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Non-violence in Surgical Training

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Summary

This paper discusses the harmful and fatal use of non-human animals in the surgical training of veterinarians. It argues and demonstrates that there is no educational reason why this must continue. References are made to alternatives that exist and which can be as or more effective than the traditional method of using and then killing animals. It calls for a change in attitude on the part of the profession in order to institute this change.

Keywords: alternative, compassion, ethics, kindness, morality, non-human animal, surgery, surgical training, teaching, veterinary medical school

The following is to stimulate thought about the dilemma of developing the psychomotor skills necessary to do surgery without resorting to using 'practice' non-human animals (animals²) in veterinary medicine. It is not intended to be a precise method of how to develop these skills, rather it is intended to argue that it is possible to achieve these skills without killing healthy animals and to urge those facing this dilemma to voice their opposition and demand they be allowed to work towards a solution (alternative).³

I have prepared and maintain a moderately comprehensive resource on all aspects of humane veterinary medical education⁴. The reader can refer to this for additional information on surgical training as well as other issues that are critical to this (such as anatomy, anaesthesia and skills development).

It must be understood at the outset that the surgical training veterinary medical students currently receive prior to obtaining their degree does not make them surgeons and, perhaps, we should not even teach this discipline to all students⁵. At best, for the average student, it may increase their confidence as it initiates them to the complexities of surgery. It has the potential, however, of reducing the student's confidence because of the confusion and frustration the students may experience during the very limited exposure they receive during school. Contrariwise, it may inspire overconfidence making the student a serious liability to patients and clients upon graduation, until experience improves the new graduate's skills.

Although these problems will not be overcome simply by instituting alternatives, certain alternatives, such as inanimate objects, may allow for increased exposure to basic skills which are fundamental to more complex procedures⁶. Because these materials are not associated with the logistical problems live animal use entails, they can be used repeatedly and at the student's

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This paper is part of a series on exploitation of non-human beings by human beings. See the first paper ([Buyukmihci 2022-12-01](#)) for arguments on the moral value of non-human animals in general.

- 2 Purely for the sake of convenience, I may primarily refer to animals other than human beings as "animals", recognizing that all are animals of one kind or another and that no one of them, even a human being, is morally superior or intrinsically more valuable than another.
- 3 Unfortunately, when students request alternatives to the killing of healthy animals, they often are met with ridicule and sarcasm. Their personal life-styles are attacked as if absolute consistency is required in order to give credibility to a moral premise. Some faculty, apparently having only 'heard' the word alternative, have made sarcastic statements to the effect that one cannot learn surgery using vegetables. Some students have also been told that they should reconsider their career choice. This type of demeaning behaviour towards these students not only is unprofessional, it also discourages a search for more humane methods of teaching.
- 4 [Buyukmihci HEVM](#)
- 5 [Kaufman et al 1987](#)
- 6 [Baillie et al 2020](#); [Buyukmihci 1998](#); [DeYoung & Richardson 1987](#); [Greenfield et al 1993](#); [Greenfield et al 1995](#); [Johnson & Farmer 1989](#); [Johnson et al 1990](#); [Millard et al 2014](#); [Smeak 2007](#)

convenience. Increased experience with knot tying boards and suturing of foam rubber models, for example, will substantially improve proficiency (manual dexterity) thereby making any subsequent live animal experience that much more rewarding.

As an example, at the Ohio State University College of Veterinary Medicine, Dr Dan Smeak taught students how to ligate blood vessels by using foam pads and red string to simulate incisions. He and his co-workers found that students who practised on these inanimate models did better when faced with a real surgery than students who had learned on the animals themselves⁷. Others have also developed models that have been effective in teaching haemostasis⁸.

The killing of animals in veterinary medical education continues out of convenience and habit, not because it is pedagogically necessary or superior to other methods. Whereas one must at some point use live animals to improve the skills necessary to do surgery, it does not follow that one must purposefully kill these animals in the process. In this respect, the typical manner in which surgical skills are taught to veterinary medical students is morally indefensible. Animals taken from pounds or purchased from dealers or breeders are used and killed as if they are disposable commodities. This is in stark contrast to the situation in human medicine in which people aspiring to become physicians do not kill human beings (nor, as is increasingly becoming the case, non-human beings) in the name of education. As with the situation in veterinary medicine, critical evaluation of using animals in human medical training has shown it to be unnecessary⁹.

Many inanimate materials can provide for the acquisition of basic skills such as suturing, manipulating instruments, some aspects of tissue handling, working in small spaces and so forth. These include knot tying boards or similar mechanical devices as already mentioned, especially when combined with visual aids such as photographs or videotapes for use during times when personal supervision is inconvenient. Models simulating various organs also have been shown to be feasible in preparing students for the real patient, even with more difficult surgery such as microneurosurgery or microvascular surgery¹⁰. The media that have been developed are realistic and effective¹¹. Advanced training is also feasible and include disciplines such as endoscopy¹² and orthopaedics¹³. A cadaver can provide the added dimension of learning surgical anatomy at the same time. There is evidence that students training on cadavers (or using other alternative methods) develop proficiency equal to those using live animals¹⁴. Methods of preserving cadavers have been developed to allow for more realistic tissue qualities and efficiency¹⁵.

If cadavers are to be used, it should be obvious that the source is important if one is proposing an alternative for moral or ethical reasons. It would be inappropriate to use cadavers from the pound, for example, if one is opposed to using these animals in the living state even though the procedures may be terminal (non-survival surgery) and, therefore, would result in the same outcome – death – for the animal. As in human medicine, cadavers can be obtained by developing

7 [Smeak 1989](#); [Smeak et al 1991](#)

8 [Griffon et al 2000](#); [Olsen et al 1996](#); [Perez-Rivero et al 2022](#)

9 [Goff et al 2001](#); [Rubeis & Steger 2018](#)

10 [Anderson et al 2021](#); [Annandale et al 2020](#); [Anwar et al 1989](#); [Badman et al 2016](#); [Chen et al 2019](#); [Colonial Scientific](#); [DeYoung & Richardson 1987](#); [Elarbi et al 2018](#); [Fahie et al 2016](#); [Fransson & Ragle 2010](#); [Greenfield et al 1993](#); [Greenfield et al 1995](#); [Griffon et al 2000](#); [Grimes et al 2021](#); [Holmberg et al 1993](#); [Holmberg & Cockshutt 1994](#); [Hunt et al 2020](#); [Johnson & Farmer 1989](#); [Langebæk et al 2015](#); [Lee & Coppersmith 1983](#); [Levi et al 2016](#); [MacArthur et al 2021](#); [Ng et al 2021](#); [Noyes et al 2022](#); [Remie 2001](#); [Tan et al 2018](#); [Tapia-Araya et al 2016](#); [Tefera 2011](#); [Williamson & Fio Rito 2014](#); [Williamson et al 2019,2020](#)

11 [Anon 2012](#); [Boness 2012](#); [Williamson 2014](#); [Woon 2011](#)

12 [Fiala 2010](#); [Whittemore & Kottkamp 2012](#)

13 [Sawbones](#)

14 [Carpenter et al 1991](#); [Patronek & Rauch 2007](#); [Pavletic et al 1994](#); [Smeak 2007](#); [White et al 1992](#)

15 [Silva et al 2007](#)

willed-body programs at the institutions and surrounding private veterinary practices¹⁶.

