. This situation could also be compounded by the fact that the gross anatomy course has been compressed into a single year of study, whereas previously it had been presented over 2 years.

It was obvious from the responses that certain topics were identified more frequently by many of the students as being particularly problematic. For example, approximately ⅓ of the respondents who had identified problems in gross anatomy, found both neuroanatomy and the inguinal canal to be difficult topics, while more than ¼ of these respondents rated the omentum/mesenteries and pleural/pericardial membranes, the nerve and blood supply to the limbs, and the topography of the abdominal/thoracic cavities and viscera as challenging (Table 1a). These topics are generally perceived by teachers of anatomy to be areas where 3D visualisation and conceptualisation play an important role in the assimilation and understanding of the relevant information. It was also significant that the range and number of problem topics was similar for all categories of students who completed the questionnaire.

The survey clearly indicated that the nervous system posed particular difficulties for the respondents. The most problematic topic in gross anatomy was cited as neuroanatomy by 41.5 % of respondents. In addition, more than 70 % of this group scored the hippocampus and nervous tissue in general as the most difficult topics in histology. This phenomenon is not peculiar to veterinary students. Women dental students at the University of Birmingham, United Kingdom, identified neuroanatomy as the most difficult of the 4 anatomy courses (topographical anatomy, histology/cell biology, neuroanatomy and embryology) presented at that university[17]. De Lahunta[7] has cautioned that 'To teach didactic neuroanatomy as an isolated exposure to spinal cord tracts and brain stem nuclei, unrelated to relevant physiology and clinical neurological signs created by disease of these structures, is folly in veterinary medicine.' This assertion is supported by a study of 1st-year medical students at the University of Michigan. This study demonstrated that teaching neuroanatomy by means of a system of self-instructional laboratory stations was not only

Table 3a: **Problem topics identified by students in histology.**

Problem topic/concept	Number of responses	% responses*	% responses**
Hippocampus	14	21	50
CNS/nervous tissue	6	9	21.5
Eye	5	7.5	18
Distinguish between cells, tissues and organs	4	6	14.5
Hoof	4	6	14.5
Osteogenesis	2	3	7
Liver	2	3	7
Identification of smooth muscle/elastic connective tissue	2	3	7

Table 3b: **Student perceptions of reasons for problems in histology.**

Possible reasons for problems	Number of responses	% responses*	% responses**
Difficult, confusing concepts	13	19.5	46.5
Difficult identifying cells and tissues	11	16.5	39.5
Insufficient time	7	10.5	25
Problem visualising 3D structure	5	7.5	18
Inadequate lectures	3	4.5	10.5
Notes, textbooks confusing/too detailed	3	4.5	10.5
Lack of integration between anatomy and histology	2	3	7
Slides inadequate for practicals	2	3	7

Table 3c: **Suggested solutions to problems in histology.**

Possible solutions for problems	Number of responses	% responses*	% responses**
More lectures/slow down pace	8	12	28.5
Simplify work/eliminate detail	7	10.5	25
Use more visual aids	6	9	21.5
More tutorials	2	3	7
Use better slides for practicals	2	3	7

*Number of responses expressed as a percentage of the total number of respondents.
**Number of responses expressed as a percentage of those respondents who identified problems.

time-effective, but was enthusiastically received by the students, possibly because it represented an interesting change from the large class lecture.[9]

The students who participated in the present survey are taught didactic neuroanatomy during the first semester. A neurophysiology course in which neurological signs and symptoms are cited as practical examples is also presented by the Physiology Department during the 1st semester. The 2 courses are not, however, specifically coordinated, and the students are not formally exposed to hands-on clinical neurology. A practical neuroanatomy course, using prepared specimens, is only presented during the 2nd semester owing to time constraints in the 1st semester. The perceived lack of relevance resulting from this situation may explain the overwhelmingly negative response of the students to neuroanatomy. Relevance in veterinary education is an important concept, and the value of integrating a basic science course with clinically relevant instruction has been shown to motivate students, create a deeper approach to learning and develop problem-solving and inter-personal communication skills. This was illustrated in a recent study of veterinary students at the University of Illinois, where the integration of case-based studies into an established, traditional histology course proved to be a positive experience for both students and academic staff[8]. It should be noted, however, that innovative teaching methods do not necessarily lead to an improvement in the retention/recall of factual information. Nursing students exposed to creative teaching methods showed no significant improvement in the recall of facts (anatomy and physiology) when compared to the control group that participated in a regular didactic teaching programme[16].

