

1 **Student perceptions of veterinary anatomy practical classes: a longitudinal**
2 **study**

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44 **Abstract**

45 Using cadaveric material to teach veterinary students poses many challenges. However,
46 little research exists on the contribution of this traditional approach to student learning.
47 This longitudinal study aimed to investigate student perceptions of cadaver-based
48 anatomy classes in a vertically integrated veterinary curriculum at The University of
49 Nottingham's School of Veterinary Medicine and Science. Likert scale statements and
50 free text boxes were used in a questionnaire distributed to second year veterinary
51 students (response rate 59%, n=61/103). The same questionnaire was subsequently
52 distributed to the same cohort two years later, in the students' fourth year of study
53 (response rate 68%, n=67/98). Students agreed that cadaver-based activities aid their
54 learning and they particularly value the opportunities to develop practical skills alongside
55 learning anatomy. There are few changes in perception as undergraduates progress to
56 clinical years of teaching. Students perceive anatomy to be important, and feel that their
57 learning has prepared them for clinical placements. This study emphasises the
58 importance of the effective use of cadaveric materials in the teaching of anatomy and in
59 particular the use of clinical skills to enhance the anatomy curriculum.

60

61 **Key words:** anatomy classes, cadaver teaching, student perception, dissection,
62 prosections, clinical skills

63

64 **Introduction**

65 Anatomy education has become an area of much discussion over recent years within
66 medical education literature, with concerns raised over a reduction in time allocated to
67 anatomy teaching and thus graduates' knowledge in the subject. ^[1-3] Furthermore, ways
68 in which cadaveric material is most effectively utilised in a clinical curriculum remains
69 under debate. ^[4-8] Teaching anatomy with cadavers poses particular challenges around
70 the control of infectious agents and exposure to chemical fixatives, problems with
71 sourcing cadaver material and the expense of collection and storage of specimens, as
72 well as the ethical questions raised by the use of cadaveric material in teaching. Add to
73 these issues the demands on staff and curriculum time and there is clear cause to
74 investigate the educational value of these teaching sessions. Nevertheless, the matter
75 has received little attention in the context of veterinary education and a search of
76 electronic databases OVID Medline and CAB abstracts returned a limited number of
77 empirical studies on the topic.

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79 Despite recent moves towards student centred learning, teaching anatomy can entail
80 conveying a large volume of detailed factual information, perceived by the student to be
81 learned by rote and then reproduced verbatim for the purpose of assessment. Practical
82 classes provide opportunity for students to 'experience' anatomy; to take the body apart
83 and understand for themselves the 3 dimensional relationships of structures. Maximising
84 the potential of these learning opportunities is the objective of many educators, ^[9] and
85 whilst there is much debate over the most effective method of teaching anatomy,
86 practical classes remain a key component in human and veterinary anatomy teaching.
87 ^[10-12]

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89 Traditional methods of practical teaching in anatomy include the dissection of cadaveric
90 specimens by groups of students and demonstration of prosections. Dissection is seen by
91 many as a key tool in teaching anatomy ^[6] and is valued for fostering others skills such
92 as teamwork, time management, independent learning and manual skills. ^[13] The
93 demonstration of pre-dissected specimens is appreciated as a more efficient way of
94 delivering anatomical information, by educators and by students ^[14] and studies have
95 shown the method to be at least as effective as students carrying out dissection for
96 themselves. ^[15, 16] Some educators have removed cadavers from the anatomy curriculum
97 entirely, arguing that the use of cadavers does not provide an authentic experience
98 representative of clinical practice. ^[17] There are however, concerns about the objectivity
99 of research into teaching methods using cadavers, as many of these studies are carried
100 out by anatomists or by teachers implementing new course designs. ^[9, 18]

101
102 Using clinical skills to reinforce anatomy teaching in traditionally pre-clinical classes is
103 less well researched, possibly due to difficulties in obtaining human cadaveric material.
104 However, opportunities to integrate some aspects of clinical teaching with first and
105 second year anatomy teaching have been introduced successfully within the medical
106 curriculum. Brown et al, ^[19] measured first year medical student perceptions of the use
107 of ultrasound in anatomy teaching and found that students overwhelmingly agreed that
108 it had been beneficial in their learning, and the experience had increased their
109 confidence and knowledge of anatomy. Interpretation of the images was also assessed
110 through the questionnaire and ninety-eight percent of students identified the structures
111 correctly, demonstrating an understanding of the anatomical structures shown.
112 Moreover, Ivanusic et al ^[20] found that students valued the clinical relevance of using
113 ultrasonography in their study of perceptions of undergraduate students at the
114 University of Melbourne. Similarly, a survey administered to first year medical students
115 following a demonstration of laparoscopic anatomy of the abdomen found that students
116 perceived the session to have enhanced their learning and improved interest in the topic.
117 ^[21]

118
119 Since the publication of Tomorrow's Doctors ^[22] which called for a reduction in factual
120 knowledge in the medical curriculum and a greater emphasis on outcomes-based
121 education, there has been increasing concern about the level of anatomical knowledge of
122 students taught through modern clinically integrated curricula. ^[23, 24] A study carried out
123 by Waterston and Stewart ^[1] highlighted concerns amongst clinicians about the
124 anatomical knowledge of new medical school graduates, and an investigation into
125 perceptions of newly qualified doctors from the University of Nottingham Medical School
126 performed by Fitzgerald, ^[2] found a divide in opinion. Results of this study showed
127 53.8% of respondents believed they were taught sufficient anatomy at medical school,
128 and 44.3% believed the anatomy they were taught was not sufficient. These studies
129 suggest that current anatomy curricula are not meeting the outcomes required by the
130 medical profession.

