

Training ethical scientists: student views on the benefits of using animals in learning

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Abstract: *The use of animals in science teaching can create an environment which enhances learning outcomes, providing opportunities for students to add value by engaging with authentic experiences, but also offering the chance to explore the ethical issues surrounding the use of animals in teaching, learning and research. This paper describes the benefits perceived by undergraduate Zoology students of exposure to animals in their learning. Results demonstrated that students value highly the chance to work with animals during their undergraduate careers, and that the nature of this appreciation changes and matures as they develop into more independent learners.*

The issue

The use of animals in biology teaching in universities worldwide is becoming more controversial (Franklin et al 2002). Indeed, there are some tertiary institutions in the UK which have removed the use of animals, or offer the chance to “opt out” of animal-based activities, in degree programs such as veterinary science (Heron 1992). These views are a reflection of the current perceptions of society (Wheeler 1993; Hagelin et al 2000), including students enrolled in courses which incorporate the use of animals in teaching and learning (Mangan 2000; Pederson 2002).

The background

Advocates of the benefits of the use of animals in teaching suggest that while alternative approaches can be appropriate in some circumstances, there are a number of situations in which there is simply no substitute for the use of animals or animal tissues (Wheeler 1993; Pederson 2002). The benefits of using animals, tissues, or preserved specimens include the following:

- 1) Having an authentic experience – there is substantial published literature attesting to the benefits that the authenticity (relevance and realism) of an experience can have on learning outcomes (see Herrington and Herrington 2006 and references therein);
- 2) Understanding dynamic and interactive systems – static examples such as diagrams, models and computer simulations simply cannot render these experiences accurately (Pederson 2002);
- 3) Tapping into multiple learning modes – it is certainly well established that many students engage and learn more effectively when given the opportunity to investigate, to actively participate in learning activities and to gain hands-on experience which complements theoretical learning (Mayer et al 1996);
- 4) Building an appreciation of ethical and animal welfare issues – working with animals affords the important opportunity to discuss animal ethics issues with students, and allows the students to develop and defend a position (Pederson 2002).

The UTAS scaffolded approach

In the School of Zoology at the University of Tasmania we have designed a vertically integrated approach to allow our students to develop an appreciation of animal ethics across the three years of the undergraduate course. This program aims to maximise learning outcomes whilst simultaneously addressing several of the UTAS Generic Graduate Attributes (GGAs); knowledge, problem-solving skills

and social responsibility (UTAS GGA policy, 2001). Our program includes the supervised handling and observation of live vertebrate and invertebrate animals, dissection of dead animals and inspection of preserved specimens. Students are asked to kill an invertebrate (sea urchin) by immersion in warm fresh water in their 2nd year, and mice are killed while students are in the room in their 3rd year. In all cases students are offered the opportunity to undertake the level of involvement with which they are comfortable; this ranges from full participation, to watching another student, to completing an alternative task at another time.

We value, and want our students to value, the use of animals in their learning experiences and, therefore, relevant assessment tasks are embedded in our learning curriculum. The University of Tasmania Animal Ethics Committee requires that activities involving animals are appropriately assessed and explicitly address stated learning outcomes. Furthermore, the Australian Code of Practice for the Care and Use of Animals for Scientific Purposes (hereafter: The Code) establishes that all teaching activities for which animals are used are required to clearly demonstrate that learning outcomes cannot be achieved in another way, and that every attempt has been made to observe the “3Rs” – Replace animals with an alternative, Reduce the number of animals used and Refine techniques and procedures, whenever possible (Aust. Govt 2004).

The Code provides that all students are “given the opportunity to discuss the ethical, social and scientific issues involved in the use of animals for scientific purposes, including teaching” (Australian Govt 2004). In the School of Zoology, University of Tasmania, observance of the requirements set out in The Code begins in 1st year, when students are introduced to the ethical framework that guides the use of animals in teaching and research. Students are also given the opportunity to discuss the advantages and disadvantages of, as well as their own views about, the use of animals in their learning experiences. They also consider relevant aspects of scientific method and experimental design such as appropriate types of animals and sample sizes for experiments. In 1st year practical classes, students examine or dissect a number of invertebrate specimens, and to improve their ability to take full advantage of these learning opportunities, we offer a “pre-Lab” on line learning opportunity to enhance prior knowledge and minimise the possibility of cognitive overload during the practical session (Cook 2006; Jones and Edwards in press).

In 2nd year, students are given their first opportunity to work with vertebrates and cephalopod molluscs in the field and the laboratory. Their roles and responsibilities under The Code (Aust. Govt 2004) are discussed in class, and each student signs the Student Declaration. The value of student learning on field trips has been clearly demonstrated in the areas of engagement, motivation, and informing future decisions (Prokop et al 2007). In 3rd year, students must take a greater personal responsibility for the care and use of animals. We have, therefore, designed specific learning tasks through which students develop a professional level of awareness of the processes of gaining animal ethics approval for scientific research. Students undertake animal husbandry responsibilities, and, under close supervision, design and undertake research projects applying rigorous experimental design and ethical guidelines, both in the field and the laboratory.

