A novel, online, interactive, problem-based approach to learning oncology

Laura C. Batmanian, School of Biomedical Sciences, The University of Sydney
L.Batmanian@fhs.usyd.edu.au

The mediocre teacher tells. The good teacher explains. The superior teacher demonstrates. The great teacher inspires.
William Arthur Ward

Abstract: *Higher education is undergoing major changes in the development and delivery of courses. An example is the introduction of online approaches to teaching and learning in the form of WebCT, The University of Sydney's official delivery tool. This paper describes implementation of pedagogy designed to enhance learning in Oncology, a second year subject in the Bachelor of Applied Science (Medical Radiation Sciences), created by the amalgamation of two cross-disciplinary units of study, Tumour Pathology and Principles of Oncology. Four instructional strategies are described: a) domain specific educational instruction, e.g., explanatory notes (text/audio hints), self tests in the form of diagnostic exam and evaluation of subject, b) student-centred, problem-based learning dependent on group work to study and solve six clinically oriented cases (developed by cross disciplinary team), c) interactive online discussion to support collaboration and communication among students, academic as well as oncologist facilitators and d) a case Proforma which summarises the step-by-step clinical reasoning process to engage the students in the learning process. Implementation of the instructional design is enabled by the selective use of WebCT course management software. An account of the infrastructure used to enhance interactive problem-based learning at undergraduate level is provided. Feedback from students has been extremely positive.*

Aims

To:
- incorporate technology into problem based learning (PBL) approach;
- include access to experts; and
- incorporate online formative as well as summative assessments in order to enhance students' learning at undergraduate level.

Rationale

Social, economic and technical factors operating across the educational sector have placed increasing pressure on academics to develop online approaches to teaching and learning. There is a growing trend worldwide to focus on learning rather than teaching (Ramsden 1992). Student-centred learning environments are replacing teacher-centred ones with increased use of technology as an aid to learning. Most importantly, the last decade has seen a profound shift towards a constructivist philosophy in teaching (Wilson 1995). This includes an emphasis on active learning, collaboration, critical thinking, problem solving and the advent of lifelong learning attitudes in a society where employment is increasingly of short-term nature and changeable (Laurilland 1993). The constructivist student-centred learning approach has been incorporated into the development of a *WebCT* (World Wide Web Course Tools) education programme for undergraduate oncology students. *WebCT* courseware-authoring tool is the commercial product selected by The University of Sydney to support web-enhanced learning approaches. Oncology, a second year subject in the Bachelor of Applied Science (Medical Radiation Sciences), has evolved from the amalgamation of two cross-disciplinary units of study. These were Tumour Pathology taught didactically in the School of Biomedical Sciences and Principles of Oncology taught didactically by the School of Medical Radiation Sciences. The initiative originated because of the overlap in content in the two subjects and the disquiet with the effectiveness of traditional approaches to didactic lectures. These problems were overcome, by introducing the principles of problem-based learning (PBL) at the inception of the Oncology unit of study in 2000. The interactive nature of the subject meant that students needed to communicate with their group members outside their face-to-face allotted times. Although full-time students, they found it difficult to organise this during the day as students in their group had

different commitments. The increasing need for online teaching and learning became apparent when the students demanded more flexibility in the system to fit their studies around domestic and employment commitments.

Rather than move into the realm of distance learning, it is an attempt to incorporate mixed mode delivery in order to exploit the properties of online technology in enhancing the flexibility of access to learning opportunities and support for students on campus. This paper describes an innovative approach to learning Oncology and the impact it has had on the students' learning experience. It details four instructional strategies, enabled by the selective use of *WebCT* course management software, which have been adopted in the implementation of pedagogy designed to enhance learning in Oncology, for the first time in 2003.

Strategy One: Domain Specific Educational Instruction

The vast, ever changing knowledge base in radiation oncology cannot possibly be fully covered during a single thirteen week semester 1 period, the length of study devoted to this subject. Class contact time per week includes a two-hour discussion time. During this time students are expected to develop skills in using their knowledge in approaching clinical problems in a systematic way and similarly to update and expand their knowledge in a systematic manner. Mere memorisation is inappropriate as it leads to surface learning. The principles of PBL were introduced into the Oncology unit of study to address the need for students of this branch of paramedical sciences to acquire a whole range of skills in problem solving, critical thinking, deductive reasoning, independent and lifelong learning skills, as well as interpersonal communication abilities, in order to become effective practitioners in the radiation therapy profession. The need to inculcate these generic attributes was the rationale behind the adoption of a PBL approach, in agreement with suggestions made by Albanese and Mitchell (1993).