There are many simulators or interactive models that can be used to prepare the student for live animal surgery¹⁷. The SynDaver canine simulator is a particularly effective example of this methodology¹⁸.

Further improving one's skills in haemostasis and critical tissue handling can best be done on living animals. There is still no need, however, to compromise the principle of not purposefully harming or killing an individual to do this. The easiest way to do this is to take advantage of animals at local shelters or pounds. This is increasingly becoming the standard approach to providing surgical instruction. Under this system, potentially adoptable animals would be transferred from a local shelter to a school of veterinary medicine (coined "benevolent transfer" by the Michigan Humane Society). The animals would be attended to by veterinary medical students. Physical examinations, diagnostic procedures and treatments would be rendered by the students, with supervision by experienced faculty. Those animals not already sterilised would be castrated (orchietomy) or spayed (ovariohysterectomy) by the students. The spay is particularly good for surgical instruction because it combines most of the principles of tissue handling that the students must learn. It is also a very practical procedure to learn because it is one that the average practitioner will be performing frequently.¹⁹ In addition, this gives the students experience in providing post-operative care. After the animals have recovered and when it is safe to have them leave the hospital, they would be transferred back to the shelter. These animals have been shown to have a favourable adoption rate. Such programs are beneficial to all: the community, the animals, and the students²⁰.

This approach can be expanded upon during the students' exposure to patients during their clinical rotations. There is no reason why we cannot use an existing patient population to improve the surgical skills gained earlier, under strict supervision by a surgical instructor²¹. In some cases, this might also involve using a patient dying of cancer or other hopeless situation. After getting permission from the client, the patient would be euthanised and various procedures would be done while the body maintains a life-like consistency. This may be deemed objectionable on aesthetic grounds by some people, but it is, in principle, no different from willing one's organs for use after death.²² It also should be obvious that this is no different in any meaningful respect from the traditional, and morally objectionable, method of using healthy animals who are killed afterwards.

16 [HSVMA 2016](#); [Kumar et al 2001](#)

17 [Badman et al 2016](#); [Buyukmihci HEVM](#); [Chen et al 2019](#); [Fahie et al 2016](#); [Gopinath et al 2012](#); [Langebæk et al 2015](#)

18 [Casimir et al 2022](#); [SynDaver Labs](#)

19 The surgical procedures taught using live animals who are then killed afterwards are not necessarily practical in terms of what the average practitioner will face. For example, removal of the kidney (nephrectomy) is commonly used in the teaching laboratory. It is not, however, something that is commonly done in private practice and, by the time the person may be called upon to do it, they will have long forgotten the procedure. Instead, it is taught because it combines numerous surgical principles: skin and deeper tissue incisions, exploring the abdomen, manipulating peritoneum and parenchymatous organs, and blood vessel ligation. All these can be taught using the spay as the "model" and provide a practical outcome as well. There is no need, therefore, for an alternative to precisely replace a particular surgical exercise.

20 [Benato & Hammond 2018](#); [Clevenger & Kass 2003](#); [Filliquist et al 2022](#); [Gates et al 2020](#); [Howe & Slater 1997](#); [Howe et al 1998](#); [Kreisler et al 2018](#); [Smeak 2007,2008](#)

21 [Johnson & Farmer 1990](#)

22 Newly deceased human patients have been used for psychomotor skill training involved in resuscitation procedures such as venous cutdown, thoracotomy and pericardiocentesis ([Burns et al 1994](#)). Brain-dead human beings have even been used to perform heart transplant surgery, which in essence was a learning experience ([Kolff et al 1984](#)).

Many veterinary medical schools in the United States and some other countries have done away with fatal surgeries in their teaching programs. Their reasons for doing so are educationally and ethically based. They now use a combination of ethically-sourced cadavers and live animal surgery on individuals who will benefit from this, as explained above. The list of schools is growing and include Oklahoma State University, Ontario Veterinary College (Canada), Tufts University, the University of California-Davis, Utrecht University (the Netherlands), Washington State University and Western University of Health Sciences, to name just a few.

Any surgical curriculum must also include training in anaesthesiology given that anaesthesia is an integral part of surgery. This can be taught best by a simulations²³ and patient care during the students' clinical training phase of their program²⁴. Studies have shown that the students trained in this fashion are as good or better at anaesthesia than their counterparts trained in the traditional method of using healthy animals repeatedly, something that is unquestionably inhumane.

The American Veterinary Medical Association (AVMA), which is responsible for accreditation of veterinary medical schools – at least in the United States – does not dictate the manner in which surgery is taught²⁵. Its concern lies primarily in ensuring that students are exposed to sufficient numbers of patients in order to have an experience base that will provide for continued learning after graduation. They do not withhold accreditation if a school has instituted educational programs which do not result in purposeful harm or death to animals.

Because many veterinary medical schools worldwide continue to use and kill cats or dogs from pounds (or shelters), it is appropriate to address this issue with respect to surgical training. The mind-set is that these cats or dogs are going to be killed anyway, so why not utilise them to some meaningful end? If it was that simple, it would be illogical to argue against this. There are, however, many factors that make the continued use and killing of animals from pounds for surgical training a problem regardless whether the animals were actually going to be killed on the day of the proposed surgery laboratory.

One of the most compelling reasons for not using animals from the pound is that it institutionalises our dependency upon a source of animals which all should find morally reprehensible and should do what we can to prevent. The 'overpopulation' of cats and dogs, with its attendant mass destruction of 'surplus' individuals, is a societal ill due to human irresponsibility. If, however, it is maintained that these animals are necessary for teaching, it may be unlikely that a concerted effort will be made to eliminate this tragic situation. The conflict of interest could be too great.²⁶

Another compelling reason for discontinuing the use of pound-derived animals is that it fosters confusion and insensitivity in students (and faculty). Most students chose the field of veterinary medicine largely because of a concern for animals. It is the height of hypocrisy to purposefully kill the very patients – in essence – they are being trained to help. There are no morally relevant differences between dogs from the pound, for example, and dogs who might have a human guardian. Dogs from either group have the same capacity to suffer or to enjoy life. The assertion by many who support using pound-derived animals that the latter animals are 'going to die anyway'

23 Jones et al [2018,2019](#); [Musk et al 2017](#); [Swanson 1991](#); [Wilson & Sneed 1992](#)

24 [Howe & Slater 1997](#); [White et al 1992](#)

25 [AVMA 2019](#)

26 I realise one could argue that using this source of animals for castrations and spays is just as objectionable, in principle, if one *depends* upon this source. One might reasonably ask, If cat and dog overpopulation is eliminated, from where would individuals for surgical training come? I believe the situation needs to be seen as a temporary solution to both issues until we alter our attitude so that we simply would *never* consider it acceptable to allow the killing of healthy animals in education. When we rise to this plane of sensitivity and compassion, we will find other methods to teach surgery.

ignores the principle of the matter. Veterinarians should have the highest sensitivity for animals and should be fostering a reverence for life in those aspiring to be veterinarians. Viewing and using animals as simple teaching tools with no meaningful regard for their lives is the antithesis of this principle. The desensitisation and loss of respect for animal life caused by the killing of animals in education is not just my own observation during many years of being an educator; it has been recognised in veterinary medical education and the biological sciences in general²⁷. The negative effects of such desensitisation are incalculable.