131
132 Whilst valuable information can be gleaned from medical education studies, there are
133 important distinctions to be made between the educational processes and outcomes of
134 medical and veterinary curricula. Graduates of human medicine enter into a supervised
135 post-graduation career structure, whereas no such period of additional supervised
136 training is required in the field of veterinary medicine. This need for veterinary graduates
137 to be proficient in clinical techniques as they relate to the Day One Competences defined
138 by the Royal College of Veterinary Surgeons ^[25] augments the impact of such teaching at
139 vet school. Although a number of authors have reported the need to modernise
140 veterinary gross anatomy curricula ^[26-28], there is a dearth of literature on the standard
141 of anatomical knowledge and the educational impact of anatomical education amongst
142 veterinary graduates and students. The introduction of new technologies has facilitated
143 the development of tools to aid in veterinary anatomy teaching ^[29, 30] and the impact of
144 educational tools such as plastination and surface anatomy learning aids has been
145 investigated and found to support traditional teaching methods. ^[31, 32] However, there is
146 little empirical data on the continuing impact of teaching practises in anatomy. This
147 longitudinal study investigates the attitudes and opinions of anatomy teaching as
148 students progress through the veterinary course from pre-clinical to clinical teaching.
149

150 The School of Veterinary Medicine and Science at the University of Nottingham (SVMS)
151 employs a systems-based spiral curriculum, as described by Harden. ^[33] This curriculum
152 design provides vertical integration of anatomy through the introduction of clinical skills
153 and concepts in the first term of the course. Anatomy teaching is integrated into
154 systems-based modules and delivered through lectures, student directed group work,
155 and practical classes. Each module is delivered as a veterinary science subject in the first
156 two years of the course and again as a clinical subject during year three or four.
157 Assessment methods include online written papers, practical and portfolio assessments

158 intended to evaluate achievement of course learning outcomes. The practical classes at
159 SVMS are designed to incorporate live animal examination sessions, cadaver activities,
160 laboratory and clinical skills and these sessions are run from the first term of the course
161 through to the last term of year 4. Classes involving the use of cadaver materials are the
162 focus of this research.

163

164 Three main teaching methods using cadaver materials are employed in the delivery of
165 anatomy at SVMS; dissection, prosections and practising clinical techniques. Dissection
166 involves groups of 4 students dissecting a mixed-breed, preserved dog cadaver. The
167 cadavers are allocated to an individual group of students and used throughout the
168 academic year as different modules are studied. Task sheets are provided including
169 instructions and structures to be identified during each session. Prosections, or pre-
170 dissected specimens are employed to demonstrate key anatomical features. Specimens
171 are fresh or preserved cadavers or part cadavers and are typically demonstrated by a
172 member of teaching staff to groups of 8 – 20 students. Practising clinical techniques
173 describes performing skills such as endoscopy of the nasal cavities of the horse, or
174 ultrasound, nerve block or joint aspiration of cadaver limbs. These procedures are used
175 to reinforce and apply anatomical knowledge. Timetabling of these sessions is such that
176 all students should be able to attempt the skills presented. Plastinated or freeze-dried
177 specimens and models are employed to supplement all three methods of teaching
178 delivery.

179

180 The aims of this study are to investigate the following:

- 181 1) How do students perceive methods of teaching with cadavers?
- 182 2) How do these perceptions change through the course?
- 183 3) Do students feel their anatomical knowledge is sufficient for clinical placements?

184

185 A greater understanding of student perceptions of learning anatomy will enable
186 educators to evaluate the curriculum and to utilise valuable time and materials to most
187 effectively teach anatomy alongside other skills and values pertinent to a career in
188 veterinary medicine.

189

190 **Methods**

191

192 *Survey design*

193 A questionnaire was designed to measure the student perceptions of each of the three
194 techniques used in cadaver teaching: dissection, prosection and practising clinical skills.
195 The questionnaire comprised thirteen statements, grouped according to the teaching and
196 learning themes of gaining anatomical knowledge, the application of anatomical
197 knowledge, enjoyment, assessment, and the learning process. Students were asked the
198 extent to which they agreed with each statement (1 = strongly agree, 5 = strongly
199 disagree) in relation to each teaching technique. Free text boxes invited further
200 comments throughout the survey. The survey was reviewed and piloted for clarity with
201 third and fifth year students.