PBL requires the students to work in groups to study and solve six clinical cases. Reliance on the use of technology in the profession is ever increasing. Moreover, if students are to develop skills for lifelong learning, it is imperative that technology and pedagogy should intermesh to enhance their learning. To more effectively meet the many different learning needs of its students, the unit of study was developed into an online mode of delivery. *WebCT* was used to provide students with a central point to collect subject resources (e.g., online books, journals, videos and clickable links to useful internet sites) and complete and submit reports through the Assignment Box. Multimode explanatory notes, in the form of audio hints which can also appear on the screen as text based hints, are located throughout the web site. This allows for continual academic support to be present even when the students are continuing their studies off campus (Figure 1). Moreover the help pages (which may be printed off) show the students how to navigate around the site and will step them through each of the tools that they will be using in the unit of study, should they have problems when they are on their own. The Post Semester Evaluation, is embedded in the Quiz facility, to give students the opportunity to provide feedback about the unit of study.

Strategy Two: Student-centred problem-based learning

Six clinically oriented cases were developed in consultation with staff in the School of Medical Radiation Sciences and oncologists from outside the University to ensure a synergy with the rapidly developing professional environment. They evolved through the blending of the varied expertise of this cross disciplinary team. The specific subject knowledge was provided by an academic in the School of Biomedical Sciences on the one hand, and the clinical management know-how was provided by radiation oncologists, on the other. Thus a supportive learning environment was created through the use of these clinical studies which provide situations where students build knowledge and share it with experts and peers, who then assess and give feedback.