In the embryology component, students most frequently (70 %) indicated organogenesis in general or aspects of organogenesis (development of the liver, heart or urogenital tract) as problem topics. As noted in the introduction, the relevant embryology is presented as didactic lectures prior to the dissection and study of the various body regions covered in the gross anatomy course. De Lahunta[7] has pointed out that, although some parts of a gross anatomy course are best preceded by lectures in embryology, other sections, for example the development of the heart, are best understood after dissection of this organ. The course in embryology has only recently been incorporated into the gross anatomy course in the veterinary science degree at the University of Pretoria, having previously been a separate examination course. The positioning of lectures in embryology in relation to gross anatomy may be causing difficulties for the students, and should be revisited.

Student responses as to why they believed they had experienced problems with the identified topics in all aspects of anatomy were dominated by their perception that they could not visualise 3D structure or orientate themselves on the material being studied. The responses also strongly indicated that the complexity of the material dealt with, coupled with the volume of work, too little time, inadequate notes and a paucity of visual material (simple sketches/illustrations) impacted negatively on their ability to understand certain topics. There is certainly some substance in these assertions. Changes to the content of anatomy

curricula have not always kept pace with reduction in time for teaching. Students are strongly aware of being rushed or under pressure. It is not surprising that the present survey identified volume of work and insufficient time as important factors contributing to student problems. Students who responded to the present questionnaire perceived the solution to be presentation of additional lectures and/or tutorials and elimination of detailed explanations. Requests for more lectures may simply indicate the students' unwillingness to do additional reading/research on their own. This may be indicative of inadequacies of the secondary school system in South Africa, which does not at present prepare scholars for independent study.

A similar trend regarding the volume of work has been reported in medical education. Medical students at the University of Natal, South Africa, identified anatomy as one of the subjects with an unrealistic volume of work (D Manning *et al.,* unpubl. data, 1993), while a detailed report on medical education in Britain recommended a general reduction in the amount of factual information being taught[23]. The decreased time available for teaching anatomy[2,6,13,14,18] is certainly recognised by students as a fundamental problem[6,15]. The decrease in time spent on dissection and in histology practicals should be carefully considered when changes to curricula are made, as decreased time also reduces the time available to students for the synthesis of difficult concepts.

It is significant that 58 % of respondents indicated that they experienced no specific problems in histology. A recent survey of the attitudes of medical, dental and veterinary students at the University of Pretoria towards the role of the optical microscope as a learning tool[20] revealed that veterinary students were most positive in this regard. They displayed a strong perception that the ability to correctly use a microscope was an essential professional skill that should be mastered if they were to successfully pursue their chosen career. This interest in the use of the microscope may possibly explain the positive attitude of veterinary students towards histology as a subject. However, there is also a general perception amongst the student body (elicited by discussions with individual students) that the histology course is 'easier' in comparison to gross anatomy and embryology.

The present survey elicited criticism by the students of their study manual and dissection guide. Respondents consistently reported that the contents of the study manual were too detailed, difficult to understand, confusing and lacking in adequate simple sketches and illustrations. The students were also critical of the dissection instructions, which they perceived as being 'vague'. These comments by the students illustrate the gap that sometimes exists between student and teacher perceptions. While the teaching staff of the Department believe that the study manual carries the necessary information in a structured format, the students find the manual overwhelming in terms of both volume and complexity. The study manual is the culmination of years of teaching experience, the presentation of a structured anatomy course and the input of a variety of expert veterinary anatomists. In our opinion, the manual is logical and self-explanatory. It is possible that problems with the theoretical contents and dissection instructions reflect a reluctance by the students to read the contents. However, changes in format and content of the manual will be considered, based on student suggestions. A survey of medical students from the University of Benin, Nigeria, indicated that the learning method that most benefited students was reading and private study[13]. The suggestion that medical students rely heavily on their textbooks for anatomical information was supported in a survey of student opinion at 13 medical schools in the United Kingdom[3]. Contrary evidence has, however, been presented, showing that medical students at the University of Natal, South Africa, rated text books as the least effective learning method in comparison to practicals and demonstrations (D Manning *et al.,* unpubl. data, 1993). The picture that emerges is that students in our course want notes that reflect only the essential information and in a simple, easy to understand form. This perception is strengthened by the expressed need of the students for more illustrations and simple sketches. These are viewed as an easier alternative to ploughing through pages of text for the same information.