202

203 The paper-based questionnaire was distributed to the 2010 cohort of the 5-year full time
204 BVMBVS course at the University of Nottingham during a practical session in the spring
205 term of year 2, at which time students had completed all the systems-based veterinary
206 science modules. The survey was then redistributed two years later to the same cohort
207 during a practical session in the spring term of their fourth year of study, just prior to
208 entering into their final year of supervised clinical practice-based learning and thus they
209 had completed all modules of formal study. The second administration of the survey
210 required students to answer the same statements retrospectively and also contained a
211 further 8 statements in which students were asked to express agreement to relating to
212 clinical studies and post-graduation expectations. Questions were chosen to reflect
213 issues in the current literature and the objectives of the SVMS curriculum. A full
214 questionnaire as administered to year 4 participants is included as appendix 1.

215
216 Ethical approval for the study was granted by the University of Nottingham School of
217 Veterinary Medicine and Science ethical review committee according to the British
218 Educational Research Association (BERA) guidelines, approval number 461 111103.
219 Participation in the study was not mandatory and participants received information
220 sheets regarding data handling and withdrawal from the study. All data were
221 anonymised, with questionnaires from the two different administrations linked by an ID
222 number.

223 224 *Data Analysis*

225 Individual Likert item scores were summed according to the aforementioned learning
226 themes and Cronbach's co-efficient alpha was used to assess the homogeneity of items
227 within the domains. When graphically represented, agreement to a Likert statement was
228 taken as 'agree' and 'strongly agree' responses. Reverse scoring of the negatively
229 phrased question was used in reporting relative frequencies.

230
231 Data were entered into the statistical package SPSS 21 and as data were considered as
232 non-normally distributed, non-parametric Friedman tests were carried out for repeated
233 measures of the three methods of delivery; dissection, prosection and clinical skills.
234 Differences between responses of the first and second administration of the survey were
235 measured using Wilcoxon signed rank tests. Significance for these tests was defined as
236 $P < 0.05$.

237
238 Analysis of the free text responses was carried out using a thematic approach, as
239 described by Braun and Clarke. [34] Coding was carried out manually using an inductive
240 approach and codes were combined to form overarching themes. The data were first
241 analysed by two researchers independently before a process of comparison and review,
242 as described by Patton. [35] A theme was defined as capturing an important element in
243 the data rather than by number of responses pertaining to it.

244 245 **Results**

246 247 *Response rate*

248 A total of 61 surveys were returned from a cohort of 103 second year students upon the
249 first administration (59%). The second administration two years later returned 67
250 surveys from a cohort of 98 (68%). Only students present for both administrations of
251 the survey were included for paired comparison, resulting in a total of 40 surveys (43%).

252 253 *Reliability*

254 Cronbach's alpha values for Likert items within a domain are shown in table 1

255
256 (Place Table 1 here)

257 258 *Perceptions of second year students*

259 Students reported a high level of agreement to all but the negatively phrased question.
260 Dissection, prosection and practising techniques all scored highly as teaching methods.
261 Responses and mean scores are shown in table 2.

262
263 (Place Table 2 here)

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265 Practising clinical techniques was more highly rated than dissection or prosection in all
266 teaching and learning themes. Further investigation using Friedman's ANOVA found
267 significant differences between the perception of teaching modalities in the areas of
268 application ($X^2=21.44, p<.001$), enjoyment ($X^2=31.66, p<.001$), and learning
269 ($X^2=21.44, p<.001$). These results are shown in table 3.

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271 (Place Table 3 here)

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Changes in perceptions between years 2 and 4

Perceptions of dissecting specimens, the demonstration of prosection and practising clinical techniques remain positive throughout the course with little change reflected in the responses of the students. Figure 1 compares the responses of students in year 2 and year 4. Statistical analysis of the responses showed a significant decrease in positive responses for dissection ($Z = -2.43$, $p = .015$) and prosection ($Z = -3.42$, $p = .001$) in the application of knowledge. Similarly, for dissection ($Z = -2.09$, $p = .036$) and prosection ($Z = -2.45$, $p = .014$) in assessment of knowledge. In these areas students placed more value on these methods of learning in year 2 than they did in year 4 of the course. Practising clinical techniques however was perceived to be equally valuable at the time of teaching and retrospectively, with no significant differences found between the two administrations of the survey.

(Insert Figure 1 here)

Analysis of free text responses

Four main themes were identified from the initial codes assigned to the free text responses from year 2 students. A further two themes were identified following the analysis of the year 4 responses: relevance and transition to clinical studies. Table 4 provides the main themes and example comments.

(Place table 4 here)

Year 4 specific questions

Responses to questions about clinical studies are shown in figure 2. Every one of the students surveyed believed anatomy to be an important part of the veterinary curriculum with 78% of students strongly agreeing and 22% agreeing to the statement. The students largely disagreed that anatomical knowledge was not required for fourth year studies and reported finding their learned knowledge useful for clinical extramural placements. However, 66% of students reported to have forgotten most of the anatomical knowledge they had learned in first and second year by the time they reached year 4 of the course, and 51% of students believe it is not re-visited in fourth year.

