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Prospective biology teachers' attitudes toward animal dissection: implications and recommendations for the teaching of biology

Rian de Villiers and **Jaqui Sommerville**
jjr.devilliers@gk.up.ac.za

A sample of 242 prospective biology teachers at a South African university responded to a questionnaire on animal dissection in a science-related context. The students were required to answer questions relating to their experiences and attitudes toward animal dissection. The influence of gender, culture, and religion on their attitudes is discussed. The implications of the findings for teaching biological science are considered and a number of recommendations are made in regard to animal dissection in the biology classroom.

Introduction

In biology education the study of the structure and function of organisms has traditionally involved the use of dissection. The use of dissection in biology education as part of mass education rather than medical training, began in the early 1900s (Kinzie, Strauss & Foss, 1993). In schools, colleges and universities the debate about the role of dissection in biology education continues, especially in regard to mammals. Pressure groups like animal rights campaigners, have forced biology educators and learners to question the necessity and relevance of dissection. Consequently, effective alternatives to animal dissection have been sought. There are inherent contradictions in killing animals and dissecting them to study the processes of life. Whilst some educators and scientists have advocated alternatives to animal dissection (Rowan, 1981; Orlans, 1988a; Orlans, 1988b; Gilmore, 1991; Orlans, 1991; Davis, 1997), others have at some stage or another, expressed support for dissection (Lord, 1990; Smith, 1990; Keiser & Hamm, 1991; Lock, 1993; Offner, 1993; Wheeler, 1993; Kline, 1995).

Over the last three decades of the 1900s, the increasing public visibility of animal-rights campaigners in north America and Europe has influenced opinion in the academic community which is comprised, among others, of teachers and learners. In the 1980s animal dissection in biology education was formally challenged when learners began to object to dissection and refused to participate, demanding alternative assignments.

According to Guerrini (2003) attitudes toward animals and experimentation developed in Aristotelian (384 – 322 BC) times and when the Alexandrians and the Roman physician Galen (*c*129 – *c*216 AD) established dissection and vivisection as methods of learning about the inner workings of the human and animal body. To date few studies have examined the attitudes of learners and students toward animal dissection. Indeed, it was not until the late 1980s that such studies were first undertaken. Sieber (1986) examined undergraduate students' and scientists' attitudes to animal research, finding that more than half (59%) of the respondents thought that there were preferable ways for students to learn about certain aspects of physiology and anatomy, rather than by killing and dissecting animals. On examining secondary school learners' attitudes toward the use of animals in schools, Millett and Lock (1992) found that only 32% found it interesting to dissect dead animals. A study conducted by Stanisstreet, Spofforth & Williams (1993) revealed that 48% of secondary school learners believed animal dissection to be wrong. In a study of the attitudes of undergraduate educational psychology students toward animal dissection, Bowd (1993) found that 27% reported exclusively negative reactions to dissection, whilst others (38%) reported mixed, i.e. both positive and negative reactions. In their study of the opinions of undergraduate students from various disciplines in regard to animal dissection, Lord and Moses (1994) found that almost half (48%) objected to the idea of dissecting a rabbit, whilst a large proportion of the students (80%) did not object to the dissection of preserved animals. Interestingly, none of the aforementioned surveys explicitly involved prospective biology teachers.

Since it is the responsibility of educators to provide the best education and to encourage the greatest possible learning, to dissect or not to dissect is a question that can be answered only through reflecting on the learning outcomes of the curriculum. In some countries, particularly in Europe and north America, this controversial question has been debated for decades, whilst in others, such as those in Africa, the debate is new to the public domain. In addition, the extent to which the curricula take into account biology teachers' and learners' cultures and religions needs to be determined.

This research was conducted in South Africa, where strong elements of European and north American culture coexist with traditional African cultural elements, to examine the attitudes of prospective biology teachers toward animal dissection. Besides reporting the findings in regard to the attitudes of prospective biology teachers, we discuss the implications of these attitudes in regard to the teaching of biology and make recommendations regarding animal dissection in the biology classroom.

Objectives of the study

The following research questions are addressed in this article:

1. What are the attitudes of prospective biology teachers toward animal dissection?
2. Do gender, culture and rel igion influence these attitudes?
3. What are the implications of the prospective teachers' attitudes in regard to biology learners?

