

Replacement of Harmful Animal Use in Life Science Education: The Approach and Activities of InterNICHE

Nick Jukes

InterNICHE (International Network for Humane Education), 19 Brookhouse Avenue, Leicester LE2 0JE, UK
E-mail: coordinator@interniche.org

Summary — Harmful animal use in undergraduate education is increasingly being replaced by alternatives, such as computer software, manikins and simulators, ethically sourced animal cadavers, apprentice work with animal patients, and student self-experimentation. Combinations of such alternatives can better meet teaching objectives, reduce costs and avoid the negative pedagogical and social impact of animal experimentation. Since 1988, the International Network for Humane Education (InterNICHE, formerly EuroNICHE) has been working with teachers to replace harmful animal use and has been supporting students' right to conscientious objection. This paper presents the approach, history and current activities of InterNICHE. With a vision of 100% replacement, the network aims for empowerment by networking information and providing support. It works with the belief that most teachers want investment in the best quality and most humane education possible. The forthcoming second edition of the InterNICHE book, *from Guinea Pig to Computer Mouse*,¹ includes practical details of progressive teaching aids and approaches, as well as case studies from teachers who employ such alternatives. In 1999, InterNICHE produced the film *Alternatives in Education*, now available in 20 languages. Such resources are complemented by outreach trips and conferences and an Alternatives Loan System, which offers products for familiarisation and assessment. The InterNICHE website (www.interniche.org) was launched in 2001.

Key words: *alternative, animal experiment, computer-assisted learning (CAL), conscientious objection, dissection, education, ethics, humane education, InterNICHE, replacement.*

Introduction

InterNICHE is the International Network for Humane Education. Formed in 1988, as EuroNICHE, it is based in the UK, with a network of 32 national contacts, stretching from Brazil to Belgium, and Israel to India. As both a network and an organisation, InterNICHE works with teachers to introduce alternatives to animal experiments and with students to support freedom of conscience.

The InterNICHE vision is one of 100% replacement of harmful animal use in education. The approach is therefore of promoting the one R of *replacement*, rather than the Three Rs of *reduction*, *refinement* and *replacement*.

Humane education in the life sciences is:

- progressive education for which the teaching objectives are met using humane, alternative methods;
- where animals are free from harm and students have freedom of conscience; and
- education that encourages compassion, respect for life and critical thinking.

Alternatives are educational aids or teaching approaches that replace harmful animal use or complement existing humane education. They comprise a range of methods detailed below.

Multimedia computer simulation

Computer-assisted learning (CAL) has brought great benefits to life science learning. High quality and powerful software has been available since the mid-1990s, with programs that can offer virtual dissections and anatomy lessons, or well-equipped virtual laboratories for experimentation. CAL can provide extra levels to the learning experience, as well as a degree of excitement, due to its often innovative nature. Visualisation and understanding of structure and function can be enhanced through high-resolution images, the ability to highlight or dissolve away different organ systems, and options to magnify images or compare tissue between species. Virtual laboratories, typically simulating animal preparations and experiments in physiology and pharmacology, can support the development of enquiry skills and an understanding of the interplay between complex and related phenomena. Virtual reality (VR) is a

¹Jukes, N. & Chiuiia, M. (2003). *from Guinea Pig to Computer Mouse: Alternative Methods for a Progressive, Humane Education, 2nd edition, 544pp. Leicester, UK: InterNICHE.*

rapidly evolving use of computer potential that has applications, in endovascular and endoscopic procedures in particular, and it can be practised in an immersive, sensory environment.

Film and video

Traditionally used to supplement practical work and to illustrate processes that need further explanation, film and video are also low-cost. Professionally performed dissections can often impart more knowledge than dissections performed by students themselves, or can better prepare students for real dissection using ethically sourced animal cadavers. Digital video is flexible and can be incorporated into multimedia alternatives and presentations.