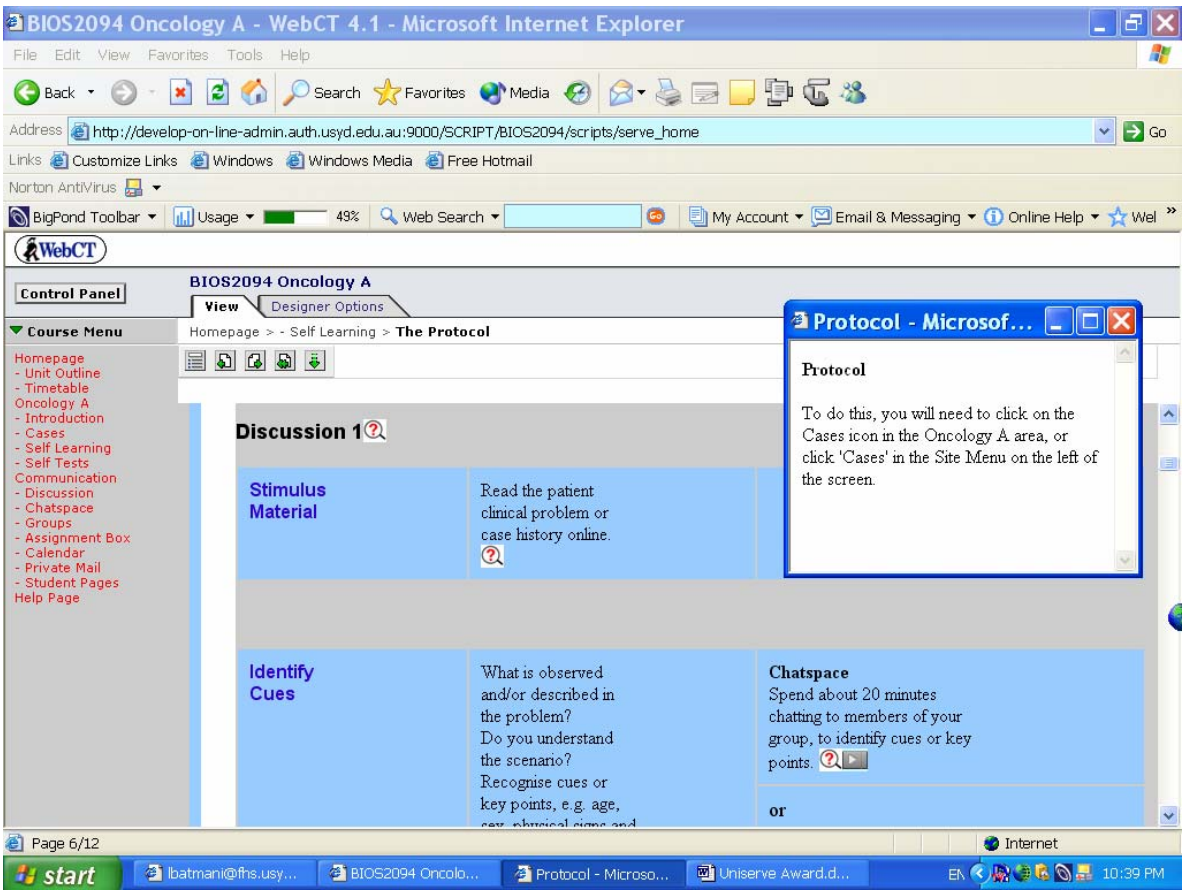

Figure 1. Screen of the step-by-step explanation of Discussion 1 in the Protocol, showing the use of text based hints (inset) and audio hints, represented by a question mark and play button, respectively[1]

To solve the cases, a step-by-step clinical reasoning process is followed that promotes active group (made up of six students) as well as self-directed participation, through synchronous or asynchronous discussion forums provided by *WebCT*. Content is not taught per se. Instead the cases form the basis of the course. The facilitators guide the students in respect to their learning. Through this process the students are made aware of their learning activities and can consequently plan, execute, monitor and evaluate these activities. Hence they are encouraged to become responsible for their own learning.

The Chatspace facility allows students to interact at a more personal level, since dialogue is not recorded. Students are active learners and the social nature of learning is acknowledged (Grabinger and Dunlap 1995). Just as children learn best by interacting with one another rather than with teachers, so do students, and hence their learning is dependent on group work. This is identified by the high level of interaction and dialogue required for group problem solving activities, preparation of group reports and role-playing exercises with the facilitator. The better they get to know each other, the better the interaction. For those oncologists who do not have the opportunity to meet face-to-face, the Student Pages[2] facility of *WebCT* allows student as well as facilitator personal details and pictures to be uploaded. This improves interaction amongst them.

Collaborative learning is emphasized, encouraged and rewarded by being allotted 5% of the total marks for this subject, as an incentive. Documentation of participation in group discussions either through online asynchronous communication or their learning journal, is assessed. Both the number of entries and their relevance to the case are considered for peer marking, but there are no penalties for 'incorrect' entries, since participants are encouraged to recognize their errors, reflect on them and rectify them.

[1] Access site at: http://develop-on-line.auth.usyd.edu.au and choose the 'Non UniKey login' (User name: oncologystudent; Password: student).
[2] Input from the Discussion Forum, Student Pages and Evaluations have been erased to address student privacy issues – thus site called 'Oncology A example'

The Quiz facility plays an important role in providing an invaluable tool for formative assessment. It contains a set of questions and answers based on problems revealed in each case and a diagnostic mock examination. These provide students with an insight into the type of questions expected in the final examination, the depth of knowledge required to answer them and their progress to date.

Strategy Three: Interactive Online Discussion to Support Collaboration and Communication
Students and facilitators interact to refine skills of analysis and rehearse problem-solving strategies in an effort to integrate theoretical concepts into clinical practice. The program has been implemented to improve the learning outcomes of Oncology students, enabling them to tackle tasks with the knowledge and confidence that was previously associated with years of clinical experience. It provides for a transformed pedagogy where students can continue to pose each other or the facilitators (academic and specialist) questions, study, research, communicate, collaborate and keep up to date with practicing professionals using 'state of the art' management techniques, outside the constrains of timetabled face-to-face class sessions. Group discussion in the form of Discussion Forum and Chatspace, allows students to share their research (which become their 'study notes') with other group members, thus enhancing and consolidating their knowledge. Central to the pedagogical benefits of problem-based learning is debriefing, which takes place after marking of all reports associated with a particular case. It is used to reinforce certain concepts and to make sure that everyone is aware of certain pitfalls and misunderstandings associated with the particular case being investigated. Basically then, it extends the classroom experience by encouraging even greater support in learning, something that is crucial at undergraduate level. It enables personal relationships to be created among students, academics and professionals and further the feeling of group rapport during a web of learning. It provides for an online community site for sharing expertise and experience and individual consultation and trouble shooting in a time and cost efficient manner. Once professional networks are established, this ongoing communication is imperative for ingraining lifelong learning methodology among a peer group that goes on beyond this unit of study and persists well after graduation.