Research methods

A sample of 242 undergraduate, prospective biology teachers in first, second and third year biology and zoology courses participated in the study voluntarily. Information was collected by means of questionnaires, which students completed during routine classes. The students were informed that the questionnaire was not a test, that there would be no time limit and that they should answer the questionnaire individually. The questionnaire contained both open-ended and closed questions, which elicited responses in regard to individual actions, experiences and beliefs. The responses to the open-ended questions were analysed qualitatively and coded to provide quantitative data, whilst the responses to the closed questions were analysed only quantitatively. The responses yielded demographic data as well as information on students' personal experiences of and attitudes toward animal dissection. The demographic items related to gender, age, religion, cultural group, year of study, and area of specialisation. The students' personal experiences at school and at university, as well as outside school and university were explored through questions about animal dissection, types of animals dissected and students' emotional reactions during the dissections.

One of the attitudinal items consisted of 50 statements requiring students to tick the relevant box (1 = Strongly agree, 2 = Agree, 3 = Don't know, 4 = Disagree, 5 = Strongly disagree) on a Likert scale to indicate the extent of their agreement or disagreement with each statement. The statements were randomly organised and covered epistemological, ethical and physical aspects. The statistical analysis [summary statistics, two-way tables and analysis of variance (ANOVA)] of the survey data was used to elaborate and enhance the discussion. The epistemological, ethical and physical areas were represented by the

average score of each student in regard to the questions in each of the three areas. An ANOVA analysis was done to explore the influence of culture, gender and religion on the responses to the epistemological, ethical and physical areas.

Results

Demographic traits

Of the total biology and zoology registrations from a single university, 242 prospective biology teachers (83%) completed the questionnaires. Of these 172 (71%) were biology students and the other 70 (29%) were zoology students (Table 1).

Table 1 Demographic traits of prospective teachers

Demographic traits	Percentage
Gender	
Female	82%
Male	18%
Year of study	
First	43%
Second	32%
Third	25%
Religion	
Protestant	71%
Catholic	23%
Eastern	3%
No religion	3%
Culture	
Afrikaans	69%
English	15%
African	13%
Other	3%

The Eastern religions included Islam, Hinduism and Buddhism. "African" included Ndebele, Northern Sotho, Southern Sotho, Swazi, Tsonga, Tswana, Xhosa and Zulu students. The Portuguese, Indian, Greek, and German cultures were grouped under "Other". The sample therefore represented diverse South African groups.

Demographic comparisons

Culture

The analysis suggested that a student's cultural group could influence the responses to the physical statements but it was not significant at the 0.05 level (Table 2).

Table 2 Results of ANOVA comparing epistemological, ethical and physical areas in terms of culture

Culture	Epistemological		Ethical		Physical	
	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD
Afrikaans (n = 166)	2.23	0.65	2.54	0.57	2.81	0.91
English (n = 37)	2.44	0.63	2.62	0.48	3.00	0.84
African (n = 31)	2.26	0.68	2.55	0.64	2.97	0.87
Other (n = 8)	2.19	0.49	2.81	0.73	3.64	1.02
P value	0.2654		0.6952		0.0990*	

* Significant at the 0.10 level

Gender

The analysis provided statistical evidence that male and female students respond differently to the ethical and physical statements. The mean female responses were less positive than the male responses. The responses to the epistemological issues were similar for males and females (Table 3).

Table 3 Results of ANOVA comparing epistemological, ethical and physical areas in terms of gender

Gender	Epistemological		Ethical		Physical	
	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD
Male (n = 43)	2.18	0.61	2.32	0.62	2.47	0.85
Female (n = 197)	2.28	0.65	2.61	0.54	2.98	0.89
P value	0.5050		0.0012**		0.0001**	

** Significant at the 0.05 level

Religion

The analysis provided no statistical evidence of a relationship between students' religion and their responses to the epistemological, ethical and physical statements (Table 4).

