Journal of Instructional Science and Technology
http://www.usq.edu.au/electpub/e-jist/homepage.htm
ISSN: 1324-0781

Published by the
Distance Education Centre
University of Southern
Queensland
Australia 4350
Tel: +61 7 4631 2215
Fax: +61 7 4631 2868

Volume 3 No. 3, March 2000

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Editorial

Welcome to Volume 3 (Issue 3) of *the Electronic Journal of Instructional Science and Technology*. There are 4 papers in this Issue and we hope you will find something of interest in all or some of them.

The first paper by **Hashem Fardanesh** *(Instructional Technology and its Exigency*) asks some very topical questions about IT. These include: Why is IT a necessity in today's educational settings? Is IT the mere use of new educational technologies in instruction, or a systematic way of dealing with instructional problems that comprises the use of new technologies in instruction? The author considers these questions of prime importance.

Jeff Thomas's paper (*Using science project work in distance learning for a personal perspective on science and society*) describes a UKOU Masters module *Science and the Public* which includes a project element, where students undertake original self-selected research that addresses a specific and meaningful instance of science's impact on society. The author claims that establishing a personal perspective via individual project work provided students with an opportunity to develop a deeper and more meaningful understanding of the influence of science on the lay public.

Linda Cooper's paper (*On-line course: Tips for Making Them Work*) will be of interest to all Instructors who are interested in offering on-line classes. This article provides various steps and procedures for increasing their effectiveness.

And finally the paper by **Philip, Davies and Naidu** (*Improving Practical Instruction in Veterinary Gross Anatomy with Multimedia Based Preparation*) describes work towards the improvement of the teaching and learning of the regional anatomy of the dog in veterinary science classes. While the use of preserved specimens is a conventional and widely adopted approach in the study of anatomy in many veterinary schools, it is a practice that has several inherent problems. These problems are related to the repeated use and storage of preserved tissue, and the artificial appearance and texture of such specimens. The work reported here sought to address these concerns with an approach to the teaching and learning of this topic with multimedia-based preparation materials and the use of non-preserved specimens.

So have fun, and as usual we will welcome your comments and thoughts on any of the issues raised in this Issue of the eJIST. Please address all such correspondence to the Executive Editors.

Som Naidu & Olugbemiro Jegede

Electronic Journal of Instructional Science and Technology (E-Jist)
Volume 3 Number 3 Mar 2000
Pages 2–7

Instructional Technology And Its Exigency

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Abstract

In the last decade of the twentieth century a restitution of a once outdated definition of Instructional Technology (IT) is observed, which emphasizes the use of technologies in instruction, and ignores the instructional technology aspects of it. Why should IT as a field of study (a discipline), as an approach to instruction, and as a necessity for today's educational settings be used? Is IT the mere use of new educational technologies in instruction or a systematic way of dealing with instructional problems that comprise the use of new technologies in instruction? Is there a way of abandoning IT in all or some instructions, or is IT a necessity for all instructions? These questions, in writer's view, are of prime importance in a time of facing vital problems and decisions about the future of our school system and the way we are going to handle our instructional processes within schools.

The limitation of 'time' allotted for instruction becomes evident in two forms: first, the limitation of man's lifespan, and second, the limited time of instruction that is allotted in 50 minute time slots. Considering these limitations, choosing to learn something is meant to exclude others, and people by choosing an aim or a topic in fact deprive themselves from other aims and topics; there is a real competition between aims and topics of instruction.

One way of dissolving this problem is to chose the 'best' or the 'most important' topics to teach/learn, but, redundancy and superfluity of knowledge with an increasing rate makes the task of choosing the topics more difficult.

Another way of resolving the problem of limited time is to increase efficiency of instruction in a given time limit. It is obvious that this solution does not resolve the problem completely either, but this is the only remaining path open to man, and the reason for renewed interest in IT. A discussion about the meaning of IT is in order.

Definition of Technology

Technology is composed of two terms; 'technique' and 'logy'. Technique means 'a skillful way of doing something', and the suffix 'logy' means knowledge and knowing (Webster's Dictionary, 1994). The two terms put together mean; knowledge of skillful ways of doing things.

Hence Technology in any discipline is the knowledge resulting from studies and explorations in that discipline for achieving the ways of skillfully doing the things subject to that discipline. Technology in any discipline is based first, on theoretical findings, and second, on practical and applied conclusions of that discipline in order to prepare the grounds for applying those findings to resolve problems in that particular context.

Definition of Instruction

Instruction is a conglomeration of decisions and activities that are made and carried out in order to procure the desired outcomes for learners. Some of these decisions and activities are as follows:

- examination of learners prior knowledge,
- determining the structure and combination of learning materials,
- use of incentives and feedback,
- determining the required capabilities for the desired learning outcomes,
- identifying required learning conditions,
- identifying ways of measuring learning outcomes,
- determining presentation strategies,
- determining the time necessary for learning,
- informing learners about learning goals,
- communicating with the learners,
- providing the learning materials,
- setting appropriate standards for performance and evaluation,
- managing the learning processes, and …

The above list is by no means intended to be complete, rather the point is that instruction is a multifaceted and complex process, which needs to be studied and dealt with as a unique and goal-oriented process.

Definition of ‘Instructional Technology’

Considering the definitions of Technology and Instruction a comprehensive definition for IT would be; the knowledge of skillful execution of instruction. This knowledge is an applied knowledge that is bound to specific conditions and circumstances. In other words, IT is one of man’s applied knowledges that looks at instruction as a systematic and cohesive process. It presents solutions, strategies, procedures and models for execution of instruction for different learners and in a variety of conditions.

There are a number of doubts and questions about IT that hinder or limit its efficiency and use. Some of the more important questions about IT are as follows;

1. Is IT aiming at implementing the principles of behavioural theories of learning?

2. Does implementing IT principles result in mechanized and dehumanized instruction?

3. Does IT fulfill all of our instructional needs?

In response to the first question, as was mentioned above, technology in a given discipline is based on the latest applied findings of that discipline, and it is obvious that the latest findings of research about learning are limited to the behavioural approach (up to late 1950s) in IT. IT was afterwards heavily influenced by the findings of cognitive psychology (a movement that started at the beginning of 1960, and continued through late 1980). Therefore believing that IT is the product of application of behavioural psychology to instruction would not be true, because IT by its nature is bound to use existing research findings in solving instructional problems, and IT today benefits least from behavioural points of view.

The history of IT can be divided into two distinct periods; in the first period IT was studied with an instrumental connotation, which emphasized the use of new instructional media and materials in instruction. This conception of IT did not last long, and diminished with the decline of behavioural psychology at the late 1950s, and this was the beginning of the second period which was marked by theories of cognitive psychology.

A new definition of IT that emphasized mental processes and cognitive analysis of learning tasks was born. The new approach to IT intends to solve instructional problems using all existing research findings, and in so doing does not see itself limited by any theoretical or psychological perspective.

The second question states that implementing IT principles results in mechanized and dehumanized instruction. It is useful to look first for the origins of the question, secondly, is posing this question from an educational theory perspective or from an instructional theory perspective relevant and thirdly, is the criticism relevant?

Re conceptualists such as Giroux, Penna and Pinar (1981) state that:

> …theorists such as James Macdonald, Dwayne Huebner, Maxine Greene, William Pinar, and Micheal Apple played a significant role in “re conceptualizing “the major issues, concerns, and modes of educational inquiry that provided a focus for curriculum theory and practice. Drawing selectively on such European intellectual traditions as existentialism, phenomenology, psychoanalysis, and neo-Marxism, … (p6–7).

Setting aside the issue of how did Americans manage to defeat the communist block on political, technological, and economical fronts, and give in to their cultural and philosophical offences, a discussion about the difference between educational theory and instructional theory is in order.

Theory is a coherent group of general propositions used as principles of explanation for a class of phenomena. Theory is more or less a verified explanation about known facts and phenomena. Kerlineger (1973) defines theory as’ …a set of interrelated constructs (concepts), definitions, and propositions that present a systematic view of phenomena by specifying relations among variables, with the purpose of explaining and predicting the phenomena. It is notable that all definitions of theory refer to a class or group of objects, events, or phenomena which is specific to that theory, and is added to the term ‘theory’ such as ‘educational theory’ or ‘instructional theory’. Therefore educational theory can be defined as an aggregate of constructs (concepts), definitions and propositions that explain the interrelationships between these constructs, definitions and … to provide a systematic view which enables one to explain, predict and anticipate all those events and phenomena subject of that theory.

In an educational theory topics such as ontology, epistemology and axiology in a broad and philosophical sense is discussed. Education as a field of study is composed of a diverse range of topics, and a theory of education must encompass the whole range of topics in its most general sense. Hence, most of the works of famous educational theorists are about the main issues of philosophical significance in the field of education.

On the other hand, instructional theory could be defined as a set of constructs, concepts, definitions and propositions that explain the phenomena or process of instruction with a systematic perspective. As was mentioned above instruction is the set of decisions and actions that are made or executed for achieving the goals of instruction by the learner. Considering this definition an instructional theory is an organized set of constructs (concepts), definitions, and propositions about the process of instruction, with which one can achieve an explanation of phenomena existing in those decisions, actions, and the relationships between them in order to explain and predict those phenomena and their consequences. In other words, and according to Reigeluth (1983) an instructional theory is the systematic relationships among three key elements of outcomes, methods, and conditions. In an instructional theory we have very specific and concise propositions declaring specific relationships between two or more concepts or constructs specific to the domain to which the theory belongs to. For example, in an instructional theory teaching procedural tasks consists of presenting the way of execution of the procedure, practicing the procedure by the learners, and providing them with feedback about their performance. This is a prescriptive proposition taken from an instructional theory.

There are at least two kinds of theories, based on their domain of reference, strong theories, and weak theories. Strong theories as far as possible encompass all the concepts, definitions, propositions and phenomena within a domain, while weak theories comparatively encompass fewer phenomena or propositions. For example, some of the instructional theories prescribe comprehensive propositions and principles about presentation of instruction for all kinds and categories of educational objectives (e.g.; Instructional theory of Gagne and Briggs, 1992). Other theories prescribe only the principles for limited kinds of educational objectives (e.g. Merrill’s Component Display Theory, 1983) which is limited to cognitive objectives.

By comparing the definitions of educational theories and instructional theories, it becomes evident that educational theories are general, and encompass all significant or key phenomena which have a key role in education with a philosophical and general approach. Instructional theories, concerning their domain of reference are more limited and deal only with the phenomena related closely to ‘instruction’. Therefore, it could be concluded that educational theories are general and widespread, and instructional theories are specific and piecemeal.

The noticeable point is that the two kinds of theories do not overlap, and their domains of reference are longitudinally ordered, and not cross-sectional. In other words, the general and broad theories of education deal with the philosophical and general educational concepts and phenomena, and might have some hints or references about instruction and teaching. However, these hints and references do not suffice for the kind of explanations necessary in instructional theories. There is a big difference between general and philosophical explanations of educational phenomena, and specific and causal explanations of instructional processes.

Considering the above differences between educational and instructional theories, and what re conceptualists have to say about education, we might be able to conclude that re conceptualists in the position of a philosopher and an expert in 'education' have some attendable and thought provoking discussions about philosophical, historical, and sociological aspects of education, and their discussions about instructional topics can not be taken seriously.

A quotation from Dwayne Huebner (1981) speaks for itself:

> '… some of the implications of this analysis for curriculum and our 'understanding' of human development are easy to generate. If we take seriously the possibility of a genetic Marxism, then further inquiry might produce more useful knowledge about the dialectical relationship between adults, the structures of the adult world and the child. Central to such inquiry would not be cognition or affect but the shape of human activity throughout the lifetime of the person, the developing power of the person for self and social production, the evolving social relations of the person, the relationship of self activity to social activity, the evolving functions of language as a manifestations of social relations and consciousness, including class consciousness, the functions of production and ownership, and the use value of the materials of production for children, the relationships of these materials to the schemata of assimilation and accommodation of the child, and the relationship of these materials to the productive forces within the society.' (p135)

This is just one of the voluminous neo-marxists' writings about education, which has no direct and clear relationship to instructional issues. As another example, review the quotation from William Pinar (1981):

> '… a re conceptualist tends to see research as an inescapably political as well as intellectual act. As such, it works to suppress or to liberate not only those who conduct the research and those upon whom it is conducted, but as well those outside the academic sub culture. Mainstream social science research, while on the surface seemingly apolitical in nature and consequence, if examined more carefully can be seen as contributing to its dissolution. Apple and Marxists and neo-Marxists go further and accept a teleological view of historical movement, allying themselves with the lower classes, whose final emergence from oppression is seen to be inevitable.' (p 93)

It is obvious that no instructional theory and even no educational theory can be derived out of such broad and general slogans.