Another consideration is the stress placed upon the cats or dogs during transportation from the pound to the school. Whereas it may not seem like much to a human observer, one needs to be empathetic to the animals' situation. Having already been caught and transported to an unfamiliar and frightening place by strangers, any further handling and transportation by additional strangers undoubtedly will cause further stress. The animals in question do not know, like a human observer would, that the trip is finite; to them, it may appear to be a permanent situation. If this was being done for the sake of these animals – as in the case of benevolent transfer – one could effectively argue that any additional stress would be outweighed by the prospect of a long life in a good home. Although killing these individuals rather than subjecting them to further handling and transportation may seem 'wasteful', it is in the animals' best interests, if it is decided that death is the final disposition.

Finally, it is specious to argue that the pound-derived animals were 'slated for death'. The most socialised and docile dogs are chosen for use in surgery laboratories. These individuals also would have the highest chance of being adopted if there were resources available to keep them at the pound for a longer period of time. To say, therefore, that these dogs were 'going to die anyway' ignores the fact that their fate is heavily dictated by financial considerations and logistics. The situation is compounded when there is an agency ready and willing to purchase these animals.

In conclusion, there are no pedagogical reasons why animals must undergo unnecessary surgery followed by death in order to teach the principles of surgery to veterinary medical students or others. Humane alternatives are available and require only a change in mind-set to facilitate their use²⁸. Students cannot legally be forced to harm or kill animals as part of their education. There is ample precedent for this. It will take, however, continued effort by students to prevail upon their professors to provide an alternative program at all the schools. It can be very intimidating to do so. If you are one of these students, however, take heart knowing that there is nothing the professors can do to you that is as bad as what they expect you to do to the animals.

Cited information:

1. American Veterinary Medical Association 2019-09-01 "COE Accreditation Policies and Procedures: Requirements. 7. Requirements of an Accredited College of Veterinary Medicine. 7.11. Standard 11, Outcomes Assessment" American Veterinary Medical Association
<https://www.avma.org/ProfessionalDevelopment/Education/Accreditation/Colleges/Pages/coe-pp-requirements-of-accredited-college.aspx> Accessed 2019-09-02
2. Ames, Edward R. and Walker, Dana 1985-01-01 "1984 veterinary student animal welfare attitude survey" *Intervet* 10-12ⁱ
3. Anderson, Stacy L.; Miller, Lynda; Gibbons, Philippa; Hunt, Julie A.; Roberson, Jerry; Raines, Jeffrey A.; Patterson, Gil and Dascanio, John J. 2021-02-01 "Development and Validation of a Bovine Castration Model and Rubric" *Journal of Veterinary Medical*

27 [Ames & Walker 1985](#); [Gilmore 1991a,1991b](#); [Heim 1986](#); [Herzog et al 1989](#); [Maki 1988](#); [Orlans 1991](#); [Shapiro 1990](#); [Shurtleff 1983](#)

28 [Greenfield et al 1994](#)

- Education 48(1):96-104 <https://doi.org/10.3138/jvme.2018-0016>
4. Annandale, Annett; Scheepers, Elrien and Fosgate, Geoffrey T. 2020-02-01 "The effect of an ovariohysterectomy model practice on surgical times for final-year veterinary students' first live-animal ovariohysterectomies" *Journal of Veterinary Medical Education* 47(1):44-55 <https://doi.org/10.3138/jvme.1217-181r1>
 5. Anonymous 2012-04-10 "Matrix and veterinary science know-how creates a cutting-edge model" *University of Sydney News*ⁱⁱ
 6. Anwar, Mohammad; Renner, Norrie and Harris, Malcolm 1989-01-21 "A simple teaching model for mucoperiosteal flaps and suturing techniques" *British Dental Journal* 166(2):38 <https://doi.org/10.1038/sj.bdj.4806696>
 7. Badman, Märit; Tullberg, Marja; Höglund, Odd V. and Hagman, Ragnvi 2016-12-01 "Veterinary student confidence after practicing with a new surgical training model for feline ovariohysterectomy" *Journal of Veterinary Medical Education* 43(4):427-433 <https://dx.doi.org/10.3138/jvme.1015-165R2>
 8. Baillie, Sarah; Christopher, Rachel; Catterall, Alison J.; Kruydenberg, Adam; Lawrenson, Karen; Wonham, Katharine; Kilfeather, Peter and Warman, Sheena 2020-07-01 "Comparison of a Silicon Skin Pad and a Tea Towel as Models for Learning a Simple Interrupted Suture" *Journal of Veterinary Medical Education* 47(4):516-522 <https://doi.org/10.3138/jvme.2018-0001>
 9. Benato, Livia and Hammond, Jennifer 2018-04-01 "Rabbit neutering in primary-care education: Insights from a surgical clinic" *Journal of Veterinary Medical Education* 45(1):91-98 <https://doi.org/10.3138/jvme.0916-149r>
 10. Boness, Laura 2012-04-22 "'The Matrix' helps cats and dogs" *Science Illustrated* <https://scienceillustrated.com.au/blog/nature/animals/the-matrix-helps-cats-and-dogs/>ⁱⁱⁱ
 11. Burns, Jeffrey P.; Reardon, Frank E. and Truog, Robert D. 1994-12-15 "Using newly deceased patients to teach resuscitation procedures" *The New England Journal of Medicine* 331(24):1652-1655 <https://dx.doi.org/10.1056/NEJM199412153312411>
 12. Buyukmihci, Nedim C 1998-01-01 "Alternatives to the harmful use of nonhuman animals in veterinary medical education" 44 pp Association of Veterinarians for Animal Rights
 13. Buyukmihci, Nedim C 2022-12-01 "Serious Moral Concern Is Not Species-limited" <https://escholarship.org/uc/item/6604b7qj>
 14. Buyukmihci, Nedim C *Humane Education in Veterinary Medicine* <https://hevm.faculty.ucdavis.edu> Last edited 2023-02-01
 15. Carpenter, Larry G.; Piermattei, Donald L.; Salman, Mowafak D.; Orton, E. Christopher; Nelson, A. Wendell; Smeak, Daniel D.; Jennings, Paul B. and Taylor, Robert A. 1991-11-01 "A comparison of surgical training with live anesthetized dogs and cadavers" *Veterinary Surgery* 20(6):373-378 <https://dx.doi.org/10.1111/j.1532-950X.1991.tb00342.x>^{iv}
 16. Casimir, Roslyn; Linn, Lorraine; King, Howard; McKenzie, David; Thompson, Melisa and Perry, R.L. 2022-12-15 "Simulation models: another approach to teaching and learning" *Journal of the American Veterinary Medical Association* 261(1):47 <https://doi.org/10.2460/javma.22.11.0509>
 17. Chen, Chi-Ya; Elarbi, Mustafa; Ragle, Claude A. and Fransson, Boel A. 2019-01-01 "Development and evaluation of a high-fidelity canine laparoscopic ovariectomy model for surgical simulation training and testing" *Journal of the American Veterinary Medical Association* 254(1):113-123 <https://doi.org/10.2460/javma.254.1.113>
 18. Clevenger, Jaime and Kass, Philip H. 2003-12-01 "Determinants of adoption and euthanasia of shelter dogs spayed or neutered in the University of California veterinary student surgery program compared to other shelter dogs" *Journal of Veterinary Medical Education* 30(4):372-378 <https://dx.doi.org/10.3138/jvme.30.4.372>^v
 19. Colonial Scientific "PracticeRat System" https://www.colonialscientific.com/CS/index.php?cPath=86_90645_90727_93449 Accessed 2021-12-11^{vi}
 20. DeYoung, David J. and Richardson, Daniel C. 1987-03-01 "Teaching the principles of internal fixation of fractures with plastic bone models" *Journal of Veterinary Medical*