Table 4 Results of ANOVA comparing epistemological, ethical and physical areas in terms of religion

Religion	Epistemological		Ethical		Physical	
	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD
Catholic (n = 54)	2.25	0.64	2.59	0.58	2.93	0.89
Protestant (n = 170)	2.27	0.64	2.55	0.56	2.86	0.89
Eastern (n = 7)	2.43	0.63	2.88	0.70	3.62	1.33
No religion (n = 7)	2.33	0.96	2.54	0.81	2.74	0.98
P value	0.7486		0.7933		0.9402	

Experiences

More than two thirds (67% of the males and 67% of the females) had dissected an animal at school or university. It is of particular interest that 48% of all the students (84% males and 41% females) had dissected an animal outside of school or university. Only 19% of the students had never dissected an animal.

Emotional reactions

When participants were asked to describe their emotional reactions during their first dissection procedure, some students wrote more than one comment. Their responses to the open-ended questions were classified as negative (27%), mixed (36%), or positive (37%). African students had the highest percentage (64%) of negative emotional reactions, followed by non-African (43%), English (21%), and Afrikaans (20%) students. Many more males (55%) than females (33%) were positive about animal dissection, whilst students with a Protestant religion had the highest percentage (39%) of positive responses.

The following comments reflect some students' negative reactions:

> "*It was really not easy even if it was a cockroach. I was so shocked. But we have no alternative.*"
>
> "*I felt sorry for the animal because it was alive in a cage before we dissected it. Halfway into the procedure, the heart of the animal began to beat. I refused to continue. Someone had to kill it again. To kill something that lived is bad, but to kill it twice, is worse.*"
>
> "*I did not look forward to the procedure, did not enjoy it, and*

was unable to take part in the procedure. Could not stand the sight of blood."

"*I felt disgusted because the animal was killed only to be dissected. It was suffocated and took hours to die. It was cruel and unnecessary.*"

"*Sad! Animals cannot choose to be killed! They also have rights! Why are human beings not killed and cut open when the systems of human beings are discussed?"*

Initially, some students were negative toward animal dissection, but their attitude changed when they experienced a real dissection themselves. Some comments were:

"*At first I was unsure of what to do. It was frightening to dissect an animal that was once alive. I did, however, enjoy the dissection. It was educational and extremely interesting. It gave me a real idea of how things work, rather than looking at pictures.*"

"*It was extremely interesting and informative, but I felt sorry for the animals.*"

"*At first I thought I would not enjoy the experience, and that I would be uncomfortable. In the end, it was not that bad, and the experience was rewarding and educating.*"

"*At first I was scared and didn't want to do it, but later on it became more fun and I saw what we learnt theoretically and remembered more.*"

"*It was gross; I don't like it at all, to think that you're cutting an animal in halves. But one learns to cope with it, and it is a great experience to see what you learn in theory is actually true when doing dissections.*"

Typical positive responses provided by five prospective biology teachers were:

"*I was excited and overwhelmed by the feeling that I was actually touching and observing the inside of an animal. It felt great!*"

"*I found it very interesting, you remember better by looking at the real life organs or systems.*"

"*I was ready and confident because my father demonstrated the first dissection at home. He told me and encouraged me not to be afraid of anything.*"

"*It was very exciting! I had to purchase my own dissection kit. I felt like a real zoologist. I enjoyed doing the dissection; it was a form of discovery.*"

"*I was really excited, I wanted to ask, see and touch everything. I really understood everything better. What you see on paper is not the same.*"

Animals dissected

Table 5 reveals that the respondents had dissected a large variety of animals and that they appeared to prefer dissecting certain types of animals. More vertebrates than invertebrates had been dissected, since the dissection of animals has been standard instructional practice in accordance with the biology and comparative anatomy school curriculum. More than a quarter (26%) of the total dissections have been carried out on mammals. Mammals most often dissected (arranged in order of most to least often) include rats, rabbits, mice, buck, cattle, sheep, dogs and pigs. Invertebrates most often dissected (arranged in order of most to least often) include earthworms, locusts, tapeworms, cockroaches, molluscs, bees and crickets.

Table 5 Classification of animals dissected

Animal group		Dissections (%)
Invertebrata		24%
Vertebrata:	Osteichthyes and Chondrichthyes	19%
	Amphibia	14%
	Reptilia	4%
	Aves	13%
	Mammalia	26%

More than two thirds of the students (66%) had dissected between one and four types of animal. One student had dissected 14 different types of animal. Four students had dissected a dog, which is considered a pet. Most of the students who had dissected sheep, cattle and chicken grew up in rural areas.

