VIRTUAL VERSUS TRADITIONAL DISSECTIONS IN ENHANCING LEARNING: A STUDENT PERSPECTIVE

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Abstract

This paper describes a study comparing the perceived effectiveness of "real" and "virtual" dissections in a first-year human biology course. Data were collected from enrolled students using surveys and focus groups within an action-research methodology. The findings suggested that there is little difference between the two types of instruction in terms of learning the structure and function of organs. However, while the results showed that over 65% of students used the virtual materials, access to computers or the Internet was not a determining factor for those students who did not access the virtual dissections. These outcomes reinforce the need to offer a variety of learning experiences that target different styles of learning.

Keywords

dissection, real, virtual, effectiveness, comparison

Introduction

The use of dissections within biology courses, especially of mammals, is becoming more controversial, leading teachers and students to reconsider the value of these procedures in the classroom. Typical alternatives to using live animals for dissection are preserved specimens, 3D models, videotapes of experiments, self experimentation, videodiscs and computer simulations. Based on our experience over the past ten years, these options appear to fulfil the majority of objectives required for the student experience of dissection. It has also been shown that when students are offered an alternative to dissection using models and charts, there was no significant difference in their written examination results, in particular on those based on the dissection, compared to students who completed the dissection (Downie & Meadows, 1995). Their study also found that although the dissection was regarded as one of the most interesting practicals in the course, it also achieved the highest disapproval rating because it involved the taking of life. Similar studies support these findings (e.g. Kinzie, Strauss & Foss, 1993; Predavec, 2001).

Over the last ten years an increasing awareness of animal rights issues and ethnic/cultural sensitivities to whole animal and animal parts dissections has led to changes in the structure of our practical classes, with some dissections being replaced by computer-based material. Many of our students no longer need the hands-on experience of performing animal dissection, particularly as the emphasis is on understanding the functional anatomy of the animal rather than manual dissection skills. We also have logistical problems supplying cat cadavers to the 800 students in the cohort each year. Consequently we have developed several computer-based simulations which allow students to investigate mammalian structure and function as an alternative to animal experiments and dissections. The modules were introduced in 2000 and are available via our online virtual learning environment (Biological Sciences, Online) and on computers in the laboratory. They are accompanied by paper-based materials and are fully integrated into the curriculum. During the course students use a part-dissected cat cadaver to handle and explore its digestive

system (learning by experience and discovery). Subsequently they use a virtual dissection to review their understanding of the digestive system (optional, used as a supplement or alternative to the actual dissection) and to investigate the cardio-vascular system (no real dissection available).

It was important for us to gain an understanding of the relative usefulness of animal and virtual dissections in terms of learning outcomes to help inform the debate on the replacement of animal cadavers in student laboratories. Given this environment, this paper examines the role of real and virtual dissections on the learning opportunities for a large group of first year students.

Methodology

This investigation of the use and usefulness of animal and virtual dissections for student learning was a component of a larger investigation examining all learning resources in the first year biology course. These included a range of computer-based learning modules, online materials and communications strategies in addition to the more traditional learning resources such as lectures and practical sessions (Franklin, Lewis & Peat, 2001). The participants for this study were 400 students chosen randomly from the cohort of 800 first year biology students. A combination of qualitative and quantitative survey questions as well as focus group discussions were used to collect data on the use of virtual dissections as a replacement for animal dissections. These data were collected in the week following the introduction of the computer-based simulation and at the conclusion of the course.

Results and Discussion

The results from the first data collection indicated that only 50% of the students had used the computer-based virtual dissection programs, and of those they were either used alone (78%), in the practical class (47%) or at home (53%). However, by the end of the course 68% of students had used the virtual computer-based dissection materials.

The results depicted in Table 1 show two important trends. First, of those students who used the virtual dissections, 66% perceived them to be either useful or essential for their learning and understanding of both the structure and functions of body systems. For those students who used the animal cadavers, 72% responded that the real dissections were either useful or essential for understanding structure whereas only 62% agreed with them being either useful or essential for understanding functions. This indicates that both forms of learning resource can play an important role in developing student understanding. Second, and more importantly, is the finding that between 28% (n=112) and 38% (n=152) of those students surveyed found either dissection method to be of little or no use. The implications for this in terms of provision of teaching resources to accommodate learning preferences is significant.

	Understanding structure (%)		**Understanding function (%)**	
	Real	**Virtual**	**Real**	**Virtual**
Of no use/some use	28	34	38	34
Useful/ Very useful/Essential	72	66	62	66

Table 1: Usefulness of real versus virtual dissections in understanding structure and function

The data in Table 2 indicate that the majority of students (71%) perceived the real dissection experience to be more useful than the virtual dissection experience (47%) in developing co-operative learning skills. However more students (64%) perceived the virtual experience as useful in developing an independent approach to learning than the real experience (51%). This difference is to be expected as students work in peer groups of 4-5 for the real dissection, whilst the majority of students (78%) reported using the virtual dissection materials alone.