- Education 14(1):30-31
21. Elarbi, Mustafa M.; Ragle, Claude A.; Fransson, Boel A. and Farnsworth, Kelly D. 2018-07-01 "Face, construct, and concurrent validity of a simulation model for laparoscopic ovariectomy in standing horses" *Journal of the American Veterinary Medical Association* 253(1):92-100 <https://doi.org/10.2460/javma.253.1.92>
 22. Fahie, Maria; Cloke, Amanda; Lagman, Minette; Levi, Ohad and Schmidt, Peggy 2016-06-01 "Training veterinary students to perform ovariectomy using theMOOSE Spay Model with traditional method versus the Dowling Spay Retractor" *Journal of Veterinary Medical Education* 43(2):176-183 <https://dx.doi.org/10.3138/jvme.0915-150R>
 23. Fiala, Jennifer 2010-01-13 "Life-like model for teaching endoscopy unveiled" *VIN News Service* <https://news.vin.com/vinnews.aspx?articleId=14819> Accessed 2019-09-26
 24. Filliquist, Barbro; Kapatkin, Amy S.; Vernau, Karen M.; Nakatani, Jamie Y.; Chou, Po-Yen and Ilkiw, Jan E. 2022-12-01 "Training Surgical Residents Utilizing an Animal Shelter Fracture Program" *Journal of Veterinary Medical Education* 49(6):778-784 <https://doi.org/10.3138/jvme-2021-0110>
 25. Fransson, Boel A. and Ragle, Claude A. 2010-05-15 "Assessment of laparoscopic skills before and after simulation training with a canine abdominal model" *Journal of the American Veterinary Medical Association* 236(10):1079-1084 <https://dx.doi.org/10.2460/javma.236.10.1079>
 26. Gates, M. Carolyn; Littlewood, Katherine E.; Kongara, Kavitha; Odom, Thomas F. and Sawicki, Robert K. 2020-02-01 "Guidelines for implementing a low-cost volunteer desexing skills training program for veterinary and veterinary technology students" *Journal of Veterinary Medical Education* 47(1):27-38 <https://doi.org/10.3138/jvme.0418-047r1>
 27. Gilmore, David R. 1991-04-01 "Politics & prejudice: Dissection in biology education. Part I" *The American Biology Teacher* 53(4):211-213 <https://dx.doi.org/10.2307/4449271>^{vii}
 28. Gilmore, David R. 1991-05-01 "Politics & prejudice: Dissection in biology education. Part II" *The American Biology Teacher* 53(5):272-274 <https://dx.doi.org/10.2307/4449291>
 29. Goff, Barbara A.; Lentz, Gretchen M.; Lee, David; Fenner, Dee; Morris, Jamie and Mandel, Lynn S. 2001-09-01 "Development of a bench station objective structured assessment of technical skills" *Obstetrics and Gynecology* 98(3):412-416 [https://doi.org/10.1016/s0029-7844\(01\)01473-9](https://doi.org/10.1016/s0029-7844(01)01473-9)
 30. Gopinath, Deepa; McGreevy, Paul D.; Zuber, Richard M.; Klupiec, Corinna; Baguley, John and Barrs, Vanessa R. 2012-03-01 "Developments in undergraduate teaching of small-animal soft-tissue surgical skills at the University of Sydney" *Journal of Veterinary Medical Education* 39(1):21-29 <https://doi.org/10.3138/jvme.0411.044R>
 31. Greenfield, Cathy L.; Johnson, Ann L.; Arends, Mark W. and Wroblewski, Andrzej J. 1993-09-01 "Development of parenchymal abdominal organ models for use in teaching veterinary soft tissue surgery" *Veterinary Surgery* 22(5):357-362 <https://dx.doi.org/10.1111/j.1532-950X.1993.tb00412.x>^{viii}
 32. Greenfield, C.L.; Johnson, A.L.; Smith, C.W.; Marretta, S.M.; Farmer, J.A. and Klippert, L. 1994-03-01 "Integrating alternative models into the existing surgical curriculum" *Journal of Veterinary Medical Education* 21(1):23-27 <https://scholar.lib.vt.edu/ejournals/JVME/V21-1/Greenfield.html>^{ix}
 33. Greenfield, Cathy L.; Johnson, Ann L.; Schaeffer, David J. and Hungerford, Laura L. 1995-06-15 "Comparison of surgical skills of veterinary students trained using models or live animals" *Journal of the American Veterinary Medical Association* 206(12):1840-1845 <https://www.ncbi.nlm.nih.gov/pubmed/7790294>^x
 34. Griffon, Dominique J.; Cronin, Paul; Kirby, Barbara and Cottrell, David F. 2000-07-01 "Evaluation of a hemostasis model for teaching ovariohysterectomy in veterinary surgery" *Veterinary Surgery* 29(4):309-316 <https://dx.doi.org/10.1053/jvet.2000.7541>^{xi}
 35. Grimes, Janet A.; Appleton, Kate L.; Moss, Lydia A. and Bullington, Anna-Claire M. 2021-12-01 "A Simulated Tumor for Teaching Principles of Surgical Oncology for Biopsy and Excision of Skin and Subcutaneous Masses to Veterinary Students" *Journal of Veterinary*