Strategy Four: Engaging the Students in the Learning Process
To encourage engagement in the learning process, each group of students is required to submit a weekly case Proforma (a summary form of the steps in the Clinical Reasoning Process). Students are provided a template document that they send via the Assignment Box. Initially students are encouraged to ask questions regarding any outstanding patient clinical data not supplied in the original case, together with associated reasons for their questions, to force them to focus solely on the problem. Only then does the facilitator answer them, in this case assuming the role of patient. Based on the feedback to these questions, usually obtained during class discussion, the students in the group formulate their objectives for solving the case, and send them in the Proforma via the Assignment Box or during the first discussion. The facilitator reviews the objectives and either accepts them or suggests further reflection based on information supplied on the patient data, via the Groups Discussion Forum or during class discussion. The outcome of reflection is learning.

During the second week, the students would be discussing and collating the literature gathered on the current case and starting to write the report, which they send on the Proforma via the Assignment Box. At the same time another case would be presented and the process repeated again. Debriefing of the report is done through the Groups Discussion Forum of the group's own secure site. This private dialogue between student and facilitator affords an ideal opportunity for cognitive coaching, as suggested by Grealish (2000), to assist students with making accurate connections among theory, content and experiential knowledge. Students are supported in their learning, by dual marking of reports and are thus provided with feedback from both the academic facilitator as well as the oncologist (the two experts for the problem). The oncologist is invited to present an interactive feedback session on their submitted work, with particular emphasis on the present day follow-up and management of the patient. The weekly repeated submission of Proformas, the receiving of feedback

on the contents submitted and reflection on the feedback provided is the basis of engaging the students in the learning process.

To dissuade students from the temptation of taking 'short-cuts' using the web and electronic material, they were encouraged to undertake as broad a reading as possible. This was reflected in 10% of the marks allocated to reports being allotted to a comprehensive bibliography. However, reports had to be succinct (1000 words) to restrict copying large segments of information from web links.

Outcomes and Evaluation

Following completion of the unit of study, a feedback questionnaire was administered to ascertain students' opinion of the effectiveness of using *WebCT* as the pedagogical infrastructure. They were asked to indicate their perceptions of the impact of the four instructional strategies described in this paper on their learning. Thirty eight out of forty two students responded. They were asked to indicate their perceptions using a 5 point Likert scale (1 – very poor to 5 – very good). Their responses were coded 1-5 and averaged to provide a relative measure.

The students found that the domain specific educational instruction assisted them in their learning (Mean=4.5, SD=0.5). They rated the generic skills scale (PBL and interactive collaboration and communication) as very beneficial (Mean=4.6, SD = 0.6). The instructional strategy to engage the students in the learning process also rated as important (Mean=4.7, SD=0.4).

Two open-ended questions invited students to list and explain the most important things about the unit of study that helped them to learn and their suggestions for improvement. Generally, students were satisfied with the methods used for teaching and learning and with the *WebCT* site. Representative comments for liking the unit of study included:

- 'Independent research—Allowed students to actively learn about specific topics and consolidating the information.'
- 'Oncologists' visits—Visiting doctors allowed us to get clinical experience—excellent learning tool.'
- 'Oncologists' visits gave insight into course and occupation.'
- 'Problem based style of learning—It was important as I was in charge of how much you learn as you yourself had to find the answers and theory on the cases.'
- 'PBL, because it was relevant to what I feel that we need to know in the workplace.'
- 'Easier for students to communicate with facilitators and peers.'
- 'Feedback – This part of the unit of study helped me to get feedback on my work. Reinforces my understanding of the learning materials and allowed me to see the professional's opinion on the topics covered.'

On the other hand there were only a few comments relating to improvements, these being:

- 'More resource books—Every time we went to use a textbook, none were left. They needed more copies of books for research.'
- 'To have smaller groups—Lessen arguing and disagreements.'