Attitudes

In response to the question "Would you as a biology teacher expect the learners to do animal dissection?" 71% indicated that they would. All the students with an Eastern religion (3%) gave a positive response, followed by those with no religion (86%), Protestant (70%) and Catholic (67%). The African students (84%) had the highest percentage of positive responses in spite of the fact that 64% had negative emotional reactions the first time they did a dissection themselves (see Emotional reactions). The students' responses, to the open-ended, follow-up question as to why they would expect the learners to dissect, were classified into cognitive, skill-based, sensory, affective, and procedural categories (Table 6). The main reason for students' negative responses, involved the affective domain.

Table 6 Responses by prospective biology teachers as to why they would expect learners to dissect animals

Categories	Yes (%)	No (%)
Cognitive	68	11
Skills	4	0
Sensory	20	0
Affective	3	88
Procedural	5	1

A large number (87%) of the respondents were in agreement with the question "Will you as a teacher do hands-on animal dissection in the biology classroom yourself?"

A very high number of the English students (94%) preferred to do animal dissections themselves rather than expect the learners to do them. Of the Afrikaans students, 87%, and of the African students, 81%, indicated that they would not mind dissecting animals in the classroom themselves. Their responses to the open-ended, follow-up question "Why?" were classified into two categories, namely, cognitive and affective (Table 7).

Table 7 Responses by prospective biology teachers as to why they would dissect animals in the classroom themselves

Categories	Yes (%)	No (%)
Cognitive	85	0
Affective	15	100

Epistemological issues

The epistemological issues included, for example, elaborating on text information, discovery learning, investigation and developing intellectual independence. Some of the outcomes of the survey were unexpected, for example, 61% of the respondents agreed with the statement "Since an animal body closely resembles the human body, dissection is exciting". In addition, a large number of the respondents (83%) felt that they could learn more about their bodies from animal dissections, as an animal's body closely resembles the human body. The fact that the human and animal bodies are similar would not deter them from dissecting animals.

The students indicated that some organisms are more acceptable for dissection than others. Most students indicated that they prefer to dissect a cold-blooded animal, e.g. an earthworm, rather than a warm-blooded animal, like a dove. No major differences were found in the distribution of responses to statements about the phylogeny of mammals. The respondents, however, preferred to dissect small mammals

rather than larger mammals. In answer to the statement: "I would prefer to dissect a rat rather than a rabbit", 48% of the respondents agreed with the statement.

Animal dissection is regarded by 42% of the respondents as the only technique which can assist them to develop manipulative skills. A large proportion of the respondents (92%) indicated that dissections give them more and precise information about the anatomy of an animal than other sources. Most of the responses were in the "strongly agree" category.

A preference for discovering more about an animal during a dissection, rather than by using alternative sources such as models and videotapes, was indicated by 68% of the respondents. More than three quarters of the respondents (77%) disagreed with the statement that "Dissection is unnecessary in biology education because one can find all the information in a textbook". The statement, "I believe dissection is an effective way to study the anatomy of an animal", elicited positive responses from 91% of the respondents.

Physical issues

This issue includes the students' reflection upon the immediate physical experience of animal dissection. Almost two-thirds (63%) of the respondents agreed that they would not be discouraged from dissecting animals by the sight of blood. On the other hand, more than half (59%) dislike the smell associated with live and preserved animals. More than two-thirds of the respondents (69%) did not regard dissection as "something dirty or unclean, and not a pleasant sight".

Ethical issues

Ethical issues included acceptable treatment of the dead, killing of animals, reflections on self, and cultural beliefs. Respondents strongly indicated (84%) that it was acceptable for a student to watch other people carrying out animal dissection. In response to the statement "I do not mind if an animal has already been prepared for me to use in dissections, but I would not actually kill animals for dissection myself". Most (56%) of the positive responses (84%) were in the "strongly agree" category. Surprisingly, exactly half of the respondents preferred to dissect an animal organ, rather than the whole body. More than half (56%) of the respondents agreed that the study of anatomy justifies the dissection of animals. An unexpected finding was that 67% of the respondents would rather do dissections themselves than watch a videotaped dissection.