- Medical Education 48(6):636-639 <https://doi.org/10.3138/jvme-2020-0028>
36. Heim, Alice 1986-06-01 "Desensitization and health" *The AV* 94:12-14
 37. Herzog, Harold A.; Vore, Tamara L. and New, John C. 1989-12-01 "Conversations with veterinary students: Attitudes, ethics, and animals" *Anthrozoös* 2(3):181-187 https://www.researchgate.net/publication/45251880_Conversations_with_Veterinary_Students_Attitudes_Ethics_and_Animals^{xii}
 38. Holmberg, D.L.; Cockshutt, J.R. and Basher, A.W.P. 1993-09-01 "Use of a dog abdominal surrogate for teaching surgery" *Journal of Veterinary Medical Education* 20(2):61-62 <https://scholar.lib.vt.edu/ejournals/JVME/V20-3/holmberg.html>^{xiii}
 39. Holmberg, David L. and Cockshutt, Joanne R. 1994-01-01 "A non-animal alternative for teaching introductory surgery" *Humane Innovations and Alternatives* 8:635-637
 40. Howe, Lisa M. and Slater, Margaret R. 1997-03-01 "Student assessment of the educational benefits of a prepubertal gonadectomy program (preliminary findings)" *Journal of Veterinary Medical Education* 24(1):12-17^{xiv}
 41. Howe, Lisa M.; Boothe, Harry W.; August, John R.; Bice, Kathy L. and Medicus, Karen L. 1998-09-01 "Using community-based service learning projects to improve surgical instruction" *Journal of Veterinary Medical Education* 25(2):12-15^{xv}
 42. Humane Society Veterinary Medical Association 2016-11-01 "Educational Memorial Programs" Humane Society Veterinary Medical Association https://www.hsvma.org/educational_memorial_programs#.XWz2VHt7mHs Accessed 2019-09-02
 43. Hunt, Julie A.; Heydenburg, Matthew; Kelly, Christopher K.; Anderson, Stacy L. and Dascanio, John J. 2020-02-01 "Development and validation of a canine castration model and rubric" *Journal of Veterinary Medical Education* 47(1):78-90 <https://doi.org/10.3138/jvme.1117-158r1>
 44. Johnson, Ann L. and Farmer, James A. 1989-03-01 "Evaluation of traditional and alternative models in psychomotor laboratories for veterinary surgery" *Journal of Veterinary Medical Education* 16(1):11-14^{xvi}
 45. Johnson, Ann L. and Farmer, James A. 1990-03-01 "Teaching veterinary surgery in the operating room" *Journal of Veterinary Medical Education* 17(1):10-12^{xvii}
 46. Johnson, A.L.; Harari, J.; Lincoln, J.; Farmer, J.A. and Korvick, D. 1990-03-01 "Bone models of pathological conditions used for teaching veterinary orthopedic surgery" *Journal of Veterinary Medical Education* 17(1):13-15^{xviii}
 47. Jones, Jana L.; Rinehart, Jim; Spiegel, Jacqueline Jordan; Englar, Ryane E.; Sidaway, Brian K. and Rowles, Joie 2018-06-01 "Teaching tip: Development of veterinary anesthesia simulations for pre-clinical training: Design, implementation, and evaluation based on student perspectives" *Journal of Veterinary Medical Education* 45(2):232-240 <https://doi.org/10.3138/jvme.1016-163r>
 48. Jones, Jana L.; Rinehart, Jim and Englar, Ryane E. 2019-06-01 "The effect of simulation training in anesthesia on student operational performance and patient safety" *Journal of Veterinary Medical Education* 46(2):205-213 <https://doi.org/10.3138/jvme.0717-097r>
 49. Kaufman, H.H.; Wiegand, R.L. and Tunick, R.H. 1987-08-01 "Teaching surgeons to operate—principles of psychomotor skills training" *Acta Neurochirurgica* 87(1-2):1-7 <https://dx.doi.org/10.1007/BF02076007>^{xix}
 50. Kolff, Jack; Deeb, G. Michael; Cavarocchi, Nicholas C.; Riebman, Jerome B.; Olsen, Donald B. and Robbins, Peter S. 1984-06-01 "The artificial heart in human subjects" *The Journal of Thoracic and Cardiovascular Surgery* 87(6):825-831 [https://doi.org/10.1016/S0022-5223\(19\)38408-9](https://doi.org/10.1016/S0022-5223(19)38408-9)
 51. Kreisler, Rachael E.; Shaver, Stephanie L. and Holmes, John H. 2018-11-15 "Outcomes of elective gonadectomy procedures performed on dogs and cats by veterinary students and shelter veterinarians in a shelter environment" *Journal of the American Veterinary Medical Association* 253(10):1294-1299 <https://doi.org/10.2460/javma.253.10.1294>
 52. Kumar, Amarendhra; Murtaugh, Robert; Brown, Donald; Ballas, True; Clancy, Elizabeth and

- Patronek, Gary 2001-06-01 "Client donation program for acquiring dogs and cats to teach veterinary gross anatomy" *Journal of Veterinary Medical Education* 28(2):73-77
<https://dx.doi.org/10.3138/jvme.28.2.73>
53. Langebæk, Rikke; Toft, Nils and Eriksen, Thomas 2015-06-01 "The SimSpay—Student perceptions of a low-cost build-it-yourself model for novice training of surgical skills in canine ovariohysterectomy" *Journal of Veterinary Medical Education* 42(2):166-171
<https://dx.doi.org/10.3138/jvme.1014-105>
54. Lee, Sun and Coppersmith, Ward J. 1983-01-01 "A microvascular surgical practice disc for beginners" *Microsurgery* 4(1):67-69 <https://dx.doi.org/10.1002/micr.1920040116>^{xx}
55. Levi, Ohad; Michelotti, Kurt; Schmidt, Peggy; Lagman, Minette; Fahie, Maria and Griffon, Dominique 2016-03-01 "Comparison between training models to teach veterinary medical students basic laparoscopic surgery skills" *Journal of Veterinary Medical Education* 43(1):80-87 <https://dx.doi.org/10.3138/jvme.0715-109R>
56. MacArthur, Sandra L.; Johnson, Matthew D. and Colee, James C. 2021-02-01 "Effect of a Spay Simulator on Student Competence and Anxiety" *Journal of Veterinary Medical Education* 48(1):115-128 <https://doi.org/10.3138/jvme.0818-089r3>
57. Maki, Barbara 1988-07-29 "Use of non-patient animals in veterinary education: A critical appraisal of effects on students" 27 pp^{xxi}
58. Millard, Heather A. Towle; Millard, Ralph P.; Constable, Peter D. and Freeman, Lyn J. 2014-02-01 "Relationships among video gaming proficiency and spatial orientation, laparoscopic, and traditional surgical skills of third-year veterinary students" *Journal of the American Veterinary Medical Association* 244(3):357-362
<https://dx.doi.org/10.2460/javma.244.3.357>^{xxii}
59. Musk, Gabrielle C.; Collins, Teresa and Hosgood, Giselle 2017-12-01 "Teaching veterinary anesthesia: A survey-based evaluation of two high-fidelity models and live-animal experience for undergraduate veterinary students" *Journal of Veterinary Medical Education* 44(4):590-602 <https://doi.org/10.3138/jvme.0216-043R1>
60. Ng, Z.Y.; Honeyman, C.; Lellouch, A.G.; Pandya, A. and Papavasiliou, T. 2021-12-15 "Smartphone-based DIY home microsurgical training with 3D printed microvascular clamps and Japanese noodles" *European Surgical Research* <https://doi.org/10.1159/000521439>
61. Noyes, Julie A.; Carbonneau, Kira J. and Matthew, Susan M. 2022-02-01 "Comparative Effectiveness of Training with Simulators Versus Traditional Instruction in Veterinary Education: Meta-Analysis and Systematic Review" *Journal of Veterinary Medical Education* 49(1):25-38 <https://doi.org/10.3138/jvme-2020-0026>
62. Olsen, Dennis; Bauer, Michael S.; Seim, Howard B. and Salman, Mowafak D. 1996-01-01 "Evaluation of a hemostasis model for teaching basic surgical skills" *Veterinary Surgery* 25(1):49-58 <https://doi.org/10.1111/j.1532-950x.1996.tb01376.x>
63. Orlans, F. Barbara 1991-01-01 "Forum: Dissection. The case against" *The Science Teacher* 58(1):12, 14 <https://www.jstor.org/stable/24145547>^{xxiii}
64. Patronek, Gary J. and Rauch, Annette 2007-01-01 "Systematic review of comparative studies examining alternatives to the harmful use of animals in biomedical education" *Journal of the American Veterinary Medical Association* 230(1):37-43
<https://dx.doi.org/10.2460/javma.230.1.37>
65. Pavletic, Michael M.; Schwartz, Anthony; Berg, John and Knapp, Deirdre 1994-07-01 "An assessment of the outcome of the alternative medical and surgical laboratory program at Tufts University" *Journal of the American Veterinary Medical Association* 205(1):97-100
<https://www.ncbi.nlm.nih.gov/pubmed/7928560>^{xxiv}
66. Perez-Rivero, Juan José; Barbosa-Callejas, Ileana María; Delgado-Garduño, Lilia; Rodríguez-Buitrón, Lidia; Lavallo-Avalos, Amira Eunice and Herrera-Barragan, José Antonio 2022-05-01 "A Low-fidelity Simulator for the Development of Vascular Ligation Skills" *Alternatives to Laboratory Animals* 50(3):195-200
<https://doi.org/10.1177%2F02611929221096677>
67. Remie, René 2001-10-01 "The PVC-Rat and other alternatives in microsurgical training"