The third question about the fulfillment of all our instructional needs by IT, it must be said that to this time, and in no field or discipline no technology has been arrived at which could satisfy all of man's needs in any known domain, and therefore having extraordinary expectations about IT is not meaningful and logical. But, since IT is the only practical and feasible way of going around instructional problems, and increasing the efficiency of class hours is of prime importance, there remains no other alternative but to invest all of our potential to improve IT principles and applications.

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Electronic Journal of Instructional Science and Technology (E-Jist)
Volume 3 Number 3 Mar 2000
Pages 8 – 19

Using Science Project Work in Distance Learning for a Personal Perspective on Science and Society

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Abstract

The UKOU Masters module *Science and the Public* includes a project element, where students undertake original self-selected research that addresses a specific and meaningful instance of science's impact on society. Students choose topics of personal significance, often related to their professional interests. Using a rich mix of questionnaires, interviews and content analysis, students were able to test many of the theoretical constructs developed in the module texts. Problems associated with project work in ODL institutions can be eased by extensive computer-based support. In this instance, the limited familiarity of science-based students with the research methods of social science made such supervision yet more crucial. Establishing a personal perspective via individual project work provided students an opportunity to develop a deeper and more meaningful understanding of the influence of science on the lay public.

Introduction

This paper explores two related areas of potential interest to those concerned with the development of distance education. First, it looks in general terms at how project work can provide educational benefits within open and distance learning (ODL) programmes, yielding outcomes that are comparable with the use of project work in more conventional learning situations. Secondly, the paper explores how a specific initiative in project work at the United Kingdom Open University (UKOU) has helped provide students with vivid and personal experience of the interactions between science and society, in ways that re-enforce key themes of a newly-developed UKOU course, *Science and the Public*.

Project Work and Open Learning

The sentiments of the American educational pioneer John Dewey have a contemporary relevance, reflecting a present-day consensus about the value of project work. He felt that the passive absorption of particular facts was both artificial and 'unnecessarily narrow' (Dewey, 1900) tending 'very naturally to pass into selfishness'. Dewey looked for a deeper, more socially significant form of school learning. This he felt could be achieved if 'active work' prevails, 'a spirit of free communication, of interchange of ideas, suggestions, results … becomes the dominating tone', (see Waks, 1997). For Dewey, the problem-solving inherent in project work was more likely to be successful if topics for investigation were volunteered by students rather than being imposed by teachers.

Since that time, project-based activities have been a widely recognized part of all levels of school learning. Some innovative approaches, notably those related to science, technology and society (STS), (see Solomon and Aikenhead, 1994) attach a particular importance to their benefits, emphasizing their potential to motivate students and to nurture the skills of locating, selecting and transforming information. In keeping with its conservative traditions, higher education (HE) in the UK was initially hesitant about embracing project work. But from the 1960s onwards, project work was increasingly used to provide advanced-level undergraduates with experience of independent learning and, especially for students of science and technology, with opportunities for extended self-directed practical work. For example, Chambers, 1972, reports that between 1964 and 1970, the proportion of science departments offering project work to its final-year undergraduates increased from 14 to 67 percent. By the 1980s, almost all chemistry courses in the UK featured project work. In most instances, a single major project comprised virtually all of the practical experience in the final undergraduate year of study (Hoare, 1980). Some HE institutions currently place a major emphasis on project work and problem-solving, most notably the Universities of Roskilde and Aalborg in Denmark, where a wide range of group programmes flourish, see Legge, 1997. ‘Project-orientated’ HE teaching, where the theoretical and practical needs of projects determine course content, has a surprisingly long pedigree, with persuasive claims to success (see Cornwall and Schmithals, 1977).

Whatever doubts may have existed about the feasibility of project work for ODL, the institutions that flourished in the wake of the establishment of the UKOU in the early 1970s swiftly and successfully absorbed this element into their curricula. Henry (1994) reports that one in nine of the course descriptions in the International Centre for Distance Learning database included the term ‘project’ or ‘project work’. (About 15% of postgraduate courses in the current ICDL database include one or other of these key words in their descriptions.) In the Science Faculty of the UKOU for example, many such projects provide ‘hands-on’ experience of practical methods – helping to ensure that UKOU students are not significantly disadvantaged in terms of practical techniques, compared to students of more conventional institutions, (see for example Varley, 1975). Other UKOU science-based project work is more concerned with the exploration and re-enforcement of major course concepts, often via one or more of the new technologies that are an increasing part of ODL, see for example Hodgson and Murphy, 1984. Most UKOU-based projects involve students in different forms of independent investigation but group projects are a feature of some ODL programmes, for example in business studies, see Helms and Haynes, 1990. As Henry (1994) reveals, project work is an area of continuing innovation in ODL institutions, alongside other innovations linked with the new technologies, (see for example, Petrie *et al*, 1998).

The UKOU Course: Science and the Public

This newly-written ODL module is a constituent of the UKOU’s Taught Masters (M.Sc.) programme and relates in particular to the *Studies of Science* study strand. In 1998, the module was presented to an initial student population of about 80 graduates, based in UK and the EU. To set the scene for a discussion of the outcomes of the project work and before reflecting on their educational significance, the next sections describe the content and method of delivery of the module and outline the controversial field of ‘The Public Understanding of Science’ that is its central theme.

Structure and Content

The text element of *Science and the Public* consists of 30 freestanding booklets, many of which are related to specific case studies of social relevance. They describe contemporary or historical events where science has played a key role, in ways that led to public controversy or confusion and had an impact on public perception of science and of scientists. Examples include;

- the BSE debate (Bovine Spongiform Encephalopathy or Mad Cow disease),
- the relationship between electromagnetic fields (especially from overhead power lines) and particular forms of cancer,
- the disposal of a North Sea Oil exploration platform (the Brent Spar controversy),
- the reported existence of a 'gay gene' and
- the likely causes of 'cot deaths' in very young infants.

These examples fuel a broader debate about 'science issues' that comprise the middle section of the module – issues such as whether scientists engender trust amongst the public, perceptions of risk, policy-making in a climate of uncertainty and conflicts between science and other forms of belief, notably religion. The final sector of the module examines the many-layered meanings behind the phrase the Public Understanding of Science (PUS), viewed from the perspective of scientists, educationalists and the public.

All of the booklets include already published material, mainly drawn from primary source journals (and some book chapters and newspapers articles) in areas of science studies, philosophy and sociology. Students have an opportunity to 'read around' the topics via the 50 or so additional articles provided on the *Science and the Public* CD-ROM, providing a 'library' of relevant sources which is accessible via the student's own personal computer.

Tutorial support for the module is provided via a small, geographically dispersed team of Associate Lecturers (ALs), whose role combines assessment (marking of extensive essays), project 'supervisor' and more general pastoral and academic support. Most student/AL contact is via telephone and computer conferencing using the FirstClass software that is an increasingly important feature of UKOU course presentation in science. Five networked groups, each of fifteen or so students, helps provide a social and co-operative dimension to study that complements the many hours of individual study - about 350 hours per module – that is a major feature of UKOU learning at Masters level, (Thomas, 1999).

Why is the Public Understanding of Science Controversial?

The 'PUS debate' in the UK developed in the wake of the Royal Society report (Bodmer, 1985), which identified what it saw as a lamentable lack of public understanding and appreciation of science. It attempted to persuade hitherto diffident scientists of their duty to communicate to the public, which it optimistically characterized as eager to learn more science, though lacking sufficient opportunity. Bodmer's diagnosis of public ignorance soon acquired an unflattering epithet – the *cognitive deficit model*, see Wynne 1991 and Thomas, 1997a. The encouragement to 'inform the public of science' soon spawned a range of activities and informal educational initiatives designed to that end, much of it encouraged by the newly created COPUS (Committee for the Public Understanding of Science), with support from the British Association for the Advancement of Science (BA). For example, the SET (Science, Engineering and Technology) week is now a major event in the PUS calendar, comprising a busy, eclectic national programme of science-based activities, which succeeds in attracting in excess of an estimated 1 million or so of the UK public.

But the SET programme and its like has its critics, (see for example Thomas, 1997b and Fuller, 1998), who claim that the programme epitomizes the cognitive deficit model, with its implication that the lack of public appreciation of science can be rectified simply by ‘showing-off the acceptable face of science to the public’. Sociologically-inspired analyses of how the public sees and uses science knowledge paint a richer, more complex picture. For example, David Layton and colleagues were concerned with the social processes whereby adults give meaning to science and with the difficulties of integrating it into ‘the grain of everyday life’. (Layton *et al*, 1993). Their studies implied that ‘the representation of science as a coherent, objective and unproblematic entity characterized by certainty and direct applicability to every day life received little support’. In consequence, they developed an *interactive* model for PUS. Rather than occupying a central, deterministic role in decision-making, science was often Americanised as it became integrated with other kinds of knowledge. In opposition to the deficit model, lay persons saw science as inseparable from its social and institutional connections. According to the interactive model of PUS ‘ignorance could be functional and defensible’. Alan Irwin has argued a broadly similar position in the context of lay attitudes to environmental controversies. He maintains that lay opinion is far from being the irrational and uninformed stance that the deficit model implies – in his view ‘citizen expertise’ is necessary and legitimate. He also emphasizes the habitual placement of science by the public in broader contexts – to become ‘situated knowledge’. Irwin sees belief in the deficit model as particularly damaging to the search for new forms of dialogue that might help bridge the current scientist/citizen divide, (Irwin, 1995).

Science and the Public Project Work

Such models of PUS are critical to questions that dominate *Science and the Public* - how can ‘science’ and ‘public’ be defined, how much science does the public know, how does the public use scientific information, do SET-style activities influence public perceptions? Empirical research that addresses these areas is presented to students in the module texts but much of it is surprisingly sketchy and over-generalized – as if the public could be regarded as a homogeneous whole. The wide geographical spread of our students and their very different backgrounds and interests provides an opportunity to find out more about lay experiences and perceptions of science, as expressed by a rich *variety* of publics. Focussed and personalized research of this type would;

- provide direct experience of relevant ‘social’ research methods,
- immerse students in key literature of a specialized area of study, and foster skills of research writing at post-graduate level,
- provide opportunities for assessment and for ‘feedback’ to students (from ALs) on their level of research competence and understanding of a key area of the module,
- encourage students to develop their own model of science/public interaction and to create meaning behind the notion of PUS.

At a relatively early stage in their study, students of *Science and the Public* therefore selected a project topic that was of individual interest, amenable to research and relevant to the core issues of the module. The aim was for students to seek out original information, sometimes by extensive use of the literature and/or Internet, but more often by gathering data anew, for example, by interview and/or questionnaire.

Thus, generating *new* qualitative or quantitative information for oneself was a high priority. A free choice of topic was permitted, though approval of relevant research questions and intended methodology was required from the assigned supervisor (AL) before the research began. The intended project needed to be modest in scale (a minimum of 30 or 40 hours investigation), but stretched over the UKOU academic year, from February to October. Consultation with their assigned AL throughout the research period provided opportunity for advice and feedback, often as electronic-exchanges, up to the formal submission of the project write-up in October. The write-up was then assessed independently by two ALs (against a previously agreed marking scheme) and the conflated mark contributed to each student's end-of-year module grading. The analysis of the 66 student write-ups submitted reveals both problems, opportunities and insights, which are discussed in the remainder of this paper.

What Benefits and Problems?

Henry (1994) identifies a range of practical concerns that are frequently associated with ODL project work. Some of those of greatest relevance to *Science and the Public* are briefly described below, together with some facilitative and remedial tactics that were adopted to ease such problems.

- Students' initial intentions were frequently over-ambitious and lacked focus; research questions were nearly always scaled down on the advice of the AL. Focussed projects, of limited scope, were generally the most successful.
- Access to literature has traditionally been problematic for ODL students. The increased availability of databases that allow searching for key words, authors, etc. has eased the problem; *Science and the Public* students were able to access search facilities (such as BIDS (Bath Information and Data Service)), though relatively little material was available on-screen in full-text form.
- Selection of relevant 'public domain' information was often problematic, in view of the large amount of information on the WorldWide Web of uncertain origin and veracity.
- *Organizing* the research work proved difficult for many, in view of the part-time nature of study. Input was necessarily spread over a long period of time, with inevitable loss of momentum. Some students left too high a proportion of the research and writing to the last few available weeks. Henry (1978) found that students who started their project work late were more likely to fail to get enough information and were more likely to subsequently advocate to others the good practice of starting earlier.
- Patchy knowledge of appropriate research methodologies caused significant problems. In particular, the methods of social science research were not well known to *Science and the Public* students, the majority of whom had a background in science. Many assumed that methodologies such as questionnaire-setting, structured interviews and content analysis required no more than 'applied common-sense', whereas issues of design, of consistency, and interpretation of data for example are crucial in these areas, just as they are in science (see for example Cohen and Manion (1985) and Denscombe

(1998)). Using qualitative approaches (from interviews for example) proved especially difficult for students with a science background – few structured their interviews effectively and some were too intrusive in their questions.