Results

We evaluated student perceptions of the use of animals in our teaching program to examine whether our approach is helping students to gain an appreciation of the advantages of such opportunities. During 2009, we surveyed students at 1st (end of Sem 1 and end of Sem 2), 2nd (end of yr) and 3rd year (end of Sem 1 and end of Sem 2) and asked them a series of questions designed to explore their perceptions of the benefits to their learning of using animals.

To investigate students' appreciation of the use of animals in their learning, we asked *"Do you feel that your learning experience was improved by the use of animals or animal tissues"* (four Likert scale options ranging from Extremely to Not at all). We saw a steady increase in the proportion of students at each year level who responded with "Extremely" helpful to their learning (Figure 1, black bars). There was a statistically significant increase between years (χ^2 (d.f. = 2) = 58.800, $p < 0.0005$). We interpreted this result as students showing an increasing appreciation for these opportunities as they matured as learners. Further, when we examined the effects of our 1st yr interventions more closely, we observed that the proportion of students who responded in this way had indeed increased significantly (χ^2 (d.f. = 1) = 32.175, $p < 0.0005$) from 1st to 2nd semester (Figure 1, grey and white bars). Excitingly, 3rd year students also demonstrated a significant increase in the number of students reporting the use of animals as extremely helpful to their learning (χ^2 (d.f. = 1) = 12.991, $p < 0.0005$)

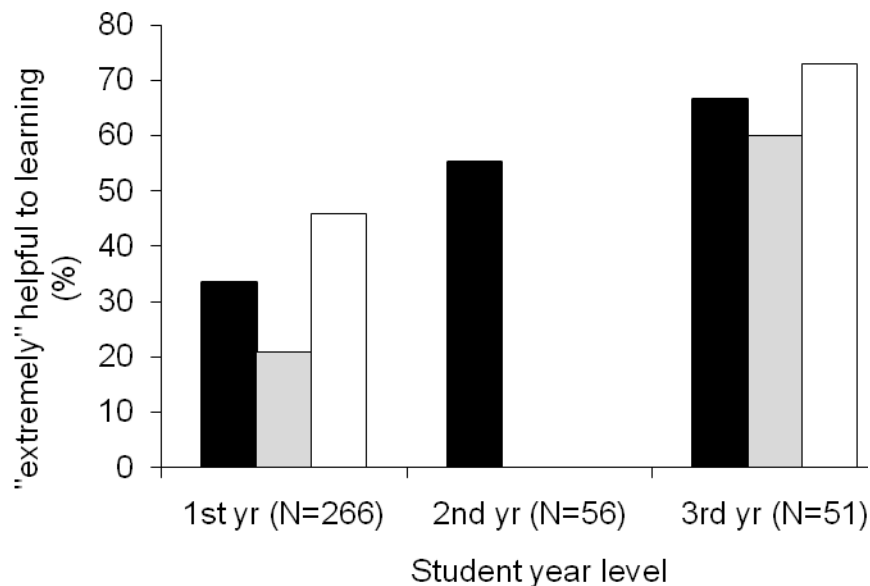


Figure 1 Proportion of total comments of students who perceived the use of animals or tissues to be extremely helpful to their learning, by year level (black). Samples sizes indicated in parentheses. First and third year comments are also separated into Sem 1 (grey) and Sem 2 (white) responses.

To examine the nature of this appreciation for learning opportunities involving animals we asked *"What benefits do you see or expect to gain from the use of animals or animal tissue in your learning in Zoology?"* Responses were assigned to one of five categories, and we examined whether the relative emphasis on a particular type of benefit varied during their progress through our undergraduate program (Table 1). Results are presented as proportions of the total number of comments made, and demonstrate that during their 1st and 2nd years of study, students were most focused on the authenticity of the learning experiences (62.8 and 57.9 %, respectively), wanting them to be realistic and engaging in order to more strongly reinforce theoretical concepts. This group of responses is typified by the following student comments:

"It's hard to form a real interest for the subject area without any interaction with real animals"

"Being able to see and examine (first hand) these animal/animal tissues cannot compare to photos or diagrams. Real-life usage of these tissues allows the experience to be unforgettable and thus, allows me to remember animal structures better"

However, by 3rd year, fewer (35.6 %) student comments identified “bringing authenticity to a learning experience” (Table 1) as a benefit of working with animals. Instead, the proportion of comments indicating the importance of seeing the relevance of current learning to future study or career opportunities increased significantly (χ^2 (d.f. = 1) = 17.710, $p < 0.0005$) from 11.5 % in 1st year to 26.1 %. Further, comments relating to the students’ learning mode and the opportunity to gain hand-on experience rose from 20.0 % in 1st year to 27.6 % by 3rd year. As exemplified below, students felt they gained:

“Knowledge about the animals i.e. what happens to them, the respect they receive and the skills learned can all contribute to employment - -a greater understanding will help make more appropriate decisions”

