Integrated Case-based Applied Pathology (ICAP): a model for learning and teaching of Veterinary Pathology

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Abstract: The Faculty of Veterinary Science, through its Teaching Innovations Unit, has made a significant effort to incorporate enquiry-based learning into veterinary science teaching. This has often involved judicious use of e-learning capabilities. This application shows innovation occurring over four years (2002-2005) with ongoing enhancements made annually to both online and face to face aspects of the Veterinary Pathology unit of study and demonstrates the impact on student learning. The innovation, called Integrated Case-based Applied Pathology (ICAP), is delivered in semester five of the veterinary science undergraduate curriculum at the University of Sydney. A key feature of this innovation is that its sustainable development has provided a conceptual framework for e-learning and blended learning throughout the Veterinary Science and Animal and Veterinary Bioscience curricula.

Introduction and background

The Faculty of Veterinary Science at The University of Sydney is committed to promoting high quality learning experiences through its staff, resources and support and e-learning is one approach that is used to achieve this aim. As part of the Faculty's five year strategic plan, one of the main objectives is to *"extend resources and migrate interactive online learning across the curriculum"*. The Faculty of Veterinary Science Teaching Innovations Unit has played an important role in supporting staff in designing and developing interactive e-learning resources and systems. The Unit was originally set up in 2003 to focus on developing resources to support enquiry-based learning, often integrated with the application of e-learning. Resources developed by this unit encourage learners to develop holistic conceptions and apply deep approaches to learning (Marcus, Taylor and Ellis 2004; Ellis, Marcus and Taylor 2005). Currently the unit develops resources across the undergraduate curriculum of veterinary science.

The case-based approach in teaching veterinary pathology
In Veterinary Science an important graduate attribute is the ability to undertake an investigative approach (Muller 1984) to a disease problem in individual or groups of animals in both scientific understanding and clinical acumen (Collins and Taylor 2002). This incorporates the generic attributes of critical analysis, adoption of a problem solving approach, and application of technical skills appropriate to the discipline. The learning environment also fosters the acquisition of generic attributes of building a body of knowledge in the field, applying that knowledge in unfamiliar circumstances, developing the ability to use information technology, communicating effectively in spoken and written English, encouraging the ability to work with others and planning skills (Anon. 2004). The need to encourage a deep learning approach in students has led to the implementation of new teaching strategies such as the group case-based or problem-based learning environments.

In the traditional veterinary science curricular model, the basic sciences are taught didactically followed by the applied sciences, also taught, to a lesser extent, didactically. Finally this theoretical knowledge is applied in the practical environment of the clinic (Miller 1997). In response to the recognition that veterinary practice requires certain graduate attributes such as critical thinking, problem solving, analytical skills, problem-based or case-based learning approaches have been adopted to various degrees by veterinary schools widely across North America (Clarke 2000) and it is from here that most of the literature on problem-based learning (PBL) in veterinary education originates. Reports from Australia are limited to anecdotal accounts.

Veterinary Pathology is the discipline that forms the basis to the understanding of disease and is a course taught in the third year of the Bachelor of Veterinary Science (BVSc) degree at the University of Sydney. Traditionally didactic methods of lectures and practical classes had the effect of forming a disjunct between the paraclinical skills necessary in the investigative tools of diagnosis and the practical clinical disciplines of Veterinary Internal Medicine and Surgery, failing to provide the vertical integration necessary for maximum effectiveness. The Integrative Case-based Applied Pathology (ICAP) project was developed to contextualise and unify learning activities in veterinary pathology with the aim of enabling the students to understand the role of pathology in the diagnostic process. As such, it seeks to promote student centred learning in the clinical problem solving context. The focus is on logical diagnostic problem-solving, utilising gross pathology and histopathological material primarily with the inclusion of microbiological, parasitological and clinical pathological data. This approach was designed to allow internal integration within the discipline but also to encourage vertical integration between preclinical, paraclinical and clinical disciplines. This focus is achieved through the presentation of stimulating and authentic cases that utilise information generated in real case investigations. The aim is to engage students with the cases in a way that a veterinary professional would engage with a real life case; by necessity tending to adopt an investigative, evidence-based approach to the task.