- Many students had difficulty adopting a suitably detached and rigorous authoring style in their project write-up. Sometimes the style was too personal and anecdotal, as student's departed too enthusiastically away from the objective and detached style of 'scientific' writing with which they were more practiced. Sometimes, the faults in presentation were more deep-seated – uncertainty for example about the precise function of an Abstract.
- Students were sometimes reluctant (despite encouragement) to be self-critical within their project write-ups. For example, some of the samples used for questionnaires were small and their representativeness was uncertain. However, relatively few such students explicitly drew attention to this key feature or expressed an appropriate note of caution in their conclusions. It is striking that concerns about the accuracy and precision of data likely to be developed in students with a science background did not always transfer to this new research arena.
- But some students appreciated the limits of their research methodologies only too well. For example, one student reported 'my questionnaire was of limited value because of the absence of free speech' and astutely comments that its use in her hands 'demonstrated that a research question may not necessarily be answered by the research results obtained'. Another wrote perceptively 'the qualitative approach enabled me to read between the lines; it enabled me to carry out the project work in a non-scientific way'.

Easing the Difficulties

Advice and guidance were provided from two sources. First, the central designers of the project activity based at the UKOU provided (on FirstClass) guidance on social science methodology, for both quantitative and qualitative approaches. (Some students used their own initiative to access Web sites or published texts relating to the design and use of questionnaires for example.) Secondly, each student's assigned AL provided detailed and individualized guidance, sometimes by phone but more often computer-assisted, via a widely-used 'conference facility' dedicated to the project on FirstClass.

As mentioned, negotiation between student and AL was critical to an early and appropriate choice of research topic. The student's first proposal was submitted in writing to the AL, who offered feedback, which in turn prompted the re-submission of modified plans. Where feasible, a preliminary 'pilot study' proved invaluable. One student wrote 'the trialling of the questionnaire proved to be a useful process in that a number of misleading/confusing questions could be subsequently modified prior to the preparation of the final version'.

Successful project work depended on extensive liaison between AL and student throughout the full period of the research. Guidance on writing-up the project was especially important. Some students were unaware of the language and culture of report writing, expressing themselves in inappropriate and overly informal or colourful sentiments. In the Methods section for example, One student writes 'I was pleasantly surprised by the number of people who wanted to help'. Another reports 'the local Clinical Science library, attached to the local hospital, was also visited on a couple of occasions to obtain further information. The first time it was closed, the next, time was very limited, but some information was found. It did proved (sic) to be fruitful.' (Most descriptions of method were of a significantly higher standard.)

The informal student networks developed using FirstClass facilitated individual project work. Through their professional links (or because of prior study) many *Science and the Public* students could offer fellow students particular expertise or opinion, via an informal 'peer learning' process that the use of FirstClass encouraged. The project work was an expression of individual effort, but networking helped break down a sense of scholarly isolation. Frequently, electronic networking had pragmatic benefits; for example as students enlisted colleagues to help distribute detailed questionnaires in different geographic areas.

The Significance of Students' Methods and Choices

There are two intriguing questions relating to student choice of area of research. First, what research *methods* did students chose to adopt, given what was in effect a 'free-choice' from the many available? Secondly, what *topics* were selected and what thinking may have underpinned such individual choices?

Quantitative methods of gathering information were preferred, with individual students using a mix of different survey techniques. Approximately 60% of student write-ups included questionnaires; only about 20% made significant use of interviews. Approaches involving group discussion or telephone interviews were much less frequent, <5%. Content analysis of texts was a popular approach (used in 45% of write-ups), mainly for the coverage of topical science-based issues in the popular media. FirstClass was used extensively to elicit views and opinions from fellow students. For many researchers, the Web represented a particularly valuable source of information, though few used Web sources exclusively. (At least one individual set up his own Web site to elicit opinions from a wider public.) The generation of *original* data was a hallmark of the great majority of projects.

In terms of choice of topic, *Science and the public* students accessed a large number of distinct and diverse publics, as the following individual examples reveal;

- school children were quizzed on their attitude to science,
- patients at a breast clinic were interviewed on attitudes to screening,
- harbour-masters and fishermen were approached for their views on the accuracy of Government figures on fish stocks,
- a research scientist interviewed colleagues about their views on the value of SET-style events for the promotion of science,
- a member of an environmental NGO looked critically at the strategies and outcomes of recent environmental campaigns,
- a volunteer worker in a zoo examined the role of volunteers in promoting greater public understanding of the zoo's activities,
- shoppers were asked about their scientific understanding of the action of antibacterial products purchased for household cleaning,
- the attitudes of doctors were investigated, with respects to chronic effects of long-term exposure to organophosphates,

- a college lecturer investigated his engineering students' perception of the importance of science.

What was striking was the richness and heterogeneity of the public views identified. It was clear that those sampled had very different experiences of science, reflecting the nuances of individual issues and broader social influences. These widely-varied reports of science/public interaction, from so many discrete 'mini-publics', exemplify the impossibility of identifying *unified* views of science that can be said to characterize the public as a whole. This is most evident from my own analysis of the full range of project write-ups – an experience not of course available to the individual student. But what is striking is that the complexity of the PUS debate was so often revealed to individual students with great vividness as they wrote-up their *own* project work, as the following student comment exemplifies:

> 'One of the achievements of the project was obtaining findings that agree broadly with the information supplied during the module but conversely also being able to explain when findings differed from that presented in the course material. The project has certainly increased my own personal knowledge (of lead and the environment) and through the questionnaire raised the issue in the eyes of at least two public groups. It has uncovered a vast rich wealth of 'lay expertise' in the public…'

In selecting topics, the 'banner headline' issues of the day were of particular appeal. For example, the following controversies were prominent in the UK in 1998 and each episode provided the inspiration for several student projects:

- the supposed risks associated with the use of the 'triple MMR' vaccine (i.e., the 'combined' measles, mumps and rubella vaccine),
- attitudes towards the use of genetically-modified (GM) foods,
- public attitudes to risks of impact of asteroids with the Earth,
- cloning (of mammals, in the tradition of Dolly the sheep).

Research topics were very seldom 'plucked out of the air'. In the great majority of cases they derive from individual students prior interests and experiences. Very often the chosen topics reflected professional concerns. For example, a psychiatric nurse chose to investigate the public understanding of the medical condition of schizophrenia from the perspective of a family member. For this student, 'the process of describing the project to colleagues became a test for the validity of the research process adopted'. Another student employed as a health visitor looked at the effect of the controversy surrounding the MMR vaccine on decision-making of her patients. A teacher of science at a secondary school examined how her school students reacted to scientific claims within TV advertisements. A keen amateur astronomer investigated levels of public understanding of the total solar eclipse due in southern parts of the UK in August 1999. Sometimes professional allegiances and a proper sense of objectivity may have been in conflict, but most in this position assumed a close professional involvement in the topic was helpful – 'being familiar with the main players from the industry side enabled me to obtain 'inside information' about the importance the industry attached to favourable public information'.

As a result, many students integrated major themes of the module – different models of PUS for example – into personal and professional contexts. For example, the psychiatric nurse looked for analogies between the relationships between therapist and client and between scientific experts and members of the public. Integration of this type brought an added bonus; it led students to challenge the usefulness and validity of some of the key theoretical constructs that underpin the PUS debate. For example, several students considered attitudes towards the genetic engineering of crops in relation to Urlic Beck's theoretical notions of 'the risk society', as discussed in the module material (see Turney, 1998). Another student looked at the influence of statistical data in decision-making, in relation to individuals' preferences for different modes of transport. Irwin's notion of 'situated knowledge' was critically evaluated with reference to lay perceptions of 'a healthy diet', in a project which looked at (non-science) influences that individuals brought into decision-making.

Project work often gave students the confidence to relate the *general* and the *particular*. Notions of trust, expertise and of uncertainty for example – all broad issues of public concern prominent in the module texts, became embedded in a whole range of specific contexts. Both the power and limitations of science were brought home, as were suggestions for helping resolve deep controversies. For example, one project considered the extent to which science can resolve disputes about fish stocks. The student sought ways for the public and scientist to work together to formulate new, imaginative policy.

Project work therefore encouraged students to develop their *own* perspective on issues at the core of the *Science and the Public* module – for example, is there value in the cognitive deficit model of PUS? Many students indeed felt that their work demonstrated 'the need for greater understanding of science by the public'. Some students highlighted the need for more information and awareness – for example one student was unsettled by 'the 'ignorance' of the public about the health threats of electromagnetic fields associated with of mobile phones'. Some were alarmed at what they saw as irrational views and urged 'greater understanding of the facts'. For example, public attitudes to different forms of drinking water (tap or bottled) 'did not seem rational'. Others stressed the understandable difficulty the public had in knowing what 'the facts' were, as their analysis of recent public health controversies demonstrated.

Although students did highlight what they saw as 'public ignorance' few students wrote as if simply 'knowing more' would ease public anxieties. Worries about the genetic engineering of crops were evident from the better informed of the sampled population. And what the public 'wanted' was far from clear. One student survey found little evidence of public support for a 5-year moratorium on the development of GM food, even though environmental NGOs claim public support for such a move. Some project authors leant to the view that greater information would heighten scepticism. For example, in a project on perceptions of the quality of local bathing water, a student reports that 'greater understanding would enable the public to 'see through' the publicity that seaside resorts produce in promotional material'.

Conclusion

This paper has emphasized the virtues of project work – for students of ODL institutions no less than those of more conventional establishments. Indeed, the new technologies that form an increasingly important part of ODL should give extra momentum to learning programmes that highlight problem-solving and self-directed learning. But this creates a challenge for ODL institutions; if the intended outcome of project work is to enhance the research skill of independent problem-solving, this can be nurtured only through extensive and skilled instruction, supervision and support.

On the evidence of their writing, project work for our students provided first-hand experience of the public impact of science and engendered greater regard for the methodologies and strengths of social research. It provided an opportunity for students to test the robustness of key concepts from the module and to integrate theoretical and practical components – to test their understanding by putting it to work.

Conducting research helped our students develop their own meaning of the problematic notion of ‘the public understanding of science’ – a meaning which, as an expression of ‘self’, is particularly vivid and relevant. On this evidence, the presentation of a written account of individual project work is a significant ‘rite of passage’, for ODL students no less than others. It helps define a transition from ‘learner as recipient’ to active researcher, where emerging skills of reflection and critical analysis contribute to greater independence and self-affirmation.

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Electronic Journal of Instructional Science and Technology (E-Jist)
Volume 3 Number 3 Mar 2000
Pages 20 – 25

On-Line Courses: Tips For Making Them Work

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Abstract

A number of post-secondary institutions are looking more seriously at offering on-line courses to meet the educational needs of a fast-paced, computer-literate society. For instructors who are interested in offering on-line classes, this article provides various steps and procedures for increasing their effectiveness.

On-Line Courses: Tips For Making Them Work

Introduction

A number of post-secondary institutions are looking more seriously at offering on-line courses to meet the educational needs of a fast-paced, computer-literate society. Regardless of whether the instructor develops his/her own Web pages, utilizes a Web-based system developed by a textbook vendor, or manages his/her on-line class materials with a computer-based course management system (CMS), there are procedures that can improve the course's effectiveness.

Over the past four semesters, approximately 200 students have enrolled in an on-line Computer Foundations course at Macon State College. The course includes basic computer concepts and terminology as well as instruction using MS Office 97. Although I use a CMS to manage my on-line course, many of the procedures I have incorporated can be effective in the facilitation of any on-line course.

What I would like to do in this article is share with instructors who are interested in offering on-line instruction various actions I have taken over the last four semesters to increase students' learning opportunities and improve their overall satisfaction with the course.

Article

On-line instruction can be offered in a variety of formats, and the process selected by the instructor will depend on a number of factors such as administrative support, technical knowledge and expertise of the instructor, technical support offered by the school, and the school's technical infrastructure (Cooper,1999). Regardless of whether the instructor chooses to develop his/her own Web pages; uses a computer-based classroom management system such as Topclass, Web CT, or Web in a Box; or utilizes an on-line system developed by a textbook vendor, there are steps and procedures that the instructor can take to encourage interaction among instructor and students, increase students' opportunities for learning, and improve students' overall satisfaction with the class.

Initial Class Meeting

Because on-line learning is a new experience for most students, an initial class meeting is beneficial. It provides an excellent opportunity for students to meet the instructor and each other, ask questions, and become acquainted with the course logistics (Cooper, 1999).