Student responses indicate a belief that good anatomical knowledge is important in practice, with 75% of responses strongly agreeing to the statement, and 24% agreeing. However, 82% of those surveyed expect to look up anatomical information as and when it is needed in practice, as is demonstrated by figure 3.

(Insert Figure 2 here)

(Insert Figure 3 here)

Discussion

This study has demonstrated that students value practical learning experiences in both pre-clinical and clinical stages of the veterinary course. Furthermore, embedding clinical skills alongside more traditional teaching practises within the dissection laboratory has proved enjoyable and motivating for this group of students. There are few changes in perception as students progress through the course to clinical teaching, with the opportunity to develop clinical skills in conjunction with learning anatomy highly valued by students in year 4 of the course.

Dissection, prosection and practising clinical techniques as teaching methods in the dissection laboratory are all perceived to have a positive impact on learning. Students enjoyed practising clinical techniques, a finding that has been reported in previous

329 studies in human anatomy teaching. [36, 37] In this study of students at SVMS, the
330 opportunity to practise clinical skills was also appreciated for the relevance to the role of
331 a veterinarian and was found to be the most motivating of learning methods. Motivation
332 to learn and participate in a task is known to positively correlate with deep learning
333 approaches, [38, 39] and linking anatomical topics to clinical aspects of the course has
334 been found to enhance learning and willingness to learn. [40] As such it is important we
335 develop interest through promoting the relevance of anatomical facts in such a way that
336 nurtures the intrinsic motivation of our undergraduate students. There are long standing
337 concerns however, regarding the cognitive load imposed on learners. [41-43] This is
338 increased by introducing teaching methods that pose additional demands on the learner,
339 for example skills in image acquisition and interpretation in the case of ultrasound.
340 However, whilst this has been found to be an issue in physical examination, it was
341 concluded that learners were able to manage the cognitive load introduced by
342 ultrasonography in anatomy teaching situations. [44] There were no comments alluding to
343 such struggles returned from students in this study, although it could be argued they are
344 simply unaware of any additional cognitive demands due to the early introduction of
345 these learning methods and thus they have no basis for comparison.

347 Fourth year students felt that dissection and prosection were less applicable to their
348 career than it was perceived to be in second year, and this supports the findings of a
349 longitudinal study of veterinary students carried out by Heath et al. [45] In this Australian
350 study, 92% of first year respondents felt that anatomy was extremely relevant to their
351 veterinary training. However, by fifth year and second year of work post-graduation,
352 there were discrepancies between the perception of what was delivered and what should
353 be delivered. Participants of the survey believed more emphasis should have been placed
354 on the skills, knowledge and techniques required for the practice of veterinary science
355 and that there should be less emphasis placed on the basic sciences. However, this study
356 was carried out a number of years ago, and before a review of the curriculum in
357 question. Also of note is that whilst anatomy is generally considered a basic science,
358 Heath's report does not define the term and the study does not investigate perceptions
359 of anatomy education specifically. It does however illustrate how perception can change
360 with students' experiences. It may be the case that a vertically integrated curriculum
361 that places more emphasis on skills and techniques would be perceived as more valuable
362 by fifth year students and graduates.

364 The study design reported in this manuscript did not invite students to select one
365 particular method over another, and as such it should not be extrapolated that scores
366 would be apportioned similarly without the context of the other teaching modalities.
367 However, practising clinical techniques remains to be a highly valued teaching modality
368 of fourth year students at SVMS. In particular, students cite the relevance of the method
369 of learning to their clinical studies and to clinical placements as having a positive impact.
370 This supports a study of Dutch medical students which found the prime motivating factor
371 to study anatomy is clinical exposure, i.e. conveying the knowledge in context. [46]
372 Context in learning has been found to improve knowledge retention and recall, [47] and is
373 more likely to encourage a deep approach to learning. [48, 49] A vertically integrated
374 curriculum facilitates this learning through providing opportunities for contextual
375 learning, as well as promoting repetition of subject matter and increasing time on task.
376 However, the results of this study of SVMS students indicate that they would like more
377 time dedicated to anatomy teaching in fourth year. A review of medical education
378 literature found that it is often the case with vertically integrated curricula that the
379 integration is unidirectional, that is to say that whilst clinical components are introduced
380 in the early years of the course, it is perceived to be far less common for the basic
381 sciences to be included in the clinical years of the curriculum, thus leading to a net loss
382 of teaching time for anatomy. [24] It is important to consider then, that if there is not the
383 time in the clinical curriculum to formally deliver anatomy, that we allow for self-study
384 time for students to re-visit anatomy teaching and that we signpost important
385 anatomical concepts effectively. Similarly, we should be arming students with the life-

386 long learning skills that enable students to recognise gaps in their knowledge and source
387 and critically review information. This is particularly pertinent as 82% of students
388 surveyed for this study expect to look up anatomical information when they need it in
389 practice. Some year 4 students recognised retrospectively their own focus on processes
390 and assessment in pre-clinical years, demonstrating reflective skills that will be
391 invaluable to them as life-long learners. ^[50] However, they also reported a preference for
392 teacher-led approaches to teaching, supporting the views of Hall et al ^[51] that students
393 under use the resources available to them and instead rely on instructors for
394 information.