- Lab Animal 30(9):48-52 https://www.researchgate.net/publication/11665034_The_PVC-rat_and_other_alternatives_in_microsurgical_training
68. Rubeis, Giovanni and Steger, Florian 2018-05-01 "Is live-tissue training ethically justified? An evidence-based ethical analysis" *Alternatives to Laboratory Animals* 46(2):65-71 <https://doi.org/10.1177/026119291804600206>^{xxv}
 69. Sawbones® <https://www.sawbones.com/catalog/veterinary-models.html> Accessed 2021-12-11
 70. Shapiro, Kenneth J. 1990-01-01 "The pedagogy of learning and unlearning empathy" *Phenomenology & Pedagogy* 8:43-48 <http://ejournals.library.ualberta.ca/index.php/pandp/article/viewFile/15120/11941>
 71. Shurtleff, Robert S. 1983-01-01 "The attitudes of today's veterinary students on animal welfare issues" *The California Veterinarian* 37(1):29-30^{xxvi}
 72. Silva, R.M.G.; Matera, J.M. and Ribeiro, A.A.C.M. 2007-06-01 "New alternative methods to teach surgical techniques for veterinary medicine students despite the absence of living animals. Is that an academic paradox?" *Anatomia, Histologia, Embryologia* 36(3):220-224 <https://dx.doi.org/10.1111/j.1439-0264.2007.00759.x>^{xxvii}
 73. Smeak, Daniel D. 1989-03-07 "Simulator/media based teaching of basic surgical skills" *Proceedings of the First Annual International Foundation for Ethical Research Workshop: Alternatives to Live Animals in Veterinary Medical Education* 10-12
 74. Smeak, Daniel D. 2007-12-01 "Teaching surgery to the veterinary novice: The Ohio State University experience" *Journal of Veterinary Medical Education* 34(5):620-627 <https://dx.doi.org/10.3138/jvme.34.5.620>^{xxviii}
 75. Smeak, Daniel D. 2008-03-01 "Teaching veterinary students using shelter animals" *Journal of Veterinary Medical Education* 35(1):26-30 <https://dx.doi.org/10.3138/jvme.35.1.026>^{xxix}
 76. Smeak, Daniel D.; Beck, Marian L.; Shaffer, C. Allen and Gregg, C. Geoffrey 1991-01-01 "Evaluation of video tape and a simulator for instruction of basic surgical skills" *Veterinary Surgery* 20(1):30-36 <https://dx.doi.org/10.1111/j.1532-950X.1991.tb00302.x>
 77. Swanson, Clifford R. 1991-03-01 "Teaching clinical veterinary anesthesia with an interactive videodisc simulation: Perceptual and academic results" *Journal of Veterinary Medical Education* 18(1):17-20^{xxx}
 78. SynDaver Labs <https://syndaver.com/> Accessed 2023-02-01
 79. Tan, Christopher; Basa, Rachel; Bennett, Peter; Hannan, Neil; Walsh, William R. and Bellenger, Christopher 2018-06-01 "Teaching tip: Simulated tumors as an aid to teaching principles of surgical oncology" *Journal of Veterinary Medical Education* 45(2):250-254 <https://doi.org/10.3138/jvme.1116-183r>
 80. Tapia-Araya, Angelo E.; Usón-Gargallo, Jesús; Enciso, Silvia; Pérez-Duarte, Francisco J.; Martín-Portugués, Idoia Díaz-Güemes; Fresno-Bermejo, Laura and Sánchez-Margallo, Francisco M. 2016-03-01 "Assessment of laparoscopic skills in veterinarians using a canine laparoscopic simulator" *Journal of Veterinary Medical Education* 43(1):71-79 <https://dx.doi.org/10.3138/jvme.0315-034R1>
 81. Tefera, Melaku 2011-01-01 "Surgical dummy: a surrogate to live animal in teaching veterinary surgery" *Ethiopian Veterinary Journal* 15(2):1-10 https://www.academia.edu/4204247/Surgical_dummy_a_surrogate_to_live_animal_in_teaching_Veterinary_Surgery^{xxxi}
 82. White, Karl K.; Wheaton, Lynn G. and Greene, Stephen A. 1992-12-01 "Curriculum change related to live animal use: A four-year surgical curriculum" *Journal of Veterinary Medical Education* 19(1):6-10^{xxxii}
 83. Whittemore, Jacqueline C. and Kottkamp, Katherine C. 2012-07-26 "Patent application title: Flexible and Rigid Endoscopic Training Device (FRED)" *Patentdocs* <http://www.faqs.org/patents/app/20120189997> Accessed 2020-04-20
 84. Williamson, Julie A. 2014-12-01 "Construct validation of a small-animal thoracocentesis simulator" *Journal of Veterinary Medical Education* 41(4):384-389 <https://dx.doi.org/10.3138/jvme.0314-037R>