Desired learning outcomes specific to the Unit of Study include the recognition of pathological processes and understanding the impact of these at a tissue, organ and whole animal level; understanding of important specific diseases affecting different body systems; and building a holistic understanding of disease based on the host-pathogen-environment interaction present in all disease.

Method of implementation and development of the resource
Students are exposed to a total of 12 cases delivered on-line in conjunction with material covered in other learning activities within the Unit of Study. The students work through the cases in groups over a two week period, ultimately submitting case reports which are provided in template form and ask specific questions which are aimed at guiding the students through the diagnostic process in a logical manner. Development of ICAPs has occurred over a four year period. Initially the cases were administered in a paper based format with provision of key diagnostic information at a single two hour large group tutorial. Development to an on-line format occurred in two phases. In the initial phase, the online format required specialist IT skills to build, maintain and deliver the case. The question of sustainability led to the innovation of a system called *CaseBuilder*. The ICAP case resources reside within the *CaseBuilder* database and often link to images in a repository called *OLIVER*. Students access these cases and other unit of study materials in an organised and integrated way through the *WebCT* learner management system. *CaseBuilder* is a system that enables staff (and students) to create their own cases using a forms-based approach, therefore not requiring any HTML programming knowledge. The significance of this innovation was to reduce the entry skill level for developing online case materials and thus accelerate uptake of e-learning across the Faculty and improve sustainability in maintaining these resources. The strengths of the University *WebCT* platform are also utilised by using it as an information portal that organises all the learning resources within the unit and provide tools such as discussion boards with private group discussion areas. The private discussion areas are used to help groups work together in the process of formulating a written case report by allowing learning to take place in physical group meetings as well as sharing of thoughts, information and insights amongst members of the group.

Assessment
The development of ICAPs has been heavily driven by student survey results and feedback [both independent surveys for the purposes of resource development as well as Unit of Study Evaluation (U.S.E.) survey results]. As a consequence, learning outcomes are closely aligned to assessment tasks. Students are assessed on their completed case report. Formative assessment is provided on cases presented earlier in semester with the final case of the semester contributing towards the overall

summative assessment result the student obtains for the unit of study. The format of the system has allowed a component of student peer assessment / peer review to be easily incorporated into the unit of study where each group assesses the case reports submitted by another group as a part of the formative assessment process, thus diversifying the learning process.

Evaluation of the innovation

USE results and ICAP Student Evaluation Survey results

USE. surveys were conducted in 2002 and 2004, in association with the Institute for Teaching and Learning, The University of Sydney. These surveys utilise the five point Likert scale ranging from one (strongly disagree) to five (strongly agree) with opportunity for additional student comment provided. In addition, in class, anonymous written surveys relating specifically to the ICAP resources that followed the same Likert scale with opportunity for open ended comment were administered within the Unit of Study at the end of semester. The aim of these surveys was to assess the success in engaging students and to provide feedback for further development of the ICAP innovation. Approximately 75% of respondents wrote comments on these forms. The comments are uniformly constructive and supportive of the innovations embraced in this Unit of Study. The students have apparently recognised the value of this innovation and provided details about the impact that it has had on their learning and suggestions for improvement. Below are some examples:

- *The ICAPs were a really good way of making us apply stuff we'd seen in lectures and pracs and helped us to see links between pathology and other subjects.*
- *ICAPs made studying pathology much more interesting and were an excellent way of integrating knowledge from other subjects both this semester and previous years. ICAPs also gave us an excellent foundation for the diagnostic process that we will be using everyday in our future careers and also proved to us that not all cases are clear cut.*
- *The ICAPs promoted understanding of disease processes and their impact on specific organs as well as on the whole animal.*
- *ICAPs are good for research and group work skills. They made me study throughout semester and showed the relevance of what I was learning.*
- *I learnt a lot from the other people in my ICAP group and was surprised at the amount of information I knew too.*
- *It would be preferable to pick your own groups because we know who we work well with.*
- *Working with others made me at first feel like I had a poor understanding of applying things we'd only just been introduced to but it also encouraged me to try and be better prepared and look at things and different ways. I learnt a lot off the others so I found it really useful.*