During the class meeting I go over information typically covered the first day of a regular class such as syllabus, textbook, instructor office hours, testing procedures, etc. One of the most beneficial handouts to both students and me is the semester calendar (also available on-line), which includes a schedule of activities, assignments, and test dates for each week of the semester. Not only does the schedule provide students with a weekly 'to do list', but it reminds students of their learning objectives and keeps all of us on task.

The initial meeting also furnishes students with an explanation of what an on-line course is and the mechanics of how 'everything works'. Because I have access to the student roster prior to this meeting, I enter all user names (students' last names) and passwords into the computer beforehand. Doing so allows students during this class session to log on with their assigned user name and actually navigate the course Web site and become familiar with the content and various features.

Because the majority of problems students encounter are computer-related, I also spend time during the initial class meeting demonstrating proper installation of a tutorial CDROM that we use, downloading and installing video player software, running a Powerpoint presentation on the Internet, and sending and receiving attachments. Should they need additional assistance with any of these operations, students are encouraged to visit the campus lab.

Because I have found that students who miss the orientation session are more likely to drop the course and because the volume of information presented during this meeting is too much for some students to process at one time, I videotape the session and make the video available to them--both in the library and on-line.

On-line Communication

An important and necessary component to successful Web-based instruction is on-going communication. The instructor must be able to communicate with the students throughout the semester, and students must be able to communicate with the instructor and receive prompt assistance when they encounter problems or have questions. Students also need to be able to interact with one another.

Instructor/Student Communication

To maintain regular instructor/student communication, every Friday afternoon I send to the class an announcement which reviews the up coming week's activities, provides any additional information or explanations about assignments, reminds the class of test dates, and addresses any concerns students have expressed to me during the past week.

Student/Instructor Communication

Because the students do not see me on a daily basis I check my e-mail frequently and on weekends so that they are able to get prompt responses when they do have questions or require assistance. In addition, I keep specific office hours so that students can be assured that I am available at certain times should they need to reach me via telephone or e-mail. To maintain continued student/instructor communication and to prevent students from simply 'drifting off' during the semester, I ask them to e-mail me at least every other week to keep me informed of their progress.

Student/Student Communication

To encourage communication among students and to prevent them from feeling isolated in the class, students are required to participate regularly in class discussion. Using the CMS threaded discussion feature, students can make comments or ask questions and can also respond to other class members' comments or questions. Participation in discussion is very helpful as it enables them to help each other with assignments and understanding of course material. Postings made by students in the discussion mode are received by all other students in the class.

Monitoring Student Activity

Using a CMS allows me the capability to track student activity throughout the term. At any time during the semester, I can check to see which modules students have accessed and the dates on which they accessed them in addition to the modules that are being accessed more than once. Being able to do this gives me the capability of observing which students are on task and which ones might need some personal assistance or encouragement as well as which modules are giving students difficulty.

Diverse Instructional Materials

Because all students have different learning styles and respond differently to various learning activities, it is important to offer them instructional materials in a variety of formats. In addition to the basic textual modules or documents such as learning objectives, lecture notes, and answers to chapter questions, I include Powerpoint presentations to accompany each chapter or topic, automatically graded practice exams, and links to interactive Web sites. Most recently I added on-line videos of my regular class lectures. The videos have been well received by students, as they offer both a verbal explanation and visual demonstration of information typically accessed only by text. In addition, they are usually more interesting and easier to understand than text.

If synchronous capabilities are available, interactive question-and-answer or ‘chat’ sessions can take place real time, an especially helpful feature during office hours or help sessions.

Additional learning resources are also available today from textbook vendors. A number of textbooks today are accompanied by CD-ROMs, which include videos, interactive exercises, glossaries, and links to a variety of Web sites. For even more interactive learning exercises and activities, vendors have created their own Web sites for students to access, and many of these Web sites will send results of student exercises or practice tests to the instructor. I include links to these sites in my course modules.

Although students may not access all learning resources, if a wide variety of materials in different formats is available for student access, the chances of reaching each student at some level is increased; therefore, the chances for learning also increase.

Student Testing

A continuous dilemma for instructors of on-line classes is whether to utilize on-line testing or require students to come to campus to take exams. Objective style on-line tests can be tedious to set up; but when they are automatically graded, they provide immediate feedback to the students and also eliminate instructor grading. Most course management systems allow the instructor to create on-line exams beforehand with date and time restrictions.

The consequence of on-line testing though is that the instructor can never be sure if the student enrolled in the class actually took the test. During the times I have utilized on-line testing, I resolved this dilemma by requiring students to come to campus for a comprehensive final exam; and I counted it a substantial percentage of their final grade.

On the other hand, when students are required to come to campus for testing, it often presents a scheduling problem for them. In addition, students often view on-campus tests as being contradictory to the major goal of on-line classes. However, on-campus testing does eliminate the need for a comprehensive exam counting such a large percentage of the final grade.

For my Computer Foundations course, I have attempted a compromise by utilizing both testing formats. For the hands-on computer exams, students come to campus. For the theory segment of the course, they take on-line, automatically graded objective tests; and although they are required to take them on specific dates, they can be taken at any time on those dates. The final exam then covers only the theory content and is administered on campus. Thus far, this strategy seems to satisfy most of the students.

On-line Course Evaluations

In an effort to continually improve my on-line course, at the end of each semester I send students an On-line Course Evaluation form as an attachment and ask them to bring it to class on final exam day. On the evaluation form they are asked to evaluate the course, its contents, availability of the instructor, on-line software features, testing methods, and interaction procedures as well as their understanding of the class organization and grading process.

Students are also asked what features they like best and least about the course and are encouraged to make practical suggestions to improve the course.

Student evaluations help determine the effectiveness of the various components of an on-line course and address areas which may need revision; they also communicate to students that their input is valuable. As a result of the student evaluations, I have made a number of positive revisions to the course.

Other Tips

Student Withdrawals

One of the biggest problems facing on-line instruction is its lack of understanding among faculty and students. Students who enrol in an on-line course often do not understand the requirements necessary for succeeding. Consequently, they drop the course when they realize they need a more structured environment. Thus, providing information to both faculty and students prior to advisement and registration is a necessary and important factor in student success.

Another step I take to minimize the number of student withdrawals is that I invite on-line class members to attend my regular class if they feel they need additional assistance. Both the on-line class and the regular Computer Foundations class follow the same schedule, which makes it easy for them to determine the classes they would like to attend.

Student Scheduling

One other approach that I have taken to meet the needs and schedules of students interested in enrolling in our on-line course is to offer at least two sessions of the class--during the day and during the evening. Because we do require students to attend class at least twice--the orientation session and final exam session--it is important that these sessions be offered at times conducive to their schedules.

Study Guides and Reviews

Because students feel that they are faced with a vast amount of information to read and do not have the benefit of hearing in classroom lectures which information the instructor emphasizes or deems most important, many students have requested exam study guides. Many have also requested review days prior to the final exam. As a result of their requests, I have added written study guides to the on-line course content and an optional final exam review session to the class calendar.

Conclusion

On-line instruction can offer to both students and instructors new challenges and opportunities. If the course is carefully planned and implemented and the instructor is open to student feedback and continuous improvement, on-line instruction can provide an effective educational environment and offer a viable alternative to traditional classroom instruction.

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Electronic Journal of Instructional Science and Technology (E-Jist)
Volume 3 Number 3 Mar 2000
Pages 26 – 53

Improving Practical Instruction in Veterinary Gross Anatomy with Multimedia Based Preparation

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Abstract

This paper describes and discusses work towards the improvement of the teaching and learning of the regional anatomy of the dog in veterinary science classes. The study of this topic in many veterinary schools entails repeated use of preserved dog cadavers. While the use of preserved specimens is a conventional and widely adopted approach in the study of anatomy in many veterinary schools, it is a practice that has several inherent problems. These problems are related to the repeated use and storage of preserved tissue, and the artificial appearance and texture of such specimens. The work reported here sought to address these concerns with an approach to the teaching and learning of this topic with multimedia-based preparation materials and the use of non-preserved specimens for dissection. An evaluation of this effort was conducted with the help of a print-based questionnaire. Students reported that the use of fresh tissues encouraged them to learn anatomical details, and that the multimedia-based preparation materials were helpful in getting a clearer idea of what was to follow in the dissection sessions and in the surgical processes.

Instructional Context

In the initial years of the Bachelor in Veterinary Science course in most veterinary schools, the teaching of anatomy introduces students to the terminology and structures of most of the domestic animals. This knowledge base is enhanced later on in the course during their studies in general and systematic pathology, surgery, medicine, obstetrics and reproduction, and in diagnostic imaging. Instruction in veterinary anatomy has traditionally been provided with lectures and integrated practical classes utilising practical dissection of the dog as a type species for a regional focus. At The University of Melbourne, the regional dissection of the dog is a pivotal component of the Bachelor in Veterinary Science (B. V. Sc.) course since it provides the most coherent study of the structure of the animal body as a whole.

Until recently the regional dissection of the dog involved twenty-two practical sessions directly, and also shared some elements with a further three sessions. This activity totalled sixty-four hours altogether and spanned an entire semester (three months). It required that dog cadavers be preserved and then utilised repeatedly over the three-month period. Students performed the dissections on these preserved dog cadavers with the help of a commercially available dissection guide, supplemented by a small accompanying manual produced in-house by the Veterinary Anatomy Section which emphasised functional and applied aspects as well as specifying the level of detailed knowledge required. Assessment of this component of the course is by practical examination using appropriate specimens in a ‘round robin’ type format at the end of the teaching year.

As indicated above, the timetabling of this practical component of the course had been traditionally confined to a single semester. This was more a reflection of technical and economic necessity (i.e., logistics of storing preserved cadavers, deterioration of these over time, and the expense of providing more than one cadaver per student group), rather than a reflection of the inherent academic value of the use of preserved cadavers in the exploration of dog anatomy. In addition the use of fixed dog cadavers necessitated that a somewhat semi-regional approach to dissection was adopted, for example, forelimb muscles were studied separately from forelimb vessels and nerves. This timetabling had also resulted in completion of the dog dissection prior to any theoretical instruction in some body systems and there was no possibility for formal integration of the dog dissection sessions with much of the systematic instruction.

Instructional Problem

While the dissection of the preserved dog is a conventional and widely utilised approach in the study of regional anatomy in many veterinary schools including that of The University of Melbourne, it has some inherent problems, such as:

- preserved tissues lack the texture, colour, and appearance of fresh tissues, and thus give an inappropriate impression of normal structures;
- handling and cutting of this preserved tissue is quite unlike cutting fresh material, so it does not adequately prepare the students for handling fresh tissue during surgery and autopsy examination;
- the concentrated focus on a single cadaver by each practical group does not necessarily prepare the students for the range of normal variations in anatomy that occur between animals;
- it has been noted that, over time, students become focussed on the processes of dissection rather than the exploration and investigation of structure and anatomical relations;
- undergraduate students are exposed to potentially toxic chemicals, such as formaldehyde used in tissue preservation; and
- adequate preservation of cadavers is inconsistent with a resultant wastage of both material and human resources.

A common approach to addressing such weaknesses in cadaver dissection courses is to use various ‘enhancements’ such as text or graphic-based supplements, audio-visual carousels or real-time demonstrations. These components are additional to the core dissection activity but they require ‘more of the same’ from the student in the form of reading and interpretation, or are relegated to acting as revision material to be used following the dissection session. Real-time demonstrations are much too dependent on teaching staff being uniformly energetic in providing consistently beneficial learning experiences. The initial approach in the Veterinary School at The University of Melbourne comprised a text-based enhancement as a supplement to the commercial dissection guide. This approach was not consistently successful as the concurrent use of two ‘texts’ confused some students while others followed one and ignored the other. The teaching staff believed that it was important that a regional treatment was retained in the course as it relates readily to many of the functional and applied aspects of the discipline, such as clinical diagnostics and surgery. Obviously then, a more fundamental change was necessary to effectively address the shortcomings of the regional dissection course.

Solution Options

Our attention was drawn to the reconstruction of the human anatomy course in the Medical Faculty at The University of Melbourne in which pre-dissection preparation sessions preceded the dissection classes. A strength of this model was that this approach aimed at informing the students of the appropriate anatomy and providing them with a focus on the functionality and applicability of anatomy to the study of medicine before dissection. Students then approached the dissection session with a more informed and focused attitude, which had the potential to encourage learning. This comprised a sound model for teaching and learning in this area and we considered it to be just as applicable to Veterinary Anatomy. As such it formed the basis of this veterinary school’s next attempt to improve the educational value of the dog dissection course.

However, the Medical School’s preparation sessions were resource intensive in terms of both material resources and staffing, which could not be matched by the Veterinary School. It was considered that the most likely way to be able to remodel the dog dissection course was to utilise some computer-based elements in the preparation sessions which could be integrated with the limited amount of material resources available and also allay some of the staffing problems. Unfortunately lack of time and funds to engage in the creation of these computer-based resources basically kept this idea at the conceptual stages. This was the situation until The University of Melbourne embarked on a concerted effort to promote the integration of multimedia educational technologies in its teaching programs, and provided funds to enable projects such as this one to begin real development.