Models, manikins and simulators

Models are classical anatomy learning tools, and manikins can support effective training of clinical skills, such as animal handling, blood sampling and intubation. Basic surgery skills such as eye–hand coordination, suturing and anastomosis can be gained using simulators. These non-animal alternatives help students gain confidence and competence before using animals. Perfusion of ethically sourced animal organs using dynamic simulators allows for realistic surgery practice, and advanced computer-assisted simulators used within medicine can better prepare students for critical care scenarios.

Ethically sourced animal cadavers and tissue

Many zoology students and all future veterinarians will require hands-on experience with animals and animal tissue, and the use of ethically sourced cadavers is an alternative to the killing of animals for dissection and surgery practice. The term “ethically sourced” in this context refers to animal cadavers and tissue obtained from animals that have died naturally or in accidents, or that have been euthanised secondary to natural terminal disease or serious non-recoverable injury. Animals that have been harmed or killed to provide cadavers and tissue are not considered ethically sourced, nor are those sourced from places where harming or killing is commonplace. Body donation programmes linked to teaching hospitals and independent practices can provide supplies of cadavers and tissue ethically.

Clinical work with animal patients and volunteers

Experience with patients is the norm within medical education. In veterinary education, clinical

learning opportunities could be expanded considerably to replace animal experiments and to better prepare students for the professions. Once basic skills have been mastered by using non-animal alternatives, supervised work with animal patients allows the gaining of skills such as wound management and basic surgery. Shelter sterilisation programmes are a huge potential resource for students, with castration and spays observed, assisted and then performed by students. This is realistic and relevant training for students who will graduate to performing many sterilisations in their careers. The clinic can also teach students many other skills that the laboratory cannot: experiencing and dealing with the clinical environment and its demands, appreciation of the diversity of patients and clinical situations, and communication skills with work colleagues and animal guardians.

Student self-experimentation

For further experience of the living body, the consenting student is an excellent experimental animal. The intense involvement and self-reference of such experiments makes them highly memorable and supports effective learning. Electroencephalogram (EEG), electrocardiogram (ECG), nerve conduction and many other tests can be performed using basic laboratory equipment or specially produced apparatus. Self-experimentation may also be useful for future veterinarians, who, like rats, dogs and cats, are also mammals and can perhaps better understand the nature of being a patient if they have been consenting subjects of non-harmful experiments.

***In vitro* laboratories**

The rapid development and uptake of *in vitro* technology in research and testing needs to be supported by student familiarity with the techniques, and *in vitro* practicals can provide this experience. Animal tissue and cells used for such work can be sourced ethically, and within some cell biology practicals, the use of animal tissue and cells can be replaced directly with plant material. For studying cell respiration and electron transport, for example, mitochondria can be sourced from yeast, potato or beet, instead of rat liver. Therefore, with ethically sourced animal preparations, or with plant material, such *in vitro* practicals can then be considered as alternatives.

Fieldwork

Students within the fields of biology, zoology, ethology and ecology may often find themselves in

situations where animals are studied in a laboratory setting as a model for nature, or they will be faced with interactions with wild animals that are invasive or otherwise harmful to the animals or their habitat. But biology is not merely experimentation, nor does its study require harm. Much of the knowledge gained about animals and nature has come from observation and other non-invasive fieldwork. This tradition of studying animals within their natural environment is a particularly rewarding alternative to harmful animal use that could be developed and explored in order to replace some harmful animal use in the above disciplines.

Such field studies offer opportunities to study animals expressing natural behaviour rather than the limited or stereotyped behaviour presented by isolated individuals or groups within the laboratory. They can provide a richer learning experience for the student, and support the appreciation of animals as free individuals of integrity, existing within a complex and dynamic web of social, cultural and ecological realities. Both cities and the countryside offer plenty of opportunities for non-invasive study of animals, from insects to birds to mammals.

Implementation

Alternatives have already replaced harmful animal use in many different university departments throughout the world. And, in some countries, such as the UK, live animal use for practice in surgery has never been a tradition. The alternative teaching approaches are, therefore, the norm in many places.

The successful implementation of alternatives impacts on many spheres.