The students themselves may contribute to this negative attitude to their notes/textbooks. Shively[22] described the phenomenon of 'overwhelmosis', which is defined as mental supersaturation. There is a temptation among students at the beginning of the veterinary course to attempt to commit all the information in their notes to memory. This, coupled with the inability to differentiate between essential and non-essential information, may explain why the respondents in this survey were critical of their manual. The weakness in the system is not necessarily the notes/textbooks (which for logical progression and completeness generally contain more information than is required) but possibly a lack of guidance from academic staff regarding what the students are expected to know. Shively[22] pointed out that 'without specific guidelines, anatomy students frequently become overwhelmed and frustrated at the immense volume of material before them.' It should be noted, however, that the study manuals issued to the students in the present survey also contain a comprehensive set of learning objectives which clearly indicate the factual information that they are expected to know. The learning objectives are discussed with the students before each section of the course and during the concluding tutorials.

In contrast to the criticism of the study manual and dissection guide, the students hardly commented, except with regard to histology (4.5 % of respondents), on the impact of lectures as a possible reason for experiencing problems with certain topics. Although the respondents did not identify lectures as a major factor contributing to perceived problems, there was a measure of support for presentation of clearer/improved lectures as a possible solution for some of the problems experienced in the gross anatomy/embryology course. This minor criticism of lectures, particularly in gross anatomy, is not unexpected. Cawunder and Tasker[5] have previously noted from their assessment of veterinary students that 'anatomy is, in fact, the subject for which the least amount of instruction occurs by lecture and much of the material is learned in the laboratory.' Students are thus able to review their anatomy in practical sessions irrespective of the quality of the lecture.

The respondents expressed very clear opinions regarding solutions to the perceived problems that, apart from the question of additional lecture time discussed above, fell into 2 clear categories. In the first instance, a demand was expressed for an 'improved' study manual. The students suggested simplifying the manual by removing unnecessary detail, highlighting important information and supplying summaries of difficult concepts/topics. The use of better, as well as additional illustrations, was also advocated. Similar sentiments were expressed with regard to the improvement of the dissection instructions. Whether this phenomenon represents 'laziness' on the part of the students, or merely reflects their perceptions of the time constraints under which they work, remains undetermined. Again, the solution is not necessarily a radical revision of the notes, but rather guidance by academic staff to help

the students condense, simplify and generalise the relevant information[22].

A third of the respondents indicated that they required the use of more visual aids, particularly as a method of understanding 3D concepts. The students placed great emphasis on the use of 3D models, videos and computer-aided instruction. A large volume of information is available, which conclusively demonstrates the value of visual material as a complementary tool in the teaching of anatomy[10,11,12,14,18,19]. According to Regula *et al.*[19], the introduction of computer-assisted learning into a traditional lecture-based course in bovine reproduction at the Free University of Berlin, Germany, resulted in more than 90 % of the students who were exposed to this form of learning, expressing a need for more of this type of tuition in the veterinary curriculum. Similar opinions were expressed by medical students at the University of Natal, South Africa, when exposed to a multimedia-based computer-aided instruction programme in histology[12].

The apparent inability of students to understand 3-dimensional structure and to orientate themselves at both the macroscopic and microscopic levels remains a perplexing problem. Although it is known that certain individuals find it inherently difficult to understand 3D concepts, the exposure of the students to cadavers for most of their course should be of great assistance in understanding these concepts. Explanation of or instruction in 3D concepts in particular, by means of simple and complex models, animated videos and computer-based programmes, is an area that obviously needs to be addressed. However, audiovisual aids and prosections are not necessarily perceived by students as absolute alternatives to dissection in their quest for a better 3-dimensional understanding of topographical relations. Jones and Sutin[11] quote a respondent to a questionnaire: 'At times I would have preferred dissection; at other times I would have liked the audiovisuals and prosections. The optimum would be a combination, with the student being able to use the method or combination that is most effective for him/her at that particular time. Flexibility is the key'. It has, however, also been noted that the use of interactive-videodisc lessons did not significantly alter the learning outcomes of students over those participating in a traditional dissection course[10].