The adoption of multimedia-based technology in facilitating the teaching and learning processes in veterinary anatomy was considered very appropriate. This was because of the ability of the medium to demonstrate motion, display high quality graphics, incorporate sound, and most importantly, enable user interactivity, which could encourage an active learning approach to the material. In addition, it would take advantage of an increasingly computer-literate student population.

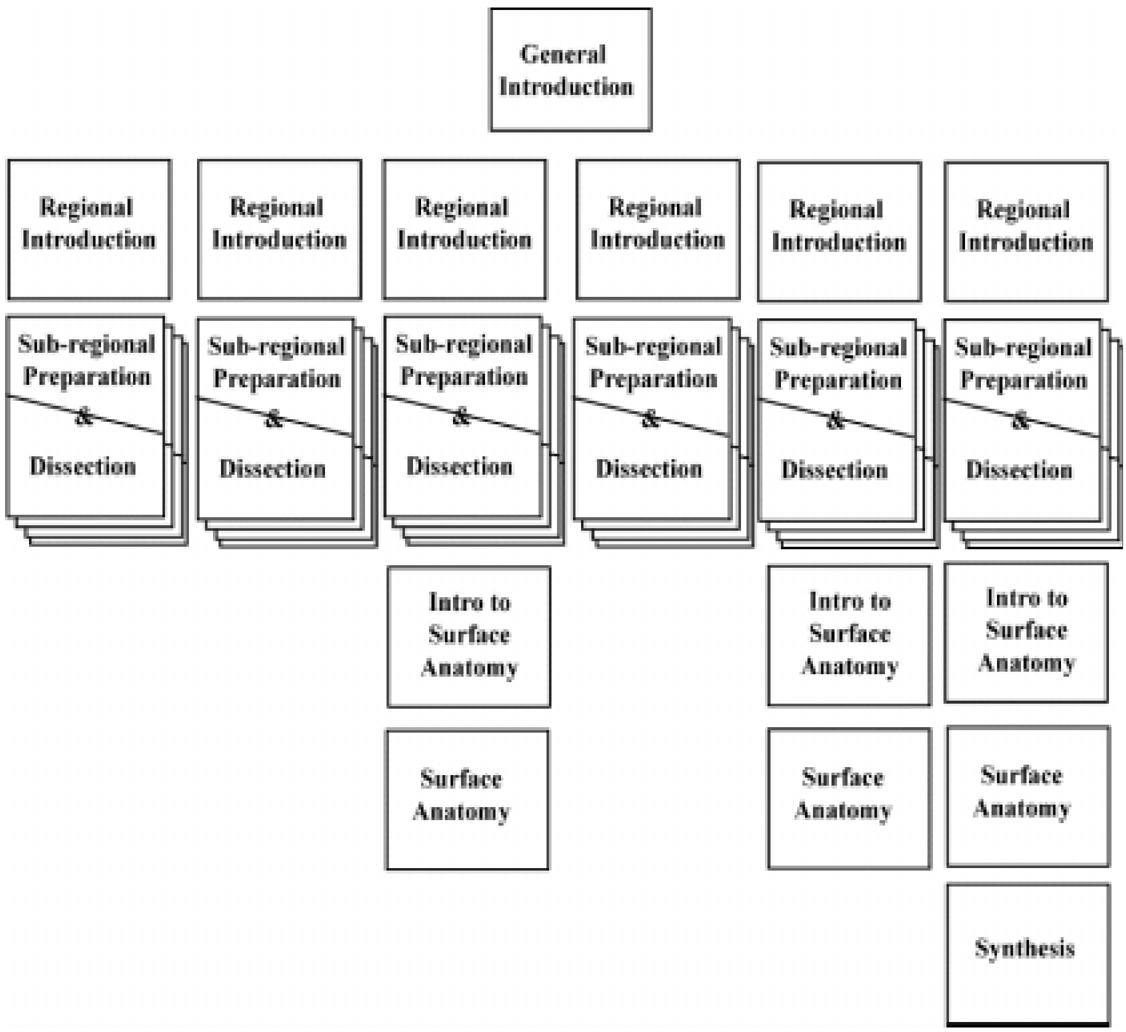
Learning and Teaching Architecture

In 1998 major changes were made to the structure of the veterinary curriculum at The University of Melbourne which necessitated that the model of separate pre-dissection preparation sessions and dissection classes be introduced immediately. It was also decided to ‘trial’ the use of fresh dissection specimens instead of preserved cadavers. Use of fresh specimens for dissection would enable students to experience the real appearance, nature, and handling qualities of normal tissues *in situ*. It would also help them learn correct instrument handling techniques on natural tissues in preparation for later instruction in the course such as in pathology and surgery. This practice necessitated the development of revised dissection procedures, as the commercial text used was no longer appropriate. Additional written material covering introductory, overview and surface anatomy sessions was also required.

The following instructional format was developed (see Figure 1). This comprised the following introductory sessions, preparation sessions, dissection classes and associated surface anatomy sessions.

- A general introductory session of 30 minutes (mini lecture),
- 6 regional introductory sessions of 40 minutes each (mini lectures),
- 24 sub-regional preparatory sessions of 1 hour each (4 sessions per body region – computer-based),
- 24 sub-regional dissection sessions of 1 hour each (laboratory dissection),
- 3 introduction to surface anatomy sessions of 30 minutes each (mini lectures),
- 3 regional surface anatomy sessions of 30 minutes each (live animal),
- A synthesis and discussion session of 1 hour.

Figure 1: The Revised Instructional Format



Whereas previously the time allocated to dissection was spent entirely in the dissection laboratory, it would now be more varied and 'modular' to some extent, which would also allow some flexibility in timetabling and delivery. This approach meant that body regions being studied in the dog dissection course could be integrated more readily with some of the appropriate systems-based lecture topics, which would help to reinforce important anatomical concepts as well as information.

General Introductory Session

This is a half-hour lecture that describes the nature, content and organization of the various classes. It introduces students to the concept of 'regional anatomy' and how it relates to body systems. Body regions that will be studied in the course are specified. General instructions on laboratory procedures (e.g., instrument handling, dissection technique safety and cleanliness) and use of the computer modules are also outlined.

Regional Introductory Sessions

A half-hour lecture describes the body region and its boundaries including the sub-regions that will be encountered. With the help of simple graphics, the various body systems and their components are identified. This session also introduces students to the functional and applied themes that will be investigated in each of the sub-regions.

Sub-regional Preparation Session

This is a half-to one-hour computer-based preparation session for each sub-region that is studied in the course. In these sessions students work through a slide show/computer module which illustrates structures of the sub-region in a systematic way. Photographs are used to illustrate the relevant structures and features of sub-regional body systems. Some of the same photographs are used repeatedly with different system components identified to demonstrate different relationships. Orientation graphics and illustrations are used to assist the students in their understanding of these relationships. Components of sub-regions that are revisited are incorporated as self-test quiz slides.

Systematic instruction is accompanied by a list of references that students can consult while working through each module. Each sub-regional preparation module includes a functional theme illustrating the role of a particular system within the sub-region, encouraging students to think in terms of 'structure/function' relationships. Sub-regional preparation sessions conclude with a graphic sequence depicting the clinical procedure that is to be simulated at the commencement of the subsequent dissection class. A short digital video of this clinical procedure is also provided to assist the students in this particular activity.

Sub-regional Dissection Session

This is a typical dissection class of 1 to 2 hours duration which utilises a specifically written dissection procedure assisting the students to identify those structures/features presented in the preceding corresponding preparation module. The class commences with students performing a simulation of a clinical procedure relevant to the sub-region that is under study. During the dissection session students are led to investigate the structural mechanism relevant to the functional theme.

Introduction to Surface Anatomy Session

This is a half-hour lecture that describes and illustrates those surface landmarks or features pertaining to the previously studied region(s), which will be examined in the subsequent live-animal class. This session also includes other domestic species as well as the dog (e.g., cow and horse). These sessions cover between 1 and 3 body regions. This arrangement was essentially due to the surface anatomy classes being held off-site requiring transportation of students and accommodating a tight timetable.

Surface Anatomy Class

These are live-animal exercises using dogs, horses and cattle. Students perform these exercises in small groups rotating each half-hour through the different species. In these exercises students work through a list of surface features and attempt to locate and identify these with some input from staff who are there to assist and emphasise any functional or applied aspect of relevance to the regions studied.

Synthesis Session

This is a half to one-hour graphics intensive group lecture session which is focussed on presenting the structure of the animal body as a whole and the integration of the various body systems as well their functions. The applicability of the regional approach is re-emphasised as an introduction to clinical studies that follow the completion of this dissection course.

Printed Manual

A printed manual is available for student’s use during the preparation and the dissection sessions as well as the surface anatomy classes. This manual includes notes relevant to all the introductory and synthesis sessions. Anatomical structures and features are included with reference to descriptions and illustrations to supplement the preparatory modules. Brief outlines are included of functional themes with illustrations similar to those presented in the related preparatory module, along with descriptions of the simulated clinical procedures with accompanying photographs (as available in the computer-based modules). The manual also carries the dissection procedures for each sub-region.

Rationale of this Architecture

For the general, regional and surface anatomy introductory sessions, as well as the synthesis session, the mini-lecture format was considered the most suitable approach for presenting this material to students. The photographs and illustrations that are used in these mini lectures are reproduced in the printed manual to enable students to focus on the emphasis placed on these images during these sessions.

For the sub-regional preparation sessions, however, computer-based instruction was adopted as a presentation medium for the following reasons:

- the possibility of achieving high graphic clarity;
- economic reproduction and distribution of high quality graphics;

- potential for incorporation of motion and sound (important in presenting functional and some applied aspects of anatomy and giving emphasis to selected material);
- flexibility in delivery – accessible outside scheduled classes/potential for self pacing; and
- the production of readily and economically updateable material.

The utilisation of the classic 'hands-on' approach in the dissection sessions, using non-formalised specimens was essential in enabling students to not only appreciate normal animal structure but be able to investigate the 'structural/functional' relationships in the sub-regions. The use of non-preserved specimens is designed to enable students to become familiar with the nature of 'natural animal tissue' including its handling characteristics. In such a learning environment students are also able to gain the relevant experience in the use of instruments and their actions on 'natural' tissues. The use of simulated clinical procedures emphasised the relevance and applicability of anatomy to their future clinical studies. These components hopefully act as a motivational strategy in encouraging students to want to pursue study in a traditionally rather 'dry' and fact-dominant subject.

For the surface anatomy sessions, it is imperative that live-animal classes are used to introduce students to the appearance and nature of the animal body in its normal state, and also demonstrate the real world applicability of their anatomical knowledge.

Development

Once the instructional format was defined, the development of the instructional materials was an apparent process, although, not without its own problems. The adoption of the sequence of separate but integrated preparation and dissection sessions is an idea that has been tried and tested before in the teaching of human anatomy and physiology. Therefore, although this was a novel approach in the teaching of veterinary anatomy in this school, it was not entirely a new concept. First, the supporting modules (i.e., introductory, surface anatomy and synthesis sessions) had to be formulated. Next the regions and sub-regions were to be defined including the identification of functional and applied themes for each sub-region. The dissection of each sub-region was performed, recorded and photographed. The dissection procedure was refined, and the structures, features, organs and systems of relevance were identified and listed. Introductory outlines and the functional theme outlines could be written now and appropriate graphics selected and produced. The writing of the clinical procedure simulation followed with the selection and/or production of appropriate graphics and video. Finally the construction of the computer-based instructional modules followed -- incorporating relevant graphics and appropriate quizzes.

The Development Team

The instructional materials development team comprised the following personnel: two academics (who were anatomy teachers and veterinarians with clinical experience); two ancillary academics (veterinary systematic content experts); one dissector/resource producer (veterinary graduate with teaching experience); one technical assistant (with general laboratory and preparatory skills); one graphic artist/designer; and one digital imaging consultant.

Implementation

The sessions which comprise the various components of any given body region are loosely integrated into the systematic anatomy course of lectures and practical classes. Particular sub-regions are studied along with relevant systemic topics (e.g., thoracic region with cardiovascular system, forelimb region with musculo-skeletal system). The ‘general’ introductory session is followed immediately by a ‘regional’ introductory session, which is followed by a sub-regional preparatory session and then the relevant dissection session. Three regions are completed before the introduction to surface anatomy session, which covered all of these regions. The whole class of 70 students in this cohort receive the group lecture-based sessions at the same time. Students work in pairs through the preparatory modules during scheduled classes with input from staff when required. Groups of between two and six students carry out the dissections with the help of written procedures with assistance from demonstrators if and when requested. These group sizes vary depending on particular sub-regions. Some sub-regions require whole bodies while others use only portions and in this case multiple specimens can be accommodated on each dissection table. Students work in groups of six during the surface anatomy classes. This number was felt appropriate for the students and the animals being examined.