	Developing co-operative learning experiences (%)		Developing an independent approach to learning (%)	
	Real	**Virtual**	**Real**	**Virtual**
Of no use/some use	29	53	49	36
Useful/ very useful/essential	71	47	51	64

Table 2: Usefulness of real versus virtual dissections in learning

Overall the data indicate that students find both real and virtual dissections useful for their studies. However, in this study a proportion of students found both methods of dissection "of no use" to their study, which reinforces the requirement for academic departments to continually review their resources to ensure they meet student needs. In addition, the data showing that selected students found the virtual dissections of no use suggests that the development of such resources, which are often costly, must be carefully justified and comprehensively integrated into the course of study. The reasons for these trends can better be understood by reviewing the responses to a variety of open-ended questions on the use of virtual versus real dissections, which were thematically analysed and categorised. There was an overwhelming response (68% of total) in favour of the hands-on nature of using dissections (even though the cats are pre-dissected and preserved), with a subsidiary comment about the availability of 3-dimensional material (11%).

> Can display live (sic) cat easily and can move organs around and can follow through the system better!
>
> Hands on learning is much better than 'virtual' learning.
>
> You could move the parts around and see them in 3-D.

Perceived advantages with the virtual material were identified by only 18% of the responses, the most frequent being on the clarity of information and ease of following it on the program (14%).

> On the VM (virtual material) more info is given which is great, however hands on experience with real cats is a great advantage!

One of the main messages was that many students (44%) perceived the real dissection to be better than the virtual as a learning resource, even though many commented on the unpleasant nature of the pre-dissected preserved material.

> With cat cadavers you can examine more closely the systems within the cat as you can move things around to get a better idea of where things are placed and can see where they are attached. The virtual dissection was probably a lot more detailed and informative, but the cadaver provided a better idea of where things fit in.

Many students indicated that the cat cadaver was more useful for understanding structure and interrelationships thus, reinforcing the findings of Downie and Meadows (1995), whilst the virtual dissection was more useful for understanding functions of structures.

> Cat cadaver and computer program should be used together as it helps identifying parts of the body. That's the disadvantage of the cadaver, it is hard to locate specific parts.
>
> Using both is excellent - the cadavers are better for forming an understanding of structure and computer are useful for understanding process (student emphasis).

However it has been suggested (Kinzie *et al*, 1993) that the use of a simulation is not the equivalent of performing a laboratory dissection, and that simply viewing a dissection on a screen does not have the same sensory experience or sense of personal discovery as a real dissection.

> You can see more doing it for yourself, notice texture etc., which can't be represented on a computer. Gives real experience. Can be a bit messy/smelly.

Quentin-Baxter and Dewhurst (1992) suggest that the benefits of computer-based simulation materials are that they offer a large amount of supporting and reinforcing information, and that students are able to work at their own pace. They recommend that students using computer-based simulations as alternatives to animal dissection should be encouraged to use them in groups to enable discussion about the material, paralleling the situation where students exchange information while carrying out a practical dissection. Our data show that 78% of students were using the virtual dissection materials alone, thus not having the opportunity to discuss the content with their peers. This may not be a disadvantage if the students are using the material for revision purposes, however care should be taken to fully integrate these materials into the classroom situation to maximise their usefulness.

The fact that a third of the students did not use the computer-based dissection materials was not due to an inability to access the resource, as the majority of students (98.5%) have access to the Internet. An issue may be that the use of the virtual resources is not compulsory - optional resources may have less attraction or perceived use than those which are specifically linked to assessment or examination components. This illustrates the value of offering a diverse range of materials to provide students with a rich learning environment - one where different views of content and a selection of resources to suit all learning styles are available should they be required. As data for non-use of the other online tutorials provided as part of the course were similar it is important that we investigate why approximately 25% of our students do not use any of the computer-based resources provided, not just the virtual dissection materials.

Implications

This study focused on the comparative value of real and virtual dissections in a first year biology course. While both resources were perceived to add value for the majority of students surveyed, a number of critical factors emerged relating to the implementation of computer-based resources within tertiary teaching programs. The questions for us to ask are: “Should we continue to replace the real dissections with virtual ones?” or “Should we provide both?” The trend for removing animal cadavers from laboratory classes is likely to continue with added pressure from an increasing student population and from within the local Animal Experimentation Ethics Committee (Wheeler, 1993). As some students are not using the virtual dissection materials, future investigations will endeavour to identify what mix of learning opportunities would best suit this large group of first year students.

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Acknowledgments

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