85. Williamson, Julie A. and Fio Rito, Robin M. 2014-06-01 "Development of a training model for small animal thoracocentesis and chest tube thoracostomy" *Alternatives to Laboratory Animals* 42(3):201-205 <https://doi.org/10.1177/026119291404200307>
86. Williamson, Julie A.; Brisson, Brigitte A.; Anderson, Stacy L.; Farrell, Robin M. and Spangler, Dawn 2019-08-01 "Comparison of 2 canine celiotomy closure models for training novice veterinary students" *Veterinary Surgery* 48(6):966-974 <https://doi.org/10.1111/vsu.13224>
87. Williamson, Julie A.; Heydenburg, Matthew; Kelly, Christopher K.; Anderson, Stacy L. and Dascanio, John J. 2020-02-01 "Development and validation of a canine castration model and rubric" *Journal of Veterinary Medical Education* 47(1):78-90 <https://doi.org/10.3138/jvme.1117-158r1>
88. Wilson, D.V. and Sneed, S. 1992-09-01 "The use of interactive computer-based case simulations to teach veterinary anesthesia" *Journal of Veterinary Medical Education* 19(4):164
89. Woon, Siaw-Yean 2011-01-01 "A veterinary student's perspective on educational animal use and the potential for humane alternatives" *Altex Proceedings* 1/12:377-385 http://www.altex.ch/resources/377385_Woon31.pdf^{xxxiii}

- i This was a survey administered by the American Veterinary Medical Association student division. Many of the categories possibly demonstrate a trend toward more tolerance of certain uses of non-human animals in 4th year students versus 1st students, which suggests a loss of sensitivity.
- ii "Working with Studio Kite the faculty developed a prototype of a silicon-based, lifelike model of a dog's abdomen that reflects the anatomical and surgical challenges of desexing, before final approval of a working model."

"The model we've created is a world-first in a couple of ways. First is that its look, its feel and its ability to be operated on is 'cutting edge'!

'Another major innovation is that the reproductive track is replaceable. To give students a true experience of desexing they need (in females) to remove the reproductive tract which is destroyed in the process. They can do that with this model because the reproductive tract is a replaceable part."

"Its walls consist of layers of skin, subcutaneous tissue and muscle layers whose varying layers of silicone are made to look and feel as true to life as possible. If the tissues are torn then silicone tubing filled with coloured fluid 'bleed'."

"Yet another advantage of using these surgical simulators is that their lifelikeness means they are perfect for teaching basic skills used in a wide range of surgical procedures, apart from routine desexing operations,' Professor Zuber said."
- iii "Studio Kite, a company that worked on *The Matrix* (Andy and Lana Wachowski, 1999), has developed a lifelike model of a medium-sized dog to help University of Sydney veterinary students improve their surgical desexing skills."

"These models have been developed to simulate the experience of operating on a real patient and in our estimation provide an experience very like that of operating on a live animal without the accompanying risk to the patient and the pressure on the surgeon that that engenders,' Associate Professor Max Zuber says."

"The model consists of moulded plastic, with indentations that represent the vertebral column, kidneys and large intestine. The abdomen itself includes an intestinal tract, the bladder and a disposable female reproductive tract, so the model can be reused."

"The technology could be used to train veterinarians in a range of soft tissue surgical procedures, according to Zuber. 'Over the last few years there have been great strides in the development of clinical skills laboratories for training our medical colleagues and these models could also be used in this context for human surgical training.'"
- iv "No statistically significant differences could be detected between the two groups [of students, with respect to skill, outcome]."
- v In this study, pre-adoption neutering increased adoptions without increasing the probability of medical or behavioral euthanasia.
- vi This had been produced by Angiotech Pharmaceuticals, Inc., which then became a part of Surgical Specialties Corporation. As of 2016-11-01, could only find a retailer that listed the product for sale, not the manufacturer.
- vii Mr. Gilmore is a biology teacher of many years and provides discourse on the subject of desensitization along with many references.
- viii "Models of the canine spleen, kidney, and liver were made from soft plastic to simulate the organs of the live animal as closely as possible in appearance and tissue handling properties. Each organ model was independently evaluated by five small animal surgeons who performed several common surgical procedures on each model. All models had a realistic appearance and, with the exception of one tissue handling problem with the kidney model, and one with the liver model, tissue handling properties of the models were comparable to those of the organs in the live animal. All models were useful for teaching each of the procedures evaluated."

The authors posit, "We believe that veterinary students will develop better surgical skills using realistic soft tissue models as an adjunct to live animal training than they can using traditional methods alone."
- ix Discusses the modification of their surgical training curriculum to meet animal welfare and student conscience concerns. Have met with approval by faculty and students and still evolving.

"At The University of Illinois, we have made humane issues a priority in our surgical teaching program and we have taken a pro-active attitude."

"Over the next few years, our surgical laboratory curriculum will continue to evolve to the point of having no nonsurvival surgical laboratories. The elective neutering procedures on humane shelter animals will be used for all instruction of live-animal surgery and postoperative patient care during the 3rd-year surgical laboratories."
- x Found that there was no significant difference between traditionally trained students for the most part.
- xi They evaluated the efficacy of a reusable plastic model mimicking the anatomy and haemodynamics of the canine female genital tract for teaching basic surgical skills and ovariohysterectomy. They found that the model was more effective than cadavers in teaching basic surgical skills and ovariohysterectomy in dogs.
- xii The results demonstrate considerable confusion and hypocrisy in views held or acted upon by the students. There is some indication that many may have become more sensitive to the plight of non-human animals as a result of their veterinary training, but some indicated they had become more callous.
- xiii The authors found DASIE (*Dog Abdominal Surrogate for Instructional Exercises*) to be an effective alternative for preparing students for live surgery. It was well received by the students.
- xiv "Texas A&M University recently established two prepubertal gonadectomy programs in association with area humane organizations as an addition to its required elective surgery rotation for 4th-year veterinary medical students. Results of a student questionnaire indicate that the addition of these programs enhances their education experience in several ways including: 1) refinement of surgical skills in certain areas including gentle tissue handling and hand-eye coordination; 2) exposure and practice in perioperative and anesthetic management of pediatric patients; 3) increased awareness of the functions, goals, and activities of humane organizations; and 4) increased understanding of the pet overpopulation problem and the unique role of the veterinarian in combating this problem."
- xv "Service learning has become a widely used tool for educating in many public schools, colleges, universities, and professional schools, and has the potential to be a more heavily utilized tool in the education of veterinary students. The College of Veterinary

Medicine at Texas A&M University has utilized service learning in association with area humane organizations for many years in the fourth-year veterinary curriculum as a method of instructing these students in techniques of veterinary surgery. Recently, the service learning program has been expanded to support the laboratory portion of a required third-year surgery course. The mechanics of both the fourth- and third-year service learning projects are described in detail in this article. Additionally, the key components of successful service learning programs are discussed, as are the benefits derived from the service learning projects at Texas A&M University."

xvi "The use of large and in some cases unrealistic models were superior to live animals for demonstrating basic concepts and allowing the students to gain basic skills. . . . Students readily accepted alternative models as long as clinical relevance had been demonstrated by the instructor."