Evaluation

Evaluation of the impact of the multimedia-based preparation materials was focussed on its use and utility to undergraduate students in the practical sections of the study of regional anatomy of the dog course. By *use* and *utility*, we meant the extent to which the multimedia-based preparation materials helped this group of students perform particular dissection procedures; recognise features of the dog’s anatomy and how these features (bones and muscles) worked. It also inquired into why students were able or unable to experience these outcomes.

Instrumentation

A questionnaire with structured and open-ended response items was used to gather this data towards the end of the semester. A two-phased procedure was adopted in the design and development of this questionnaire. In the first phase, subject matter experts (there were two of them in this case) were presented with a semi-structured *proforma*, which they were asked to use to identify the focus of the evaluation. The questions posed in this *proforma* focussed on the following areas: learning goals/outcomes, design architecture, delivery attributes, and the learning process (See Appendix A). The subject matter experts were asked to respond to several questions on each one of these areas. For example, on ‘learning goals/outcomes’ they were asked to identify ‘what are the learning goals or outcomes for your students? What is unique about these learning goals? What are your instructional goals? And what is unique about these instructional goals?’ For each one of these questions they were also required to reflect on what evaluation strategy/instrumentation they could, or might like to use to gather the necessary data and also to find out whether, and to what extent these goals had been achieved.

The purpose of this activity was to focus the subject matter experts’ thinking on issues of critical importance from the learning and teaching perspective, and there were several advantages in adopting this design and development strategy for the evaluation phase of this project. Firstly, it offered a structure for the subject matter experts to focus their thinking.

Their thoughts captured in this manner provided material for negotiation amongst the team on areas that we needed to concentrate (issues that we needed to evaluate) on and those that were either not relevant for this project or not so important. This activity in itself served to validate not only the focus and content of the evaluation but also the instrumentation for gathering such data. It was important that we collect data on the most essential features and with the most appropriate instrumentation and this procedure enabled us to facilitate this process.

This developmental process led to the identification by us of the precise areas and issues on which we agreed to focus our evaluation. It is interesting to note that this final set of areas and issues were not all of those that we initially thought we needed to evaluate. This is to suggest that without a systematic process for identifying the areas of real interest, chances are that a great deal of time and effort could be (and often has been) wasted in collecting data of no real interest to anyone. This set of issues became the focus of our evaluation. Since we were interested in students' individual perceptions of the computer-based learning exercises, we developed question items which required students to provide both a quantitative response as well an explanation of their response (See Appendix B: Evaluation Questionnaire). An external evaluator administered this questionnaire in one of the special sessions of the class towards the end of the semester. Names of respondents were not required on the returned questionnaires.

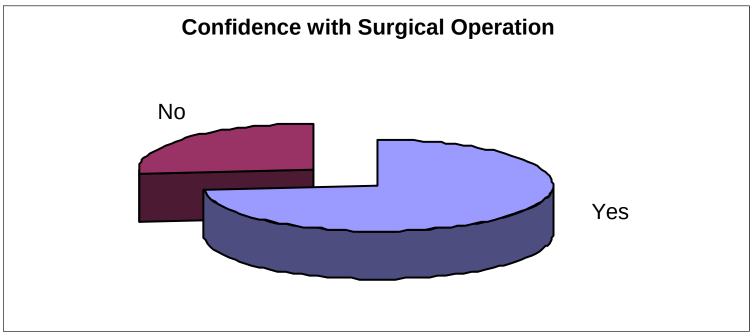
Data Analysis and Discussion

The quantitative data derived from the questionnaire was summarised using Microsoft Excel^{TM}. The qualitative comments of the respondents have been used in this paper to explain their quantitative judgements.

Confidence with Surgical Processes

Foremost, as part of our evaluation, we were interested in knowing if the computer-based preparation had any impact on the confidence levels of students with the surgical approach, and the dissection session that followed, and if it helped them readily identify the structures and features in the sub-region under study.

Figure 2: Confidence With Surgical Operation



On the whole students felt that being able to watch a demonstration gave them a 'visual idea' of what was to follow. Seventy five percent of the respondents felt that the multimedia-based preparation sessions did help their confidence levels as it enabled them get 'some idea of what they were about to do, and see clear pictures of what it should look like', and also 'become aware of the anatomical landmarks'. Twenty-five percent of the group didn't find the multimedia preparation materials of any use in improving their confidence levels.

The disappointments that students had with the utility of the multimedia preparation in the dissection sessions had to do mostly with the technical quality of the video and some of the computer generated images.

"The video (the times that I saw it) did not have sound and focussed only on the surgery site so finding it during the dissection relative to other structures wasn't possible. The video was often of poor quality. The surgical film is very small with very little resolution on the MAC Screens."

It also seems that many students found the treatment of the content for dissection somewhat insufficient.

"Not detailed enough especially with respect to blood vessels and nerves. No transverse or cross-sections were provided with labels. Because the surgery on the computer was only for the initial incision and did not include deeper structures. It had no bearing on how to do the dissection. The digital video was not very clear either."

Given these observations, it is not surprising that some of the students did not experience substantially improved levels of confidence with the surgical procedures that followed the multimedia preparations sessions.

Some students found the multimedia preparation session 'helpful in the surgical approach' and others felt that 'knowing where the major muscles, arteries, veins were before starting, enabled them to proceed with confidence.' A majority (seventy-one percent) of the student group found that the multimedia-based preparation materials actually helped them proceed with the dissection more confidently. It is important to recognise that twenty-four percent of the group did not think this was so for them.

Figure 3: Confidence With Dissection

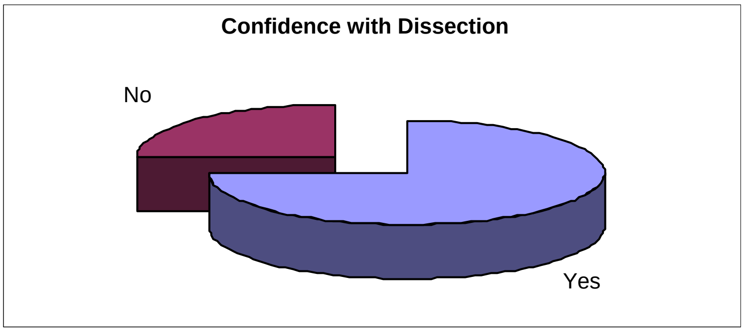


Figure 3. Confidence with dissection.

Several problems were identified with the multimedia-based preparation material that can help explain this outcome.

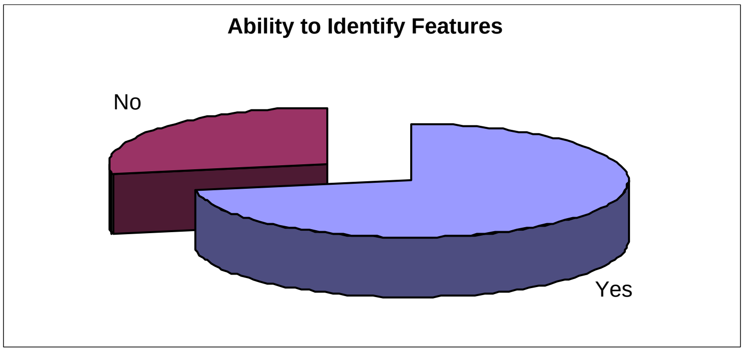
"The multimedia preparation was especially helpful for the initial surgical approach but ultimately we fell back on the written/typed sheets. Only a fraction of material was covered by multimedia. The slides were no good for that. The digital video was not very clear either. The session on the computer was often not directly related to the dissection (i.e., it was in the wrong sequence). It did not help with the actual dissection.'

'Not detailed enough especially with respect to blood vessels and nerves. No transverse or cross-sections were provided with labels. These are needed. The RAD is not always clear if the picture we are shown is too close up—meaning that it is hard for us to orientate ourselves in some of the pictures given.'

'In some of the slides presented, it was hard to get my bearings, i.e., what end was up? Hard to tell on the small screen. Easy to identify, but hard to find exact areas of insertion/origin.'

There was one thing that the multimedia-based preparation materials were useful for, and that was in enabling students readily identify the structures and features in the sub-region under study. Many (seventy percent of the group) claimed that 'although nothing beats getting in there and correctly orienting yourself…the multimedia preparation materials was very useful for orientating in a new area'.

Figure 4: Ability to Identify Features



Still there were many problems with orientation for some of the students (at least twenty-seven percent). Most of these problems had to do with the manner in which the material was presented (zoomed in or out, step-by-step etc.) and the quality of some of the pictures.

'Sometimes the view was too close-up so didn't even know what you are looking at. Needed to zoom out, then zoom in. Close up shots need to be accompanied, at all times, with a wider view first.'

'The diagrams/slides were too complicated to follow after muscles have been removed from their origins. Should show step by step removal of muscle one by one.'

'Pictures in the RAD multimedia did not identify clearly or label clearly some of the more obscure structures. Hard to tell on the small screen. Some of the pictures on the computer were really hard to make out. Often the photographs in the presentation were difficult to orient and so made finding the structures while dissecting difficult. The pictures were often unidentifiable (red and bloody mess)----need to indicate cranial/caudal, dorsal/ventral orientation, say which muscles have been removed. Sometimes photographs were unclear (but overall very good).'

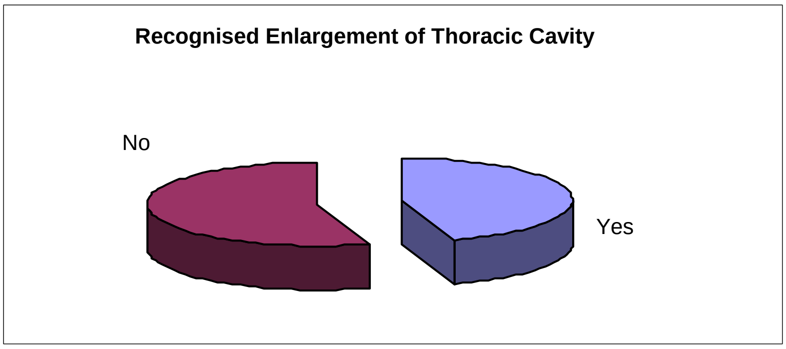
'Orientation was sometimes not clear on the slides. In some of the slides presented, it was hard to get my bearings, i.e., what end was up?'

Recognising Body Functions

Next, we wanted to find out if the multimedia preparation materials enabled students to recognise particular body functions. The two body functions we focussed on were: how enlargement of the thoracic cavity results in expansion of the lungs; and how irritation of the phrenic nerve might result in synchronous diaphragmatic flutter.

So, did the multimedia preparation materials enable this group of students to recognise how 'enlargement of the thoracic cavity results in expansion of the lungs'? Well, not quite. This student group seemed fairly evenly divided on this one. In fact, a little more of them thought that multimedia preparation materials did not enable them to recognise how enlargement of the thoracic cavity resulted in expansion of the lungs (44 percent no, to 37 yes).

Figure 5: Recognised Enlargement of Thoracic Cavity



From those who had found the multimedia preparation materials helpful in recognising how the enlargement of the thoracic cavity resulted in expansion of the lungs (thirty-seven percent of them in this case), we wanted to know what specific feature(s) of the preparation session had enabled them to achieve that? So we asked them to identify those specific features and this is what they identified and said.

- 'Clear labelling.'
- 'The balloon in syringe demonstration.'
- 'The talk before the actual dissection and the computer slides.'
- 'Showing the way that the units move, external and internal intercostal muscles.'
- 'The details on the relevant muscles and describing their alignment in relation to their operation.'
- "Just seeing how all of the thoracic components come together relative to one another and get an appreciation of the sizes and location of things tangibly helped."

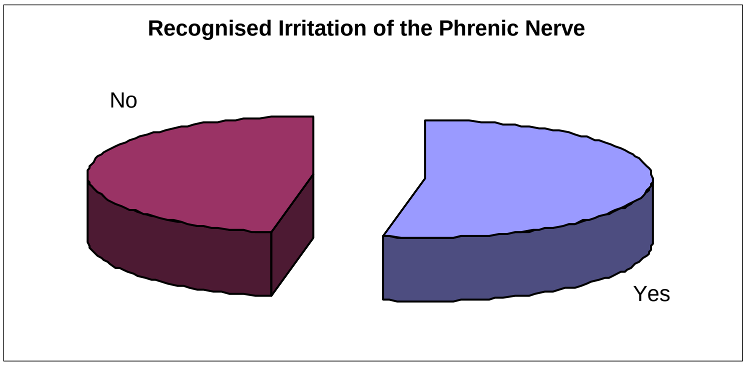
- "I knew how it happened already, but this showed how the direction of muscle fibres for expiration and inspiration, and their contraction contributed to movement of thoracic wall."