Many students (70%) indicated that animals should be used for dissection only for the purposes of education and research. It is significant that approximately two-thirds (64%) of the respondents indicated that dissecting animals for teaching/learning purposes increases their respect for life. Most students (70%) preferred to dissect a preserved, rather than a fresh animal in a biology investigation. More than half (60%) of the respondents would be comfortable with the thought that an animal has been killed "as long as it is for a good reason".

Most of the respondents (69%) disagreed with the statement: "In my culture it is ethically wrong for man to kill animals for dissection". More than three-quarters (75%) of the respondents thought that the way they had been brought up would not prevent them from dissecting. Just over half (53%) of the respondents indicated that they felt better about dissections knowing that the animal had been raised specifically for dissection.

Discussion

Limitations of the study

Seeing that some of the groups in this research were too small for statistical testing, the focus fell on larger groups. This is in keeping with the view expounded by Babbie and Mouton (2001) who aver that it is never possible to observe all the actions and actors relevant to the social phenomenon under scrutiny. Whilst the majority of the students (82%) were females, only 13% of the biology and zoology students were African. A mere 3% of the respondents practised an Eastern religion, and 3% practised no religion. These low representations in the sample may have affected the outcome of the analysis of responses in terms of culture and religion.

Implications for the teaching of biology

Although more than two-thirds of the students had positive attitudes in regard to animal dissection, a minority of students were against it. Most students coped with animal dissection and indicated that they learn from it. It is the teacher educator's responsibility to sensitise the pro-animal dissection students to ethical, epistemological and physical issues. The teacher educator and the biology teacher must be sensitive to students' and learners' needs, and should create an awareness of alternative instructional tools.

The responses of prospective biology teachers to the attitude statements have important implications for those teaching biology or the biological components of a science curriculum. Since teachers are mediators between the learners' views of the world and the generally accepted scientific view, their attitudes have important implications for the learners they teach. Those teachers, who are proponents of animal dissection as an effective instructional tool, should acquaint themselves with the religious concerns of all learners in a diverse society. Some religions do not support the killing of certain types of animals, or any animals, unnecessarily. Biology teachers need to understand their learners' concerns and feelings about animal dissection and should endeavour to meet learners' intellectual, moral and emotional needs. It is important for biology teachers to be sympathetic and aware of learners' attitudes in regard to animal dissection. Learners' attitudes may impinge on the subject the teacher is teaching and result in detracting from or resisting effective learning. A teacher's opposition to animal dissection could oppress the intellectual needs of some learners. This research revealed that dissection alienates some students from learning whilst it serves as a useful learning tool for others.

Animal dissection in secondary schools and undergraduate biology, anatomy and zoology courses, has been scrutinised increasingly during recent years. Consequently biological science educators have been forced to re-examine the morality and instructional effectiveness of this practice. According to Orlans (1988a) judicial and legislative decisions in California and Florida protect the rights of students who do not wish to participate in dissection. There learners have the right to learn and the biology teacher must accommodate them in a manner they find acceptable. Whilst they acknowledge the fact that animals have rights too, biology teachers may not exclude learners, who are strongly concerned about animal rights, from a course.

Biology learning outcomes can be sensory, cognitive, affective, skill-based and procedural. Only a very small percentage of learners will need dissection skills in future (post-school) courses or careers. Teachers need to be aware of the fact that the vast majority of learners forced to perform dissections in secondary school, will not enter professions in which such skills will be required. The authors agree with Orlans (1991) that animal dissection is an integral aspect of the training of mature learners who have made a career commitment in a field in which dissection is necessary for the acquisition of pertinent knowledge and skills. Yet, even at higher education level, this concession does not mean that all students in biology courses should carry out dissections when alternative methods may suffice.

Despite numerous educational alternatives, animal dissection is included in many physiology, anatomy, biology and zoology courses. Burkett (2000) contends that many biology teachers, when questioned about their attitudes toward excluding dissection from the curriculum, are vehement in their defence of the practice. They cite various reasons, but often argue that there is no effective substitute for hands-on experience. Millett and Lock (1992) indicate that, if learners could choose, they would prefer to dissect human cadavers rather than animals.