Pedagogic and scientific impact

Over 35 published academic studies have shown that students using alternatives perform at least as well as those using animals in conventional, harmful ways. Both software and the use of simulators allow for students to repeat exercises until they (and their tutors) are satisfied that progress to the next learning stage is appropriate, and so learning in general is also more effective. Moreover, the gaining of essential scientific skills such as problem-solving and good experimental design is treated as very important in many software products, helping to prepare future graduates for research.

Combinations of alternatives applied to the educational process will clearly do even better: teachers committed to good course design will have audited their courses and identified teaching objectives before choosing the best tools and approaches.

Learning veterinary surgery procedures, for example, can be most effectively and ethically achieved by progressing from models, manikins and simulators, to ethically sourced cadavers, and then to apprenticeship in the clinic with animal patients. Using alternatives, students will learn that life is valuable and not to be taken; furthermore, the need for conscientious objection is obviated, and the learning environment is improved as a result.

Civil liberties and social impact

Validation of compassion, empathy and respect for animals by using alternatives will ensure that students who would not have entered the life sciences because of harmful animal use can now participate and contribute. This increased accessibility is relevant for all students, but in many countries, this will have a significant positive impact on increasing the number of women in the life sciences. These qualities are important both for individuals and for society as a whole.

Harmful animal use also betrays a hidden agenda. The messages given to students teach that it is acceptable to harm and kill animals and to use them as disposable tools. The result is that positive social values such as compassion are effectively dismissed as unimportant.

For those who are already students, the threat of academic or psychological penalty when conscientiously objecting is a form of discrimination, and the lack of opportunities to use alternatives is limiting students' experience with best practice learning tools and approaches. Compulsory harmful animal use is unacceptable coercion, and can cause psychological trauma for students. Animal use in education is clearly an ethical issue, and by dealing with it through discussion and action, teachers will demonstrate that science and ethics can be compatible and that problems can be faced rather than denied. This is a good lesson for future scientists to learn.

Many alternatives are inexpensive to buy, and teachers can also make their own, based on their own experience and their specific course requirements. Developing and implementing alternatives can also enhance individual and institutional reputations, as well as create revenue. Costs in general will decrease, as the need to purchase, keep, kill and prepare animals disappears.

Finally, the use of alternatives accords with the spirit of many national laws and international conventions and directives, which state that alternatives should be used wherever possible.

Animal welfare and environmental impact

Harm comprises any action, deliberate or otherwise, that impinges on an animal's current and future

well-being by denying or limiting freedoms, such as the freedom to live, to express full natural behaviour, to be part of a social structure and ecosystem, and to be have no pain or distress inflicted. Animals caught from the wild, bred, caged, killed or experimented on do, therefore, suffer harm. Being killed for dissection, or used to demonstrate physiological principles or surgical techniques, is not acceptable from the perspective of animal ethics.

Taking animals from the wild can seriously disturb local ecosystems and has contributed to the decline of some species, such as leopard frogs. Threatened or endangered species, including dogfish, are also caught for educational use, despite the alternatives available. Toxic chemicals used for preparing the millions of animals killed each year have a damaging environmental and health and safety impact.

Available Resources

How does InterNICHE go about realising the vision of 100% *replacement* of harmful animal use? The network offers a range of information and other resources to teachers and students to empower them to facilitate change.

from Guinea Pig to Computer Mouse

The forthcoming second edition of this alternatives book is organised into four major sections, each of which supports curricular transformation. Part A provides the background to alternatives and animal use in education, and chapters by Jonathan Balcombe and Lara Rasmussen describe assessment of alternatives and the concept of curricular design, respectively. Part B comprises case studies written by teachers who have implemented alternatives and replaced harmful animal use; they share their experience of the process of change and the advantages of using alternatives. The authors include:

- Hans Braun, from the Institute of Physiology at Marburg University, who co-developed the award-winning Virtual Physiology series of virtual laboratories, which have fully replaced the animal experiments in his institute. Braun found that students were much more active in practical classes with the simulations and were successfully learning how to make use of their knowledge.
- Henk van Wilgenburg, a pharmacologist from the University of Amsterdam, who developed the “Microlabs” computer simulations, and who advises on the process of implementation.
- Mykola Makarchuk, from Kiev State University, who uses self-experimentation and com-

puter simulation for human and animal physiology teaching, and who explains the challenges facing replacement in the Ukraine.