USE surveys (2002, 74% response; 2004, 71% response) and annual ICAP survey results consistently reveal high numerical scores for good teaching, generic skills, relevance, responsiveness to student feedback, integration, facilitation of effective learning, facilitation of active learning, independent learning, critical evaluation, teamwork and overall satisfaction (Tables 1 and 2)

Table 1. Summary of USE results for 2002 (74% response) and 2004 (71% response), five point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree)

USE Question	2002	2004
Good Teaching Scale (Q2)	3.86	3.95
Generic Skills (Q3)	3.73	3.75
Relevance (Q6)	4.72	4.75
Staff responsive to student feedback (Q7)	4.00	4.10
Integration with other units (Q9)	4.43	not asked
Online component enabled effective learning (Q9)	not asked	4.03
Participation as active learner (Q11)	3.77	4.08
Overall satisfaction (Q12)	4.00	4.15

Table 2. Summary of ICAP Survey results from 2002 – 2004, five point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree)

ICAP Survey Question	2002	2003	2004
Integration with other Units of Study	4.2	4.4	4.4
Teamwork	3.9	3.8	3.9
Independent learners	3.9	3.9	3.8
Critical evaluation skills	3.9	4.1	4.0
Promoted understanding	4.2	4.2	4.3

Enhanced learning and improved learning outcomes

A Faculty study conducted in 2004, evaluated the use of case based teaching resources across years two and three of the veterinary science degree and the ICAP learning resource was a key resource analysed within this study. A phenomenographic approach was implemented in which interviews and questionnaires were utilised to determine student perceptions of what they were learning and the things they did to engage with the resources (Marcus, Taylor and Ellis 2004; Ellis, Marcus and Taylor 2005). Analysis of the student's written answers and descriptions in open ended questionnaires enabled the students to be grouped into four categories of depth of learning based on how they utilised the resources to assist their learning with the highest level of learning category demonstrating an approach that applied theory to practices and showed an awareness of how this relates to the professional practice of a veterinarian. The results of this study indicated that, consistent with other evaluations, there was a mix between surface and deep approaches to learning and that those students that adopted a deep approach to learning tended to adopt a cohesive conception of the utilisation of the case-based material with other material presented in the unit of study. Further, analysis of the relationship between different categories of conceptions and student performance (in terms of marks received as assessment for the subject) revealed that students that held a cohesive conception of case based learning tended to perform at a higher level than students who held a more fragmented conception of the case-based material (Ellis, Marcus and Taylor 2005).

Discussion and future innovations

Deep and surface learning

Marton and Säljö's work (1976) showed a difference between students in learning style, identifying students who had a deep, rather than a surface understanding of material. This work has informed studies of the ICAP innovation to identify where students have holistic, integrated conceptions of veterinary pathology as a result of using the resources. This contrasts with fragmented approaches where students compartmentalise knowledge and don't see it related to other related topics.

Whilst the ICAP format is primarily utilised in the teaching and learning of systemic veterinary pathology in semester five, it is linked and congruent with the adopted problem-oriented approach in the other paraclinical disciplines taught in semesters five and six as well as clinical disciplines of semesters seven, eight, nine and ten and the case-based format utilised for Veterinary Clinical Pathology in Semester seven. In particular, final Year five students have the opportunity to assist in the development and refinement of further ICAPs, thereby reinforcing the importance of pathology in the veterinary diagnostic process.