From those who had *not* found the multimedia preparation materials helpful in recognising how the enlargement of the thoracic cavity resulted in expansion of the lungs (forty-four percent of them in this case), we wanted to know, what they thought was the problem? This is what they pointed at:

- 'It was hard to determine actual extent of thoracic cavity and how structures were used to expand it. This was easier to understand/observe in the dissection class.'
- 'There was only the structures involved, the expansion wasn't clear.'
- '3-D maybe, to look from a different angle.'
- 'The movement of muscles is not demonstrated.'
- 'No diagrammatic drawing of how this occurs, just photos of gross anatomy.'
- 'Not really explained at all.'

Now onto the second body function…did the multimedia preparation materials enable this group of students recognise how 'irritation of the phrenic nerve might result in synchronous diaphragmatic flutter'? Once again, a similar experience was recorded. This student group seemed fairly evenly divided on this one too. A little more of them thought the multimedia preparation materials enabled them to recognise how irritation of the phrenic nerve might result in synchronous diaphragmatic flutter (43 percent yes, to 38 percent no).

Figure 6: Recognised Irritation of the Phrenic Nerve



From those who found the multimedia preparation materials helpful in recognising how 'irritation of the phrenic nerve might result in synchronous diaphragmatic flutter' (forty-three percent in this case), we wanted to know what specific feature(s) of the materials had enabled them to achieve that? This is what they identified and said:

- 'Clear nerve passing over the heart and contracting the diaphragm. Great slide!!!'
- 'When following the nerve passing over the heart, it could be seen joining the diaphragm. Shown where it crosses over heart clearly and labelled.'
- 'Because the surrounding tissue was cleared from the heart and phrenic nerve. It was very easy to see the relationship between the nerve and the diaphragm.'
- 'Good clear pictures with accompanying description.'
- 'Good description of the processes that occur to cause thumps.'

And from those who had *not* found the multimedia preparation materials helpful in recognising how ‘irritation of the phrenic nerve might result in synchronous diaphragmatic flutter’ (thirty-eight percent of them in this case), we wanted to know, what they thought was the problem? This is what they pointed at:

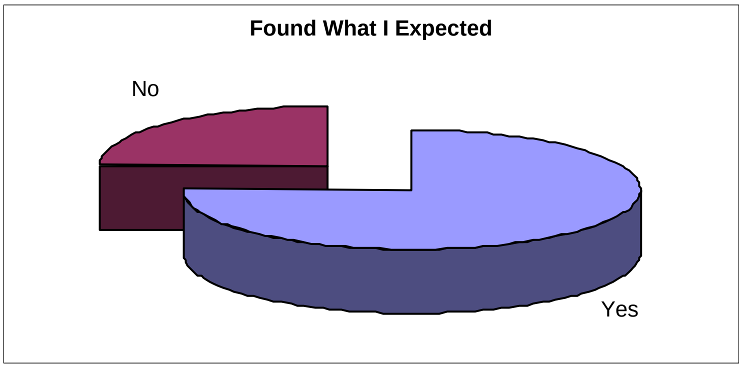
- ‘Unclear.’
- ‘Seemed to show just where the nerve ran and not what it did.’
- ‘Not much written details supplied on the computer programs. It is more useful for the location and relative location of structures grossly.’

From the Dissection Session

Next, we wanted to know if, from the dissection session, students were able to see, do and achieve certain types of understanding that we expected to occur. These were: being able to find what they expected to find; being able to develop a mental picture of the course of the *vagus* nerve through the thorax; being able to palpate the third intercostal space; and finally, being able to insert a needle into the right ventricle of the heart.

First, during the dissection session, were the students able to find what they expected? The majority (seventy-three percent) of the group found what they expected to find. A smaller number (twenty-four percent) of the group were unable to do this.

Figure 7: Found What I Expected



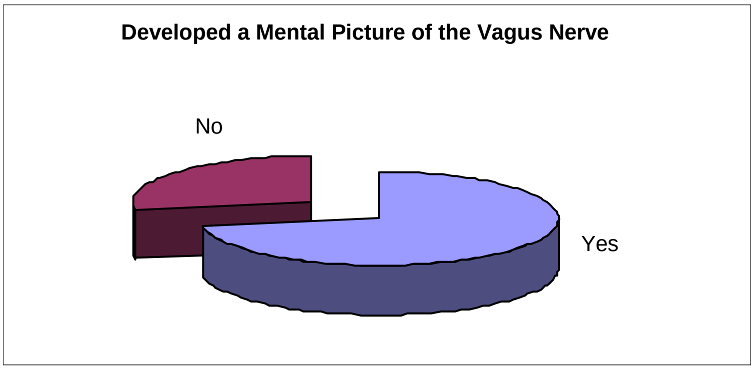
Why some of the students were unable to find what they expected was a concern for us. So we asked students if that was the case for them, then what did they think was the problem? The problems they identified related to the manner, in which the task was attempted, some level of haste and carelessness on their own part, and sometimes the quality of specimen as well was a problem. Here is a selection of the problems identified by students, in no special order of importance or frequency.

- ‘Often I was lost when I got to the detail because the program didn’t show it well.’
- ‘Often we manage to sever, remove or damage material before we came to looking at it.’
- ‘Sometimes the dogs were in relatively poor condition and we would mess up the dissection.’

- ‘Making nervous incisions into muscles.’
- ‘Sometimes it was bit difficult especially when starting and a few of the practicals there was too little time.’
- ‘It is sometimes hard to identify small vessels and nerves. Many are in close proximity and look the same. It can be difficult to differentiate these.’
- ‘Stubborn group members and too many people per dog. Practical too stressful. Dissection procedure not detailed/specific enough. Could not pre-read for practical since notes were not given out until in practical room.’
- ‘The problem of not seeing certain structures were, at times, due to the illogical way the dissection procedures was written (shifting from one region to another without being notified in the notes).’
- ‘Some of the structures can be found theoretically but practically it is very hard to find.’

As teachers of this subject matter, we have often had difficulty with getting students to develop a mental picture of the course of various nerves and muscles in a dog’s anatomy. So we asked students if from the dissection session, they were able to achieve such a mental picture of the course of the *vagus* nerve passing through the thorax. The bulk of the student group (sixty-eight percent) had no problems developing such a mental image.

Figure 8: Developed Metal Picture of Passage of the Vagus Nerve



We were interested in knowing if there were specific features of the dissection session that enabled them to develop this mental picture. We asked them that and most of their responses suggested learning by doing, or being explained the path of the nerve either via the multimedia-based preparation session or by a demonstrator.

- ‘Opening of thoraxis cavity helped me.’
- ‘Actually seeing the nerve made it stick in my mind.’
- ‘Dissecting and following it. Do it and see it rather than imagine it.’
- ‘Basically going through it with demonstrator.’
- ‘You could actually follow the nerve and see where it went.’
- ‘Preparation session.’

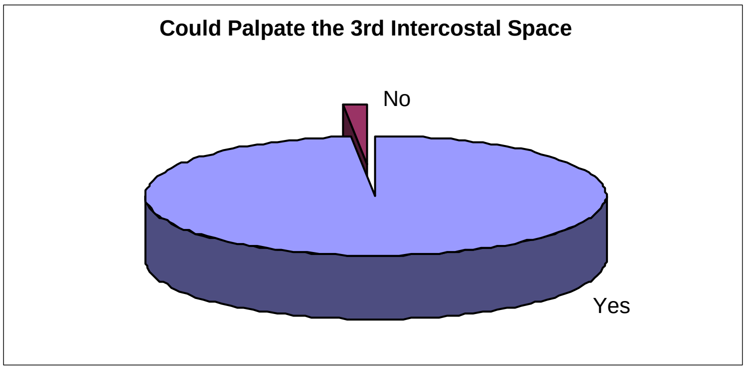
- ‘The *vagus* nerve within our dog was very clear especially after the multimedia session. This was true for most structures (esp. vessels and nerves).’
- ‘Being able to move around objects in the thoracic cavity and seeing how the nerve sat relative to these.’
- ‘RAD presentation was very helpful. It would have been harder if we relied just on the dissection.’

Twenty-five percent of this student group was unable to achieve this mental image. So what did they think was the problem? Some of their problems were concerned with the multimedia-based preparation session, and others with the nature and amount of information that was provided.

- ‘Holes in the pathway and found them difficult to visualise.’
- ‘I needed to look at the specimen in order to orientate myself and picture what is where.’
- ‘More explanation in the notes is needed regarding exactly where we are looking and where it runs.’
- ‘Would be good if had ‘maps’ of vessels on the multimedia program because nerves and vessels etc. are hard to picture and track their course.’
- ‘RAD failed to give overall picture centred on specific bits. If you could have a general revision slide showing how everything fits together.’
- ‘It wasn’t clear exactly how long the nerve ran from. It would have been better to place indicators to where it ran even if you couldn’t see the parts on the multimedia session.’

As shown in Figure 9, almost all of the students in this cohort (ninety-four percent) were able to ‘palpate the third intercostal space’.

Figure 9: Palpate the 3rd Intercostal Space



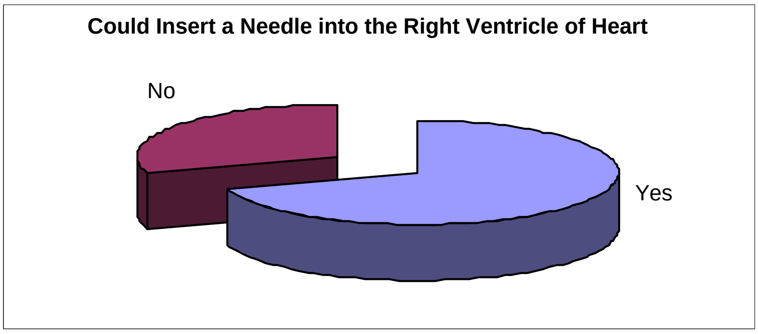
What specific feature(s) of the dissection session enabled them to be able to do this was of interest to us, so we inquired into that. Many of the comments pointed to the usefulness of the multimedia-based preparation session.

- ‘This was shown on the multimedia (video) and was easy to find.’

- 'By feeling along the rib cage and the visual picture that was given in the multimedia sessions.'
- 'But only after reading (was not in procedure) text as to its position, cardial to scapula.'
- 'Feel the ribs and count from backward i.e. Cardial to cranial to find the third space.'
- 'From the RAD I got an idea where the space was, although I wasn't certain that it was correct until I took the leg off and saw it was the correct ribs.'
- 'Clear image from multimedia presentation of where to locate 3rd intercostal space.'
- 'The video gave a clear dissection procedure and exactly where the third intercostal space was.'
- 'The dissection note and knowledge gained from lectures.'

Interestingly though, not as many of the students could "insert a needle into the right ventricle of the heart'. Only sixty-seven percent of the student group was able to do this task.

Figure 10: Could Insert Needle into Right Ventricle



These students identified a number of features that enabled them to achieve this task. Some of the most commonly mentioned ones are cited in the following.

- 'It was really the lectures which helped me do this.'
- 'It took a few goes, but with help I was able to withdraw some blood.'
- 'Instructions on dissection procedure sheet.'
- 'Used the intercostal space as landmarks.'
- 'Being able to appreciate location of Right Ventricle in relation to the rest of the body."
- 'We were able to identify specific portions of the heart from knowledge on landmarks on the external (pericardial) surface.'
- 'Videos, 3rd and 4th intercostal space. Demonstrator help.'

Why were twenty-nine percent of the students unable to do that? Here is selection of some of the commonly cited reasons, many of which had to do with the specimen itself.

- 'The dog was too frozen.'

- ‘Fat dog, heart shifted position.’
- ‘Our dog was too big for the needle.’
- ‘The heart had tipped backwards due to damage of the diaphragm.’
- ‘The directions in the presentation were clear, however, the heart of the dog we were dissecting had moved in relation to its normal position, so we were unable to locate it where it should have been.’
- ‘The heart had moved back further into the thoracic-cavity. It may have hit the heart but no blood could be drawn out. It may have coagulated or possibly hit the wrong part of the heart.’

Use of Fresh Tissues and Specimens

A major impetus of this project was the inherent problems we have faced in the practical dissection of the dog as a type species in the study of its regional anatomy. This component of the course (comprising a total of 64 hours of study spanning a period of 3 months) requires that dog cadavers be preserved and then utilised repetitively during this time. While this is a traditional and widely utilised approach, it has inherent problems.