This survey also identified the often unarticulated plea by students for assistance with learning. This was demonstrated by a request for more lectures and tutorials, more visual material and better course notes. This is not an isolated call. Parkin and Rutherford[17] report 'an overwhelming demand for increased guidance from staff' by dental students. Dependency on academic staff was also demonstrated in the present study by the suggestion of some respondents (6 %) that more tests should be set in gross anatomy. These respondents suggested that additional tests would 'motivate/force' students to study. Shively[22] argued that veterinary students should be given numerous examinations in gross anatomy, as this is the only way they can actively practice 'their newly acquired anatomic knowledge'. The value of tests and examinations has been further emphasised by the report that administering a test after a lecture doubles information recall when measured after a period of 8 weeks[21]. It is recognised, however, that academic staff do not always have the time at their disposal for assisting students in this time-consuming fashion[21]. While the assistance of staff is imperative, the balance between staff guidance and student dependency remains delicate. Students need to develop independent learning skills, an analytical capacity and the ability to seek and find information for themselves, if they are to become life-long learners.

CONCLUSION

This survey succeeded in identifying a range of problem topics/concepts experienced by undergraduate students of veterinary science taking a traditional anatomy curriculum. While it is true that the information supplied by a survey of this nature is only valid for a particular group of students at a particular time, some of the specific problem topics (*e.g.* neuroanatomy) experienced by this group of veterinary students are mirrored in other studies of veterinary, medical and dental students. There appears to be a need, therefore, for an assessment of 'universal' problem topics experienced by all students of gross anatomy, embryology and histology. We believe that these universal problem topics exist in many anatomy courses, despite the application of innovative teaching methods and advanced audio-visual technologies. Only by identifying these topics can suitable strategies (within the constraints of the particular curriculum) be devised for their resolution.

This study illustrates the value of obtaining student opinions and perceptions when addressing curriculum and teaching issues. This is in agreement with other studies (*e.g.* refs 1, 13, 17). Barrett and McDonald[1] cautioned, however, that although students are able to judge how a course is presented and organised, and make useful comments on aspects such as intelligibility, their own workload and assignment difficulty, 'course content, the quality of the material, the currency and accuracy of content and appropriateness of course objectives can best be evaluated by colleagues in the same subject area'.

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Book review — Boekresensie

OIE manual for standards of diagnostic tests and vaccines (4th edition)

2000. Office International des Épizooties, Paris, ~800 pp., hard cover. Price €120. ISBN 92 9044 510 6.

This is the 4th edition of the Manual, which was first produced in 1989, by the Office International des Épizooties (OIE). It contains recommendations on the use of diagnostic tests and production of vaccines for List A and B diseases of mammals, birds, and bees, as well as some additional diseases that may affect international trade. The stated aims of the OIE Commission are to 'provide guidelines and standards for health regulation applicable to international trade in animals'.

The Manual contains general introductory chapters on sampling procedures, quality management in laboratories, sterility testing, laboratory safety, principles of veterinary vaccine production, validation of laboratory tests, and biotechnology for diagnosis and vaccine development. A chapter on the international regulation of veterinary biologicals has been added to this edition.

Separate chapters are dedicated to each of the list A and B diseases: each chapter is prefaced by a brief synopsis of the disease, including aetiology, epidemiology, diagnosis and control, followed by 2 sub-sections on various diagnostic tests for the agent and requirements for vaccine and diagnostic biological production. In the current edition, the prescribed diagnostic test for international trade appears in blue text to distinguish it from other tests that may be used within countries or economic trade regions.

As a reference document for veterinary laboratories involved in diagnostics or vaccine production as well as regulatory authorities, the manual is extremely valuable: it provides good guidelines for general practices and detailed methods of diagnostic tests. Most of the chapters are well-written by experts in the particular fields.

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