395
396 The training in clinical techniques and the use of clinical veterinary equipment was cited
397 by students in this study as building their confidence and thus aiding feelings of
398 readiness for clinical studies and placements. This was supported by 77% of respondents
399 agreeing that their teaching had helped them on clinical placements and this may
400 explain the overwhelmingly positive response to the statements that anatomy is an
401 important subject in the veterinary curriculum and important for practice. The students
402 recognise the importance of the subject, however, that does not necessarily mean they
403 are motivated to learn it. In the study of Dutch medical students it was concluded that
404 junior medical students were more likely to judge how important it is to study a subject
405 based on how heavily it is assessed rather than how relevant the subject is to their
406 career. ^[46] Drivers for learning such as assessment and instructor expectations feature in
407 comments made by students in second year and in fourth year at SVMS, indicating an
408 extrinsic motivation that persists throughout the course. However, comments received
409 by fourth year students describe a desire to become a good vet, reflecting a change to
410 an intrinsic motivation for learning as undergraduates progress through the course.
411 Retrospectively fourth year students felt dissection and prosection were less valuable in
412 relation to assessment than they believed the methods to be in second year. This result
413 is perhaps unsurprising since students spend a limited amount of hours in the dissection
414 laboratory in year three and thus are not examined on anatomical concepts in this year
415 of the course. At the time this survey was carried out fourth year assessments had not
416 begun. It is not the remit of this paper to consider assessment in relation to student
417 attitudes, thus further work should be conducted in this area to evaluate the impact of
418 assessment on learning anatomy.

419 *Limitations*

420 This study captures the perceptions of one cohort of students studying at one vet school
421 in the UK and so caution should be applied to generalisations. Similarly, the
422 questionnaire investigates perceptions at one moment in time after a practical class
423 which will likely bias opinion based on the module under study at the time of
424 administration. Response rates for paired analysis were limited by students' attendance
425 in practical classes and a flux of students into and out of year groups. It is accepted that
426 further information could have been garnered by distinguishing 'interesting' from
427 'motivating' in the questionnaire and subsequent analysis. Finally, alpha values were
428 below 0.7 in some domains and as such summed data should be interpreted with
429 caution.

430 *Conclusions*

431 This study has highlighted the value of cadaver practical classes throughout the
432 veterinary undergraduate course. The introduction of clinical skills within the anatomy
433 curriculum has a positive impact on students' perceptions of learning anatomy, with
434 learners appreciating the relevance of the material covered in these sessions from pre-
435 clinical to clinical years. Anatomy as a subject is mostly knowledge based, but its
436 application to practice is significant and can be taught through the introduction of clinical
437 techniques early in the curriculum, allowing factual information to be contextualised and
438 consolidated. It is suggested therefore that anatomy continues to be delivered using
439 cadaver materials using a combination of traditional methods and clinical teaching.
440 Moreover, it is believed that further investigation into perceptions of multiple cohorts of

- 443 students and the educational outcomes of anatomy teaching can further inform the
 444 veterinary anatomy curriculum.
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572 **APPENDIX 1. Year 4 survey**

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574 **You may remember participating in a survey in 2nd year in which you gave your opinions on learning**
575 **with cadaver material. As a continuation of this, I'd really appreciate your time in completing the**
576 **similar survey below. The recently published results of the AVS survey reported that Nottingham**
577 **students rated practical classes very highly, and we want to make sure the classes remain valuable**
578 **to you. Thank you for your participation so far.**
579 **I'm asking for your help again now that you are two years older (and hopefully wiser) as I'm**
580 **interested to see how and if your perspective has changed. Therefore, please respond to the**
581 **statements by marking the box that most reflects your experiences and feelings to the statements.**
582 **Please add any comments not covered by the statements in the free text space at the end of each**
583 **section.**

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585 Please note – for the purposes of this study:

586 'Dissection' is intended to mean the dissection of cadaver material carried out by the student either individually
587 or in small groups

588 'Demonstration of prosections' refers to teaching whereby a demonstrator/lecturer will present material to
589 the student in order to describe anatomy/physiology

590 'Practising clinical/practical techniques' denotes the use of cadaver material in performing practical
591 veterinarian skills and includes such activities as ultrasound, endoscopy, suturing etc.

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593 **Section 1 Gaining anatomical knowledge**

594 **Thinking back to your year 1 and 2 practical classes** please rate how strongly you agree or disagree with
595 each of the following statements relating to how cadaver material aids in your **understanding of anatomy** by
596 placing a tick (✓) in **one** of the boxes for each statement.