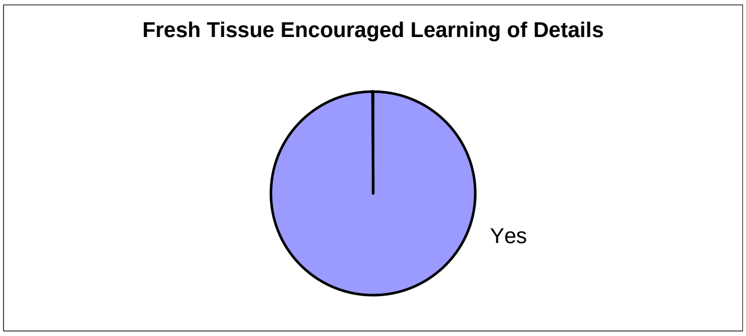
The preserved tissues lack the texture, colour, and appearance of fresh tissues, and thus give an inappropriate impression of normal structures. The handling and cutting of this preserved tissue is quite unlike cutting fresh material, so it does not adequately prepare the students for handling fresh tissue during surgery and autopsy examination. And the concentrated focus on a single cadaver by each practical group does not necessarily prepare the students for the range of normal variations in anatomy that occur between animals. These are only some of the problems with using preserved tissues and specimens in teaching the subject.

The use of fresh tissue and specimens for these dissection classes would allow students to experience the appearance, nature, and handling qualities of normal tissues *in situ*, as well as to begin to learn correct instrument handling techniques on natural tissues in preparation for later instruction in the course, in particular Pathology and Surgery.

As part of our evaluation we asked students a couple of questions about the use of fresh tissues and specimens in this project. These were concerned with whether the use of fresh tissue and specimens encouraged them to ‘want to learn anatomical details’; if it encouraged them to ‘try to remember anatomical details’; and finally if ‘being able to manipulate fresh specimens enabled them to clearly see how muscles act on bones to move them’?

So, did the use of fresh tissues and specimens ‘encourage students to want to learn anatomical details’. There was resounding yes to this question and no doubt about it at all.

Figure 11: Fresh Tissue Encouraged Learning of Details

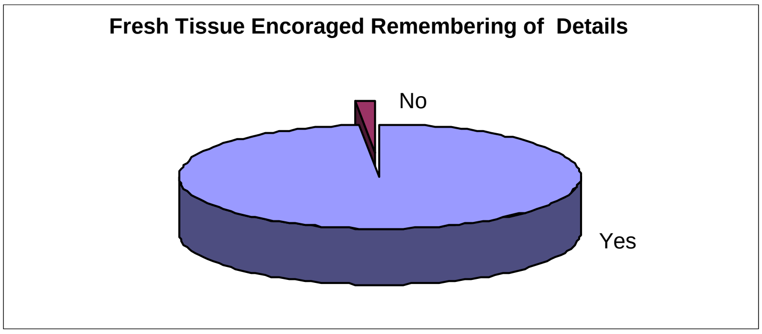


The reasons for this were quite obvious and unanimous.

- ‘The use of fresh specimens is much more pleasant and realistic.’
- ‘It was certainly much more ‘inviting’ to be working on fresh dogs. We also saw a lot which is not visible on dog which has been preserved/treated with Formaldehyde.’

Next, did the use of fresh tissues and specimens encourage them ‘to try to remember anatomical details’? Again there was a resounding yes to this question.

Figure 12: Fresh Tissue Encouraged Remembering of Details

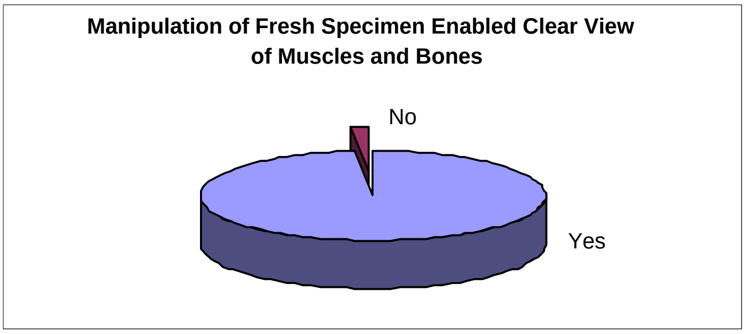


What were the reasons for this? Quite simple.

- ‘Fresh specimens are really good. Details (e.g. Muscle definition) easier to see, not as smelly.’
- ‘I liked fresh tissues very much, also good getting different dog each time. Starting from fresh helped in revision.’

Finally, we asked students if being able to manipulate fresh specimens enabled them to clearly ‘see how muscles act on bones to move them’? Once again their answers were a resounding yes.

Figure 13: Manipulation of Fresh Specimen enabled clear view of Muscles and Bones



We asked students, if this were the case then, could they specify the specific feature(s) of the dissection session that enabled them to see that? Many of their comments had to do with the use of fresh tissue and specimen, a selection of which are produced below:

- 'I could see tendon attachments working.'
- 'Palpation of specific sites. When pulling tendons and muscles it was possible to see how the bones responded/acted and how joints moved etc.'
- 'Use of fresh specimen each week. Also revision dogs can look at different groups of muscles working together and hence gain a better understanding of how they all fit.'
- 'Use of fresh specimens i.e. before the tendons had become hard and crusty was useful.'
- 'Able to see the real colour of the tissues without the formalin smell. The fresh muscle still had the rigid strength as if it were a dissection in surgery.'

Conclusion

Much of what is taught and learned in the early stages of veterinary anatomy is of a factual and procedural nature. All students are expected to know this declarative information (i.e., the structural/functional relationships in sub-regional dog anatomy, dissection instrument handling, dissection technique safety and cleanliness). This information does not change over several years with a change in the instructors or even veterinary schools. To have instructors of this subject matter produce their own materials is not only time and resource intensive, but could be unethical as the chances of variation in the content increases with each version, and depending on the choices made by individual instructors, possibly advantaging or disadvantaging different student cohorts. It makes good sense then to prepare and produce these materials in a manner such that the same material forms the basis of the teaching of this subject by different instructors over a number of offers (no doubt with their own individual idiosyncrasies). This was one of the principal motivations of the work that is reported on in this paper.

The advantages of developing a set of instructional materials that is considered by a team of professionals as consistent and valid in the profession and in the subject matter domain has many advantages. Firstly, in being delivered in an electronic form, these materials can be more readily and economically updated. Moreover, these instructional materials are a product of a team effort which comprises not only more than one subject matter or content expert, but several other professionals who bring to this working environment skills and expertise in message design, and the communication of that message to novices. By its very nature, such a collaborative working environment has the built-in mechanisms to ensure a high quality process, as well as product. The instructional materials developed in this environment will necessarily reflect a collective and negotiated view by professional veterinarians and veterinary science teachers of what is necessary and acceptable during study at that level in the domain. This is important not only for certification in the profession but ensuring reliability of service and practice in it.

The work reported in this paper is about improving the teaching and learning of the ‘regional anatomy’ of the dog in veterinary science classes at The University of Melbourne. In the past the study of this subject entailed repeated use of preserved dog cadavers. While the dissection of the preserved specimens is a conventional and widely utilised approach in the study of the regional anatomy of the dog in many veterinary schools, this practice has several problems which are related to the repeated use and storage of preserved tissue. Attempts at helping this situation with the use of text- and graphic-based enhancements have not been too successful.

Clearly a fundamental change in the approach to the teaching and learning of this subject was necessary to address its shortcomings. This change needed to focus on the structure/function relationships in sub-regional anatomy in the preparation sessions of the course. To ensure that the preparation sessions didn’t turn out to consume too much of staff time, multimedia-based materials were considered most appropriate as it had the capacity to incorporate high quality graphics, visuals, and also demonstrate motion and sound. Along with this change, fresh specimens began to be used.

An evaluation of this effort (with external input) was carried out. This exercise focussed on the use and utility by students of the multimedia-based preparation materials, as well as their experience with fresh specimens. A print-based questionnaire with structured and open-ended response items was used for this purpose. Its focus was on ascertaining the effects on students of the revised instructional format on such things as their confidence with surgical processes, ability to recognise body parts and functions, and of the use of fresh tissues and specimens.

On the whole students felt that multimedia-based materials with its attendant visuals and moving images gave them a clearer idea of what was to follow in the dissection sessions. The few disappointments they had with the utility of the multimedia preparation materials in the dissection sessions had to do mostly with the technical quality of the videos and the images. Students found that the multimedia preparation materials helpful in the surgical approaches. They also said that knowing where the major muscles, arteries and veins were before starting dissection, enabled them to proceed with confidence. Finally, nearly all students felt that the use of fresh tissues and specimens had a positive impact on their motivation to learn anatomical details. For the instructors, this was the most interesting and satisfying outcome of all.

Acknowledgment

This project has been supported by funding from the *Teaching and Learning Multimedia Educational Technologies Committee* (TeLMET) which is a sub-committee of the Academic Committee of The University of Melbourne, Australia. Support in the form of hardware and consumables was provided by the Dean of the Faculty of Veterinary Science (The University of Melbourne).

Appendix A:Focusing the Evaluation

Focusing the Evaluation *Proforma*		
Learning Goals/Outcomes	**Evaluation Strategy**	**Instrumentation**
1. What are the 'learning goals or out-comes' for your students?		
2. What is unique about these learning goals (e.g. in comparison with conven-tional practices)?		
3. What are your 'instructional goals' (as teachers of this subject)?		
4. What is unique about these instructional goals (e.g. in comparison with conven-tional practices)?		
Design Architecture	**Evaluation Strategy**	**Instrumentation**
1. List attributes of this approach to the study of dog dissection that are of par-ticular interest to you?		
2. Why are these of particular interest?		
3. What problem or weakness in the teach-ing of dog anatomy is this curriculum addressing/changing?		
4. How is this curriculum changing or addressing this perceived weakness?		
Delivery Attributes	**Evaluation Strategy**	**Instrumentation**
1. What is unique about the delivery mode of this curriculum? (i.e., as self-instruc-tional mode, interaction, just-in-time access)		
2. What is unique about the selected deliv-ery mode?		
3. How is this delivery mode addressing a need in existing methods of teaching dog anatomy and dissection?		

Learning Process	**Evaluation Strategy**	**Instrumentation**
1. What about the learning process is this curriculum changing?		
2. How is this curriculum changing that learning process?		
3. What about the current practices in the teaching of dog anatomy and dissection is this curriculum changing?		
4. How is this curriculum changing these practices/processes?		

Appendix B:Evaluation Questionnaire

RADog Multimedia Dissection Preparation Session Evaluation Questionnaire

Instructions: *We are interested in your experience with the RADog multimedia assisted dissection course. The information you provide here will have no bearing at all on your assessment in this course. Please respond to all the questions in the spaces provided and if you give us your name, we will be able to help you with your concerns later on.*

Your Name (OPTIONAL*)*:

1. The multimedia preparation session enabled me to:

	Yes	No	If no, why not?
• perform the surgical approach with confidence.			
• proceed with the dissection confidently.			
• readily identify the structures and features in the sub-region under study.			

2a. The multimedia preparation session enabled me to recognize how:

- enlargement of the thoracic cavity results in expansion of the lungs.

☐ Yes

if yes – What specific feature(s) of the preparation session enabled you to achieve that?

....

....

if no – What do you think was the problem?

☐ No

. ...

... .

2b.The multimedia preparation session enabled me to recognize how:

- irritation of the phrenic nerve might result in synchronous diaphragmatic flutter (thumps).

☐ Yes

if yes – What specific feature(s) of the preparation session enabled you to achieve that?

....

....

☐ No

if no – What do you think was the problem?

....

....

3. During the dissection session I found what I expected to find.

☐ Yes

....

....

☐ No

if no – What do you think was the problem?

....

....

4a. From the dissection session:

- I developed a mental picture of the course of the vagus nerve through the thorax.

☐ Yes

if yes – What specific feature(s) of the dissection session enabled you to do that?

....

....

☐ No

if no – Why do you think you were unable to achieve that?

....

....

4b. From the dissection session:

- I could palpate the third intercostal space.

☐ Yes

if yes – What specific feature(s) of the dissection session enabled you to do that?

....

....

☐ No

if no – Why were you unable to do that?

....

....

4c. From the dissection session:

- I could insert a needle into the right ventricle of the heart.

☐ Yes

if yes – What specific feature(s) of the dissection session enabled you to do that?

....

....

☐ No

if no – Why were you unable to do that?

....

....

5. The use of fresh tissues and specimens:

	Yes	No	If no, why not
encouraged me to want to learn anatomical details.			
encouraged me to try to remember anatomical details.			

6. Being able to manipulate fresh specimens enabled me to clearly see how muscles act on bones to move them.

☐ Yes

if yes - What specific feature(s) of the dissection session enabled you to see that?

....

....

☐ No

if no – Why were you unable to see that?

....

....