Table 1 Proportion of total comments in response to the open-ended question “What benefits do you see or expect to gain from the use of animals or animal tissue in your learning in Zoology?”

| Benefit | Type of benefit | End of 1 st yr (%) | End of 2 nd yr (%) | End of 3 rd yr (%) |
|---------|--|----------------------------------|----------------------------------|----------------------------------|
| 1 | Bringing authenticity to a learning experience | 62.8 | 57.9 | 35.6 |
| 2 | Seeing relevance of current learning to future | 11.1 | 17.1 | 26.1 |
| 3 | Wanting to help others/animals/environment* | 4.5 | 5.3 | 10.8 |
| 4 | Relating to learning mode - seeing, hearing, doing, 1 st hand experiences | 20.0 | 19.7 | 27.6 |
| 5 | Few or none | 1.7 | 0 | 0 |

*Includes the opportunity to develop awareness of animal ethics issues, aligned with UTAS GGA of Social Responsibility

To investigate the development of students’ ethical awareness, we asked “Were you given any verbal/written/online information about animal ethics at the time the animals or animal tissues were used?” Figure 2 shows that the proportion of students responding positively to this question also increased significantly between years (χ^2 (d.f. = 2) = 35.355, $p < 0.0005$), particularly from semester 1 (47.0 %) to semester 2 (66.0 %) in 1st year (grey and white bars), and then again by the end of the 2nd year (80.0 %) of our teaching program, showing that our scaffolded strategy does increase student awareness that animal ethics issues exist.

Similarly, the proportion of comments relating to the University of Tasmania’s GGA of Social Responsibility* (Table 1) doubled from 1st to 3rd year in students surveyed (4.5 to 10.8 %) and the survey also elicited some reflective comments which endorsed our teaching approach:

“Using animals makes us think more ourselves about the animal ethics issues, which are likely to be important in our futures in this field”

“At every stage animal ethics [issues] are drilled in. No one in the School of Zoology at UTAS could possibly take this for granted”

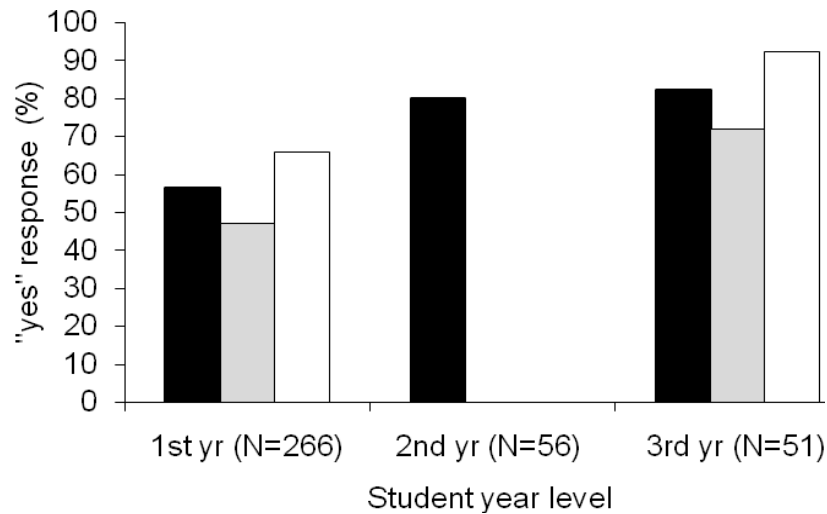


Figure 2 Proportion of students who recalled being given information relevant to animal ethics at the time of the activity, by year level (black bars). Samples sizes indicated in parentheses. First and third year comments are also separated into Sem 1 (grey) and Sem 2 (white) responses.

Conclusion

Our results show that as undergraduate students matured as learners, their perceptions of the advantages to their learning gained from the use of animals shifted, from the benefits of hands-on experiences for successfully completing the task at hand (1st year), towards the cumulative contribution those experiences were making toward their future learning and careers (3rd year). Students themselves appreciate and gain high satisfaction from hands-on authentic activities in biology laboratories (Peat and Taylor 2005; our own survey data (Table 1)).

Final year students in the present study also demonstrated an increased appreciation of the importance of developing an awareness of relevant animal ethics issues. Our findings are supported by previous research which demonstrated proportion of students in favour of animal-based experiences increased with year level (Smith 1994). Students are perhaps better prepared to benefit from these experiences later in their time at university (Downie and Alexander 1989; Hagelin et al 2000). With University animal ethics committees increasingly demanding justification that learning objectives cannot be met by the use of alternatives such as computer simulations, videos or models (Predavec 2002), educational goals need to be carefully considered when deciding if the use of animals is necessary (Hagelin et al 2000).

Our study draws attention to the need for careful planning in accordance with the rigorous framework of The Code. As teachers, we need to create and implement animal-based activities which simultaneously enhance student learning outcomes and afford students the opportunity to comply with their responsibility under The Code to gain maximum benefit from the learning opportunities offered to them.

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