597 **Dissection of cadaver material**

| | Strongly Agree 1 | Agree 2 | Neutral 3 | Disagree 4 | Strongly Disagree 5 |
|--|---------------------|------------|--------------|---------------|------------------------|
| Helped me to relate structure to function | | | | | |
| Helped me with 3D appreciation of structures | | | | | |
| Improved my understanding of anatomy | | | | | |

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599 **Demonstration of prosections**

| | Strongly Agree 1 | Agree 2 | Neutral 3 | Disagree 4 | Strongly Disagree 5 |
|--|---------------------|------------|--------------|---------------|------------------------|
| Helped me to relate structure to function | | | | | |
| Helped me with 3D appreciation of structures | | | | | |
| Improved my understanding of anatomy | | | | | |

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601 **Practising clinical/practical techniques on cadaver material**

| | Strongly Agree 1 | Agree 2 | Neutral 3 | Disagree 4 | Strongly Disagree 5 |
|--|---------------------|------------|--------------|---------------|------------------------|
| Helped me to relate structure to function | | | | | |
| Helped me with 3D appreciation of structures | | | | | |
| Improved my understanding of anatomy | | | | | |

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Do you have any other comments regarding learning anatomy using cadaver specimens?

Section 2 Application of anatomical knowledge

Thinking back to your year 1 and 2 practical classes, please rate how strongly you agree or disagree with each of the following statements relating to the **application of knowledge** to veterinary skills using cadaver material by placing a tick (✓) in **one** of the boxes for each statement.

Dissection of cadaver material

| | Strongly Agree 1 | Agree 2 | Neutral 3 | Disagree 4 | Strongly Disagree 5 |
|---|---------------------|------------|--------------|---------------|------------------------|
| Opportunity to put theory into practice | | | | | |
| Is relevant to my career | | | | | |

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Demonstration of prosections

| | Strongly Agree 1 | Agree 2 | Neutral 3 | Disagree 4 | Strongly Disagree 5 |
|---|---------------------|------------|--------------|---------------|------------------------|
| Opportunity to put theory into practice | | | | | |
| Is relevant to my career | | | | | |

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Practising clinical/practical techniques on cadaver material

| | Strongly Agree 1 | Agree 2 | Neutral 3 | Disagree 4 | Strongly Disagree 5 |
|---|---------------------|------------|--------------|---------------|------------------------|
| Opportunity to put theory into practice | | | | | |
| Is relevant to my career | | | | | |

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Do you have any other comments regarding application of knowledge using cadaver material?

Section 3 Enjoyment

Thinking back to your year 1 and 2 practical classes, please rate how strongly you agree or disagree with each of the following statements relating to **enjoyment** of classes using cadaver material by placing a tick (✓) in **one** of the boxes for each statement.

Dissection of cadaver material

| | Strongly Agree 1 | Agree 2 | Neutral 3 | Disagree 4 | Strongly Disagree 5 |
|--|---------------------|------------|--------------|---------------|------------------------|
| I found it interesting/motivating | | | | | |
| I found it to be a negative experience | | | | | |
| Please comment as to what made the experience negative | | | | | |

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Demonstration of prosections

| | Strongly Agree 1 | Agree 2 | Neutral 3 | Disagree 4 | Strongly Disagree 5 |
|--|---------------------|------------|--------------|---------------|------------------------|
| I found it interesting/motivating | | | | | |
| I found it to be a negative experience | | | | | |
| Please comment as to what made the experience negative | | | | | |

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Practising clinical/practical techniques on cadaver material

| | Strongly Agree 1 | Agree 2 | Neutral 3 | Disagree 4 | Strongly Disagree 5 |
|--|---------------------|------------|--------------|---------------|------------------------|
| I found it interesting/motivating | | | | | |
| I found it to be a negative experience | | | | | |
| Please comment as to what made the experience negative | | | | | |

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Do you have any other comments regarding your enjoyment of sessions utilising cadaver material?

Section 4 Assessment

Thinking back to your year 1 and 2 practical classes, please rate how strongly you agree or disagree with each of the following statements relating to **assessment** by placing a tick (✓) in **one** of the boxes for each statement.

Dissection of cadaver material

| | Strongly Agree 1 | Agree 2 | Neutral 3 | Disagree 4 | Strongly Disagree 5 |
|---|---------------------|------------|--------------|---------------|------------------------|
| It is important because it is assessed in exams | | | | | |
| I found it useful preparation for exams | | | | | |

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Demonstration of prosections

| | Strongly Agree 1 | Agree 2 | Neutral 3 | Disagree 4 | Strongly Disagree 5 |
|---|---------------------|------------|--------------|---------------|------------------------|
| It is important because it is assessed in exams | | | | | |
| I found it useful preparation for exams | | | | | |

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Practising clinical/practical techniques

| | Strongly Agree 1 | Agree 2 | Neutral 3 | Disagree 4 | Strongly Disagree 5 |
|---|---------------------|------------|--------------|---------------|------------------------|
| It is important because it is assessed in exams | | | | | |
| I found it useful preparation for exams | | | | | |

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Do you have any other comments regarding assessment?