The success of this innovation has been recognised by our peers and adopted by several other units of study within the BVSc (e.g. Ruminant Health and Production) and BAnVetSci (e.g. Animal Nutrition) curricula as well as by other Faculties across the University [i.e., the discipline of Education at the postgraduate level (Sutherland, Marcus and Jessup 2005)]. This demonstrates the flexibility of both the learning resources and teaching strategy. From the perspective of resources, the case design can easily work with other disciplines and can easily be decoupled from the teaching strategy, allowing staff to apply aspects of the innovation in a way that they are comfortable with rather than needing to adopt the entire strategy. This is especially useful to staff new to e-learning and blended learning.

Future innovations

Research-led advancements have been made each year to ensure the innovation continues to yield and maintain the significant successes as evidenced by evaluation data.

Problems with group work that impact on the quality of the learning experience is one of the next things that will be addressed. Additionally, a study to determine the long term effectiveness of the innovation is in the process of being implemented that will identify how this innovation in year three impacts on learners in their fifth year of study and as graduates.

Issues of sustainability require the further development of the e-learning system generated by the ICAP and subsequently by *CaseBuilder*, into a system called *ResourceBuilder*. The *ResourceBuilder* system will enable staff to generate their own learning templates and customised display formats to provide even greater control over the e-learning resource design and development process. Our intention is to provide staff with a higher degree of flexibility in the online resource design and development process and also to engage more disciplines within the Faculty and University in learning resource creation. Additionally, we aim to use *ResourceBuilder* as a technological model for the Australasian Veterinary Science e-learning Collaboration. This collaboration is in its early stages with the potential to develop and share e-learning tools, learning materials and best practice in a way that forwards learning and teaching in veterinary education.

Conclusion

This paper discusses an innovation developed at the Faculty of Veterinary Science, The University of Sydney that enables learners in the Veterinary Pathology unit of study to engage with authentic, real

life cases. The innovation resulted in positive evaluations and a positive impact on the student learning experience and also to the technological opportunities for the development of e-learning resources. Future alterations to the innovation are planned with changes to the group work process and also to the system that builds the learning materials.

References

Anon. (2004) *Generic attributes of graduates of the University of Sydney*. [Online] Available: http://fmweb01.ucc.usyd.edu.au/FMPro?-db=POL_Main.fp5and-lay=wwwand-format=/pol/pol_summary.htmland-RecID=32978and-find [2006, June 21].

Clarke, C.R. (2000) Problem-based learning – a theoretical evaluation of its applications in veterinary medicine. *Journal of Veterinary Medical Education*. **27**, 6–12.

Collins, G.H. and Taylor, R.M. (2002) Attributes of Australasian Graduates: Report of a workshop held at the Veterinary Science conference centre, Faculty of Veterinary Science, University of Sydney, January 28-29, 2002. *Journal of Veterinary Medical Education*. **29,** 71–72.

Ellis, R.A., Marcus, G., and Taylor, R. (2005) Learning through inquiry: student difficulties with on-line case-based material. *Journal of Computer Assisted Learning,* **21**, 239–252.

Marcus, G., Taylor, R. and Ellis, R.A. (2004) Implications for the design of online case-based learning activities based on the student blended learning experience. In R. Atkinson, C. McBeath, D. Jonas-Dwyer and R. Phillips (Eds), *Beyond the comfort zone: Proceedings of the 21st ASCILITE Conference* (577–586). Perth, 5-8 December. [Online] Available: http://www.ascilite.org.au/conferences/perth04/procs/marcus.html [2006, 3 April]

Marton, F. and Säljö, R. (1976) On qualitative differences in learning – I: Outcome and process, *British Journal of Educational Psychology*, **46**, 4–11.

Miller, C.W. (1997) Experiential learning in veterinary education. *Journal of Veterinary Medical Education*. **24,** 48–51.

Muller, S. (1984). Physicians for the Twenty First Century: Report of the project panel of general professional education. *Journal of Medical Education*, **59**(11).

Sutherland, L., Marcus, G., and Jessup, A. (2005) From face-to-face to blended learning: Issues and challenges in redesigning a professional course. In A. Brew and C. Asmar (Eds) *Proceedings of Annual International HERDSA Conference 2005. Higher Education in a Changing World*, **28**, 551–558, Sydney, (3-7 July 2005).