"Basic psychomotor skills that are essential to the surgeon can be learned with inanimate models. In addition, motor proficiency can be achieved with repetition on models, making the use of models a superior alternative to live animals for learning basic motor skills."

xvii Discuss the methods of teaching surgery using patients.

xviii "Bone models simulating radius curvus and a femoral nonunion were developed. The models were used successfully in senior student orthopedic surgery rotations and in a continuing education laboratory. The models were ideal for demonstrating and teaching preoperative planning, operative principles and procedures, and postoperative results of corrective osteotomies to veterinary students, interns, residents, practitioners, and clients."

xix "Although the ultimate success of surgery depends on the use of adequate psychomotor skills, the evaluation of the abilities of a trainee and the teaching of these skills has not been systematized. The choice of a trainee in surgery should be based at least partially on his innate abilities, and his training should be begun at an appropriate level. The procedures he may do should be analyzed to determine the skills required for their performance. Then these skills should be taught specifically, initially in non-threatening situations such as laboratory settings, and their acquisition assessed so that he can be progressed to more advanced work at the appropriate time. Ultimately a decision must be made whether to train a candidate to a skill level or whether to train him for a set period and then counsel him regarding which procedures he has the skills to perform. There are well developed concepts in educational psychology that may be used in developing improved methods to assess and train prospective surgeons."

xx "In order to assist beginners in microsurgery in practicing microvascular suturing without the use of an animal model, we devised an apparatus composed of a Lucite disc with Lucite cylinders attached to either side. On the one side, a piece of rubber glove can be attached for practice of either continuous or interrupted suturing. On the other side, four slots in the cylinder permit suture material or simulated blood vessel to be placed and held for practice in tying knots or end-to-end anastomosis. The disc apparatus is very inexpensive, durable, and easily obtained."

xxi "It has been documented (Janis and Mann 1977) that psychological distress, such as that experienced by many veterinary students in 'animal labs', can result in decreased observational and cognitive functions; the use of non-patient animals in veterinary education may therefore result in decreased learning."

"Finally, use of non-patient animals in veterinary medicine may decrease students' abilities to be compassionate and empathic. It has been documented in a variety of situations that exposure to violence or other aversive stimuli leads to desensitization; 'animal labs' may desensitize students to animal suffering."

xxii "Results of this study indicated video game performance of third-year veterinary students was predictive of laparoscopic but not traditional surgical skills, suggesting that laparoscopic performance may be improved with video gaming experience."

xxiii Dr. Orlans, who had taught biology for many years, provided a reasoned and logical presentation of reasons to eliminate dissection in pre-college education. In so doing, she discussed the issue of desensitization.

xxiv Surgical procedures assessed were: "Ovariohysterectomy, Castration, Laceration Abscess, Laparotomy, Gastrotomy, Eyelid surgery, Cystotomy, Intestinal anastomosis, Splenectomy, Gastric torsion/Gastropexy, Simple fracture repair, Cast/Splint application, Thoracotomy, Other"

Medical and diagnostic procedures assessed were: Transtracheal aspirate, Urinary catheterization (male), Urinary catheterization (female), Bone marrow aspiration, Venipuncture, Needle aspirate, True cut needle biopsy, Ophthalmic examination, Otic examination, Cerebrospinal fluid tap, Cystocentesis, Venous catheter placement, Other"

"Our results suggest that use of cadavers during the third-year laboratory program, when supplemented with additional clinical training during the fourth year, can provide training comparable to that provided in a conventional laboratory program."

xxv "A close examination of the evidence base for the presumed advantages of [live-tissue training] showed that it is not superior to simulation-based methods in terms of educational benefit."

xxvi This was a survey comparing first and fourth year students. A charitable interpretation of the finding that there was some moderation of opinions between the 1st and 4th years is that there is a loss of sensitivity over time.

xxvii "At present, new fixatives have been developed to allow a better and longer preservation of animal corpses in order to maintain organoleptic characteristics, i.e. colour, texture, as close as possible to what students will deal with living animals. From 2004, in our college, surgical technique classes no longer use living animals for students' training. Instead, canine corpses chemically preserved with modified Larssen (MLS) and Laskowski (LS) solutions are preferred. The purpose of this study was to investigate comparatively the biological quality of preservation of these two solutions and to evaluate students' learning and acceptance of this new teaching method. Although these fixatives maintain body flexibility, LS solution failed to keep an ordinary tissue colouration (cadavers were intensely red) and tissue preservation was not adequate. By contrast, MLS solution, however, did not alter the colouration of cadavers which was fairly similar to that normally found in living animals. A remarkable characteristic was a very strong and unpleasant sugary odour in LS-preserved animals and therefore the MLS solution was the elected method to preserve cadavers for surgical technique classes. The students' feedback to the use of Larssen-preserved cadavers was very satisfactory. . . ."

xxviii "Surgical training in veterinary medicine has evolved rapidly over the past several decades. Catalysts for change include pressure from concerned students and the public to reduce the use of live animals in teaching; less-than-effective preparation of students for live surgery experience; an overall reduction in faculty time and effort devoted to skills training; college budgetary reallocations mandating reductions in expensive group laboratory experiences; and more specialized case-load patterns in clinical rotations, which have reduced students' exposure to common surgical conditions. In response to these trends, methods for surgery educators to reduce, refine, and replace live animals in surgery training courses at veterinary schools have received broad attention. When

these methods are used effectively in a curriculum, it is no longer necessary to sacrifice animals for adequate student training. This article describes a successful and ethical surgical training program used at the Ohio State University College of Veterinary Medicine (OSU-CVM). This program provides early exposure to skills training using surgical simulators and auto-tutorials, ensures that basic skills are mastered before students are exposed to cadaver practice, and requires application of model-based skills to cadavers, with final matriculation to intensive exposure to multiple live-animal procedures via a collaborative surgery program with a local shelter.”

- xxix “Cooperative efforts between animal shelters and veterinary schools can provide crucial opportunities for outreach teaching initiatives, particularly for teaching medical and surgical skills. Prior to establishing a program, it is necessary to establish workable policies about euthanasia, what conditions warrant rehabilitation, and how prescription drugs are dispensed and to organize a medical records system. The shelter instructor should have a comprehensive understanding of shelter issues and must have the patience and interest to teach students on the floor daily. Shelter faculty should be incorporated into core clinical teaching programs to keep them current and engaged and to provide for continued learning and growth in their interest areas. These measures will help sustain shelter collaboration and retain teachers who provide vital instruction in our clinical training programs.”
- xxx “Second-year veterinary medical students used an interactive videodisc simulation as part of the curriculum in an introductory principles of anesthesia course. Subjective responses to a questionnaire filled out immediately following their first-use experience indicated a positive response regarding the simulation’s realism, clarity, and ease of use. Upon entering the third year, the same students prepared for an introductory clinical anesthesia laboratory either by using the simulation, or by attending a 50-minute lecture/discussion. A comparison of test scores indicated no significant difference in academic performance between treatment groups on either of two laboratory days.”
- xxxi “The results show that students who first practiced using the surgical dummy had better psychomotor and basic surgical skills. Comments made by the students were positive in relation to sensation of tissue during handling rated as natural. Their confidence increased during surgical procedure due to freedom from worry of consequences of surgical errors.”
- xxxii “The small animal surgical faculty have noted that students from the alternative surgical laboratory program are more timid and hesitant the first time they incise living tissue. This hesitancy is only apparent on the first live tissue surgery. In all other segments of the 4th-year small animal surgery and anesthesia rotations, including patient care, the alternative students perform on a par with the students from the standard laboratory experience.”
- xxxiii One alternative discussed and illustrated here is the University of Sydney Faculty of Veterinary Science’s ovariohysterectomy simulator model.