Section 5 Learning process

Thinking back to your year 1 and 2 practical classes, please rate how strongly you agree or disagree with each of the following statements relating to the **learning process** by placing a tick (✓) in **one** of the boxes for each statement.

Dissection of cadaver material

| | Strongly Agree 1 | Agree 2 | Neutral 3 | Disagree 4 | Strongly Disagree 5 |
|--|---------------------|------------|--------------|---------------|------------------------|
| It relates to other teaching sessions | | | | | |
| It promotes peer learning | | | | | |
| It provides the opportunity to participate and ask questions | | | | | |
| It encourages respect for the material | | | | | |

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Demonstration of prosections

| | Strongly Agree 1 | Agree 2 | Neutral 3 | Disagree 4 | Strongly Disagree 5 |
|--|---------------------|------------|--------------|---------------|------------------------|
| It relates to other teaching sessions | | | | | |
| It promotes peer learning | | | | | |
| It provides the opportunity to participate and ask questions | | | | | |
| It encourages respect for the material | | | | | |

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Practising clinical/practical techniques

| | Strongly Agree 1 | Agree 2 | Neutral 3 | Disagree 4 | Strongly Disagree 5 |
|--|---------------------|------------|--------------|---------------|------------------------|
| It relates to other teaching sessions | | | | | |
| It promotes peer learning | | | | | |
| It provides the opportunity to participate and ask questions | | | | | |
| It encourages respect for the material | | | | | |

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Do you have any other comments regarding the learning process relating to cadaver material?

Section 6 Year 4 teaching

Thinking about your current studies, please rate how strongly you agree or disagree with each of the following statements by placing a tick (✓) in **one** of the boxes for each statement.

| | Strongly Agree 1 | Agree 2 | Neutral 3 | Disagree 4 | Strongly Disagree 5 |
|--|---------------------|------------|--------------|---------------|------------------------|
| I think anatomy is an important part of the veterinary curriculum | | | | | |
| I have forgotten most of the anatomy I learnt in the first two years of the course | | | | | |
| We re-visit anatomy in our year 4 teaching | | | | | |
| I have found the classes to be relevant to CEMS | | | | | |
| I have not needed anatomical knowledge in year 4 | | | | | |

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Do you have any other comments regarding anatomy in year 4 of the curriculum?

Section 7 Beyond graduation

Thinking about your future role as a clinician, please rate how strongly you agree or disagree with each of the following statements by placing a tick (✓) in **one** of the boxes for each statement.

| | Strongly Agree 1 | Agree 2 | Neutral 3 | Disagree 4 | Strongly Disagree 5 |
|--|---------------------|------------|--------------|---------------|------------------------|
| | | | | | |

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|--|--|--|--|--|--|
| I think that good anatomical knowledge will be important in practice | | | | | |
| I feel confident my knowledge of anatomy is sufficient for a job in practice | | | | | |
| I expect to look up anatomical information as and when I need it | | | | | |

Do you have any other comments regarding anatomy beyond graduation?

Tables

| | Domain | Alpha score |
|-----------------|------------------------------|-------------|
| Questions 1 – 3 | Gaining anatomical knowledge | .829 |
| Questions 4 – 5 | Application of knowledge | .742 |
| Questions 6 – 7 | Enjoyment | .705 |
| Questions 8 – 9 | Assessment | .910 |
| Questions 10-13 | Learning process | .866 |

Table 1. Internal consistency of items within an area of learning by year group

| Questions | Method | Strongly Agree (%) | Agree (%) | Neutral (%) | Disagree (%) | Strongly Disagree (%) | Mean score |
|--|--------|--------------------|-----------|-------------|--------------|-----------------------|------------|
| 1. Helps me relate structure to function | D | 53 | 39 | 5 | 3 | 0 | 1.6 |
| | P | 44 | 44 | 10 | 2 | 0 | 1.7 |
| | T | 64 | 31 | 3 | 0 | 2 | 1.4 |
| 2. Aids in 3D appreciation of structures | D | 71 | 28 | 2 | 0 | 0 | 1.3 |
| | P | 54 | 34 | 12 | 0 | 0 | 1.6 |
| | T | 66 | 30 | 5 | 0 | 0 | 1.4 |
| 3. Improves my understanding | D | 61 | 38 | 2 | 0 | 0 | 1.4 |
| | P | 67 | 30 | 3 | 0 | 0 | 1.4 |
| | T | 66 | 26 | 8 | 0 | 0 | 1.4 |
| 4. Provides an opportunity to put theory into practice | D | 49 | 46 | 5 | 0 | 0 | 1.6 |
| | P | 33 | 53 | 13 | 2 | 0 | 1.8 |
| | T | 84 | 15 | 2 | 0 | 0 | 1.2 |
| 5. Is relevant to my career | D | 64 | 33 | 3 | 0 | 0 | 1.4 |
| | P | 44 | 48 | 8 | 0 | 0 | 1.6 |
| | T | 90 | 10 | 0 | 0 | 0 | 1.1 |
| 6. I found it interesting/motivating | D | 33 | 59 | 7 | 2 | 0 | 1.8 |
| | P | 38 | 53 | 8 | 2 | 0 | 1.7 |
| | T | 89 | 12 | 0 | 0 | 0 | 1.1 |
| 7. I found it to be a negative experience | D | 0 | 5 | 4 | 45 | 47 | 4.3 |
| | P | 0 | 2 | 7 | 44 | 48 | 4.4 |
| | T | 2 | 2 | 2 | 19 | 76 | 4.7 |
| 8. It is important because it is assessed in exams | D | 57 | 39 | 3 | 0 | 0 | 1.5 |
| | P | 57 | 36 | 7 | 0 | 0 | 1.5 |
| | T | 59 | 31 | 7 | 3 | 0 | 1.5 |