Students can learn about internal animal structure through a number of alternative methods. Implementing alternative methods in the teaching of biology does not entail excluding animals from the classroom. If the acquisition of practical dissection skills is essential, alter-

native methods cannot completely replace dissection.

There is an interesting dilemma regarding students who will become biology teachers in the secondary school. On the one hand, it is unlikely that they will use dissection in the secondary school, while on the other it makes sense for them to have first-hand experience of what they will teach. Perhaps, as in the case of doctors and veterinarians, dissection should be an obligatory part of prospective biology teachers' courses. At the same time, given the alternatives in the secondary school, prospective biology teachers should have training in those alternatives too. This could endorse the current emphasis on field-based and ecological research, as the focus continues to shift away from the laboratory to investigation of life in the natural environment. Orlans (1991) stresses the fact that few learners are motivated to follow a biological career because of their aversion to animal dissection. One aim in teaching biology at school is to engender a positive attitude in learners in regard to nature conservation. Ironically, it is as a result of their positive attitude toward conservation that learners question the practice of animal dissection.

This study has revealed that students from rural areas are likely to have more liberal attitudes toward animal dissection than students from urban areas and that they are more likely to be familiar with animal dissection, as a result of their lifestyle. One Northern Sotho student stated: "I was so scared the first time doing an animal dissection, but I got used to it because at home we do it often, and many times when I am back for holidays". This suggests that individuals have a tendency to develop positive attitudes toward familiar life experiences.

Teachers are role models, consequently their attitudes toward animals can affect learners' attitudes toward the animal kingdom. Biology teachers can assist learners by encouraging consistent and responsible behaviour toward animals. They can also help learners to understand animals and how human actions affect them. This should be done in the early elementary years when learners' value systems are still developing. In order to accommodate the changes in biology and medical technology, primary and secondary school biology teachers should include a bio-ethics component in their courses.

Recommendations and conclusion

Biology teachers should take note of the following recommendations resulting from this research. They are advised to

- take cognisance of different cultures and religions in the biology classroom
- consider ethical and moral issues in regard to animal dissection
- be aware that female learners are more averse to dissection than male learners
- present alternative options, such as videotapes and models, and ensure that the resultant activities are equal in respect of time and effort
- offer learners a choice between fresh and preserved animals
- insist that the animals dissected should be treated respectfully;
- use mammals low on the phylogenetic scale
- never allow animals normally kept as family pets to be dissected
- ensure that the learning outcome will be achieved by means of the dissection, e.g. if the learning outcome entails the use of manipulative skills, then only organs need be used.

The following additional recommendations for biology teachers are based on the authors' personal classroom experience. Biology teachers should

- minimise the number of species used for dissection
- optimise the number of learners per specimen to minimise the number of specimens needed
- not allow endangered species to be used in the classroom
- avoid the use of gestating female animals
- be *au fait* with the dissection process
- avoid unnecessary repetition
- reassure learners/students that the teacher/teacher educator will help with any dissection that the learners/students are unable to perform themselves.

Dissection, perhaps more so than any other laboratory exercise, is dramatic. Teachers need to be aware that it entails more than the intellectual stimulation of examining and identifying the inner parts of an organism. Learners should respect all forms of life, including the animals dissected and should appreciate and be aware of individual variation, as well as the continuity of life. A positive attitude toward and respect for animals can be inculcated by allowing learners to observe the characteristics of various species.

The questionnaire responses in regard to dissection have implications for biology teachers in terms of their approach to animal dissection in the classroom. Ultimately, it is the teachers' responsibility to decide whether to dissect or not, therefore the teachers should be aware of the possible responses of different demographic groups. The results of this research can be used to inform biology teachers in primary and secondary schools, as well as teacher educators in the higher education sector. The results could be useful to curriculum designers responsible for biology curricula, and to policy makers.

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Rian de Villiers is Senior Lecturer in the Department of Science, Mathematics and Technology Education, School of Teachers Training, at the University of Pretoria. He has lectured in zoology, biology, general science and elementary science. His research focuses on teacher migration and teacher training in biology education.

Jaqui Sommerville is Senior Research Consultant in the Department of Statistics at the University of Pretoria and has 16 years experience as a statistical software consultant. She assists postgraduate students and staff with the statistical analysis of their research data. Her research interests are in the biological and medical sciences.