- Garry Scroop, a physiologist from the University of Adelaide, who has implemented self-experimentation “research project practicals” to support the learning of problem-solving strategies to encourage teamwork and to replace animal use.
- Amarendhra Kumar, from Tufts University, who helped develop a sustainable client donation programme, which derives ethically sourced cadavers from euthanised animals at the teaching hospital; 100% of the cadaver requirements for anatomy, clinical skills and surgery training are now met.
- Daniel Smeak, from Ohio State University, who has developed and uses widely a range of skin/suture pattern and hollow organ simulators for skills acquisition. Students progress on to ethically sourced animal cadavers and then shelter animal sterilisation, rather than performing surgery on laboratory animals.
- Lara Rasmussen and colleagues, from the Western University of Health Sciences, where the new veterinary college will be zero animal consumptive and have a “reverence for life” philosophy. A skills-oriented curriculum with a major focus on clinical work will ensure only beneficial or neutral interaction with animals for veterinary training.

Part C of the book is a database of over 500 alternative products, detailing for each their application, specifications, and source. Part D comprises over 1000 further resources such as on-line curricular material, printed resources, organisations worldwide and producers. An appendix presents the InterNICHE policies for animal use within education, including the use of animals and animal tissue for making alternatives.

At least 12 language translations of the book are under production, and a CD-ROM, DVD and web version with a searchable database will also be produced.

Alternatives in Education

This video, produced in 1999, and available in 20 languages, is an exploration of alternatives within anatomy, physiology, pharmacology, clinical skills and surgery. Interviews with university teachers who have developed and implemented alternatives are complemented by visual demonstrations of a range of tools and approaches. The multiple benefits and ped-

agogical superiority of alternatives compared to conventional laboratory animal use are explained using specific examples.

Alternatives loan system

This is an evolving library of multimedia CD-ROMs, videos, models, manikins and simulators from a variety of fields. Teachers and students can borrow items from the Alternatives Loan System to try them out, giving the opportunity to familiarise themselves with some of the best products available.

The Alternatives Loan System is being used across the world, and products are being taken to a variety of conferences. Some loans have already brought about replacement. A Special Collection of items is currently on loan to the University of Ljubljana, and new micro-Loan Systems will be established in Brazil, India and Japan.

Website

Launched in late 2001, this is the largest existing website on alternatives in education. It provides a wide range of information and resources on-line, including comprehensive background on the issues, news, student testimonies and links to producers and external resources. The majority of the new book *from Guinea Pig to Computer Mouse: Alternative Methods for a Progressive, Humane Education*, will also be on-line, and various language translations are under production.

Humane Education Award

Teachers from former Yugoslavia and Romania have been invited to submit proposals for replacement, with 20,000 Euro (US\$18,000) available to be split between successful applicants. Projects

accepted for support to date include the making of a Romanian physiology CD-ROM and the establishment of a computer simulation laboratory, using reconditioned high-specification computers recycled from the UK. Together, these will replace the annual use of over 1000 animals.

InterNICHE conference

InterNICHE holds a major international conference every two years, offering leading international and local speakers, challenging workshops, an alternatives centre with some of the latest teaching products and an opportunity for discussion and networking. Delegates include teachers, product developers, students, legislators and animal protection campaigners.

Conference visits and outreach tours

Both the InterNICHE coordinator and the national contacts have co-organised and spoken at a number of international and national events. Larger outreach tours have also taken place, including visits to Russia and the Ukraine, and planned speaking tours across India and Japan. These visits allow the presentation of the InterNICHE vision, distribution of resources, support for local humane education initiatives and identification of local needs.

In summary, the *replacement* of harmful animal use has been gaining momentum across the world, supported by developments in technology and the evolution of ethical thought. InterNICHE has played an important role in promoting humane education and in supporting those who are committed to the most effective and ethical ways of gaining knowledge and skills in the life sciences.