| | | | | | | | |
|--|---|----|----|----|---|---|-----|
| 9. I found it useful preparation for exams | D | 46 | 46 | 8 | 0 | 0 | 1.6 |
| | P | 51 | 43 | 3 | 2 | 2 | 1.6 |
| | T | 69 | 26 | 3 | 2 | 0 | 1.4 |
| 10. It relates to other teaching sessions | D | 48 | 53 | 0 | 0 | 0 | 1.5 |
| | P | 49 | 46 | 5 | 0 | 0 | 1.6 |
| | T | 66 | 33 | 2 | 0 | 0 | 1.4 |
| 11. It promotes peer learning | D | 41 | 48 | 10 | 2 | 0 | 1.7 |
| | P | 20 | 39 | 33 | 7 | 2 | 2.3 |
| | T | 44 | 46 | 10 | 0 | 0 | 1.7 |
| 12. It provides the opportunity to ask questions | D | 45 | 40 | 15 | 0 | 0 | 1.7 |
| | P | 51 | 36 | 13 | 0 | 0 | 1.6 |
| | T | 56 | 38 | 7 | 0 | 0 | 1.5 |
| 13. It encourages respect for the material | D | 23 | 47 | 27 | 3 | 0 | 2.1 |
| | P | 18 | 56 | 21 | 5 | 0 | 2.1 |
| | T | 34 | 41 | 23 | 2 | 0 | 1.9 |

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Table 2. Results of year 2 questionnaire. Values are expressed as a percentage of total student responses recorded on a 5 point Likert scale (1 = Strongly agree; 5 = strongly disagree) thus lower scores indicate a higher value. D refers to dissection activities; P, prosection and T, practising techniques. Percentages may not sum to 100 due to rounding.

| Teaching method | Mean ranks by area of learning | | | | |
|-----------------|--------------------------------|-------------|-----------|------------|----------|
| | Knowledge | Application | Enjoyment | Assessment | Learning |
| Dissection | 2.0 | 2.1 | 2.3 | 2.1 | 2.1 |
| Prosection | 2.2 | 2.4 | 2.2 | 2.1 | 2.3 |
| Techniques | 1.9 | 1.5 | 1.5 | 1.8 | 1.6 |

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Table 3. Mean rank scores for dissection, prosection, and practising techniques by area of learning. (1 = strongly agree; 5 = strongly disagree).

| Theme (year of study) | Definition | Example comment |
|--|---|--|
| Positive impact (yr2 and yr4) | Positive comments reflecting enjoyment of practicals. Classes are useful or helpful to learning | "Couldn't pass Vet School without them. Makes lectures actually make sense." – Yr2 |
| Barriers to learning (yr2 and yr4) | Negative aspects of classes that students feel hinder learning. Barriers include large group sizes, poor quality or validity of specimens, bad smells and difficulty of tasks | "When techniques have to be altered for cadaver material" – Yr2 |
| Student/teacher balance (yr2 and yr4) | Demonstrates student preferences for either student-led learning techniques, teacher-led techniques or a balance between the two. Year 4 comments include those expressing a need to re-visit anatomical topics | "More time should be spent on demonstration before dissection as otherwise we don't know what we're looking for" – Yr4 |

| | | |
|---|---|---|
| Respect (yr2 and yr4) | Concerns regarding a lack of respect towards cadaveric material | "There should be more emphasis on respect for dissection material" – Yr2 |
| Relevance (yr4) | The positive impact of an activity's relevance | "Much more enjoyable when made clinically relevant and practising actual techniques that would be used on live animals" – Yr4 |
| Transition to clinical studies (yr4) | The change in motivation for learning | "Earlier in the course I think it is more about exams but now it is about learning to do it to become a good vet" – Yr4 |

Table 4. Themes arising from free text responses

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Figure Captions

Figure 1. Relative frequencies of positive responses by year of study, all students

D refers to dissection activities; P, prosection and T, practising techniques.

Counts for strongly agree and agree were summed for each question within a domain and presented as a percentage of overall response for that domain

Figure 2. Responses regarding year 4 teaching

Figure 3. Year 4 student responses regarding post-graduation expectations