The strategies described in this paper have led to deep learning, as evidenced by a 10% increase in graded passes following the introduction of PBL and a further 10% increase following the implementation of *WebCT* as the course infrastructure, to 93% graded passes. The design and instructional methods facilitated by *WebCT* have enhanced (i) participation and interaction; (ii) peer collaboration and student motivation; (iii) consultation with peers and facilitators; (iv) written communication through constantly writing and reviewing the work of others in the discussion fora; and (v) ability to apply theory to practice (as evidenced by their improved grades associated with solving new problems in the examination). Additionally, many students who were not familiar with online technology became quite skilful at navigating and using the facilities provided by the Web. As

far as facilitators are concerned, the increased consultation with facilitators imparted more responsibility on their shoulders, made them more confident and consequently made their role more rewarding. Furthermore, the oncologists' visits were advantageous, because they allowed academic facilitators who are not clinical experts themselves, to learn more about the 'state of the art' practical strategies used in clinical practice, which they could then incorporate into their own teaching.

WebCT overcame many difficulties previously associated with managing and communicating with staff within the School of Biomedical Sciences and outside the University, especially new members like the oncologists. Facilitators were able, through their individual logins, to see the direction and scope of the subject and interact with the students more effectively. This saved preparation time and gave a good indication of the range and standard of instruction expected. Once the site was operational, the amount of pre-class preparation time was reduced. Furthermore, the teaching team found that having the *WebCT* site facilitated more timely contact with students and each other. The students were thus provided with access to experts in their particular fields, whenever required. The ability to work outside the University increased the amount of interaction with group members and allowed the outside practitioners as well as the academics to stay in contact with the students on a more continual basis.

The fora relieved some of the load normally associated with answering student emails, since it is common for several students to ask the same or similar questions. Special administrative notices could be directed to them easily via the private forum facility of their group's own secure site. Subject updates, alerts and notices could be published at any time in the Calendar and students were able to access these from anywhere with internet connection.

Conclusion

The concept of online research-led teaching provided by the oncologists is novel, not only to Oncology teaching, but also to other subjects which integrate online and PBL aspects (Meyers, Nulty, Cooke and Rigby 2003; Nulty, Vegh and Young 2002). In addition, the inherent advantages of the programme include increased student responsibility and initiative through metacognitive and self-directed learning activities and added scope for dynamic, generative learning, authentic learning, collaboration and reflection. Nowadays, teaching needs to be flexible, incorporate multimodal teaching techniques and constructivist teaching philosophies and marry new student-centred learning approaches with the latest technological advances. Problem-based learning was found to promote teaching and learning strategies that foster independent lifelong learning skills in classes small enough to be manageable in groups, such as the Oncology unit of study. Feedback from the students (quoted above) indicates that it increases motivation for learning and understanding of the topic and gives students more control over their learning with a concomitant sense of ownership. Johnson, Johnson and Stanne (1986), support the notion that when students are able to participate in active learning activities, they find the learning more pleasurable and satisfying. Such environments lead to an enhancement of student learning by both the individual and joint efforts within the group, leading to higher levels of task related interaction. This is evidenced by our students' high levels of satisfaction, enjoyment, interest and engagement with their learning experience, together with significantly enhanced learning outcomes.

WebCT was found to be an invaluable support to the on-campus student learning experience by increasing student communication with each other and professionals in such a way as to build a sense of community, convenience of access to course material any time, any place, without losing the advantage of real facilitator student contact and peer interaction characteristic of a traditional university, also emphasized by Brown (1998). It engages students into learning whilst offering them information about the course, resources for independent study, a set of clinical cases, assessments and feedback opportunities. It provides an integrated and easy way to create infrastructure that supports instruction designed for problem solving activities and synthesising of information (including audio and video which attempts to retain the interest of the student), to facilitate a deeper

form of learning and a better association between theory and clinical problems. It aims to educate candidates to make appropriate clinical decisions in a fast changing professional environment. It meets the challenges of the information age and augments the Faculty's capacity to facilitate flexible modes of delivery. Using a single system which is easy to navigate, namely *WebCT*, for all their work, allows students to focus on learning the material rather than the system, or systems, at an earlier stage. This is particularly important for students where this is their first exposure to IT and for international students where English is not their first language. Furthermore, it has the advantage of being easily adaptable to other undergraduate units of study, irrespective of discipline.

As the quote at the start of this paper suggests, it meets my aim to inspire students by encouraging them to apply their knowledge base to solve career-related problems. More importantly, it addresses my goal to impart my enthusiasm for learning onto my students, so that they realize that learning is not an end unto itself, but a means onto which they will base their future professional practice.

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