

AuPS/ASB Meeting - Canberra 2005

Free communications 9: Education

Friday 30 September 2005

Chair: Ann Sefton

Enhancing the first-year experiences of undergraduate students enrolled in large classes

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BIOL105 (Human Biology) is a 2-unit, integrated, interdisciplinary course offered by the School of Biomedical Sciences (The University of Queensland) to first-year students. Physiology forms a major component of the content. Student enrolments are high (n = 315 in semester one, combined Pharmacy and Human Movement Studies cohort) to very high (n = 860 in the semester two, Science cohort). BIOL105 provides a foundation of disciplinary knowledge, conceptual frameworks, practical skills and socio-affective orientations. As a keystone course, student experiences can strongly influence engagement in learning, consequent course selection and career paths linked to global knowledge economies. This paper describes the substantial re-culturing of BIOL105 in 2005, framed around an explicit learning model and the building of a learning community. It presents findings from a comprehensive evaluation of the effectiveness of the course in enhancing their first-year experience.

The course has been renewed with substantive, benchmarked improvements to learning and assessment experiences for students. Two innovative assessment tasks were designed and implemented. The first task was to write a Personal Response (weighted as 10%) around contemporary biological issues. The aim was to develop students' abilities to communicate to various audiences. This task comprised a two-page written assignment of their response to recent audio interviews from Radio National's "Science Show" presented on a CD. As a complementary assessment task (weighted as 5%) students wrote a review of one other students' Personal response, guided by explicit criteria. The second task was an e-Conference which enabled students to actively and collaboratively contribute to learning about contemporary issues of biology. Students worked in collaborative pairs which formed larger clusters of 16 pairs. Each cluster addressed one broad interdisciplinary topic related to the course content. Students worked on-line within their cluster to develop: (a) a brief paper, weighted 9% (b) a related PowerPoint presentation, 4% and (c) presented one question and one answer to members of their cluster, 2%. Submissions were assessed by on-line tutors using pre-specified criteria. Students were supported in these tasks by explicit teaching and use of exemplars during lectorials (combined lecture-tutorial format).

Participants in the evaluation included 246 students (80% of the total combined cohort), four academic staff and one research assistant. The course was evaluated in terms of the: impact of teaching, effectiveness of course design, levels of students support, course delivery and student perceptions. Data were gathered from the following sources: print-based individual questionnaires; field notes; focus group interviews; analysis of student work using detailed criteria sheets, and analysis of assessment results. Interview and open-ended questionnaire items were analysed using qualitative methodologies (open, axial and selective coding). Survey data were analysed using non-parametric quantitative methodologies. Key themes emerging from the data were grouped into three categories. These were: teaching and management; learning pathways; and learning collaboratively. As expected, students expressed both positive and negative views about the e-Conference as a teaching and learning activity. Some students had difficulties articulating their learning pathways explicitly. An unexpected finding was the importance of social dynamics in affecting students' learning. Findings indicate that the adopted model of learning could be extended to include a social dimension. The findings also support the importance of collaboration, dialogue and reflection as key learning constructs from previous research.

Creating an effective learning community in a large-class service teaching physiology course

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Ideally students should enjoy a community of practice that includes students, academics and industry representatives, and that facilitates learning based on inquiry, discovery and practice. In large-class service teaching courses this is seldom feasible. However, we believe that by creating effective learning communities in these courses, we are able to engender creative interest from students and enhance their learning experiences. In such learning communities students and teaching staff all engage with each other to acquire knowledge and share understanding, counteracting the trend towards isolation students feel in such large cohorts and their disillusionment with the field of study and its relevance to their chosen profession. In this study we set out to facilitate the creation of an effective learning community in a 3rd year Physiology course for Pharmacy students by (1) focusing on clear learning objectives, (2) delivering interactive lectures that concentrate on major physiological concepts, (3) providing discovery based practicals, (4) convening an on-line discussion board, (4) providing practice questions to reassure students about the validity of the learning objectives and to stimulate in-depth, out-of-class learning activities, and by (5) convening a final voluntary tutorial before the end-of-the semester exam for students in need of further nurturing. We received very positive student feedback and student performance in the end-of-the semester assessment was markedly increased compared to the previous year, from an average of 66% in 2003 to an average of 89% in 2004.

The place of physiology in an integrated medical curriculum

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In 1996 Flinders University took its initial cohort of students into Australia's first Graduate Entry Medical Programme (GEMP) (Finucane *et al.*, 2001). The teaching of basic sciences such as physiology in the first two years was by Problem-based Learning (PBL) tutorials with a small number of supporting lectures and practical sessions. The tutorials involved analysis of PBL cases which were clinical patient scenarios written to highlight particular areas of body function in a relevant context. There were no groups of lectures under the heading of "Physiology", or under the names of any of the other preclinical departments that had previously taught their own disciplines. This of course generated concerns that basic science would no longer be learned in any depth. The extent to which physiology appeared in the preclinical years of the course was measured by analysing the "Learning Objectives" – a group of brief statements that define the course designers' intentions for student learning, week by week. Learning Objectives define the course content and are decided at the earliest stage of course design before PBL cases are written or lectures planned. The first 59 teaching weeks of the 4 year GEMP involved teaching basic human biology integrated with clinical science, using PBL cases. Over this period there were a total of 494 Learning Objectives in the area of basic biomedical science, on average 8 or 9 per week. The number of Learning Objectives that could be considered as relating to physiology, eg: "Describe the mechanisms (muscles, pressures and volumes) underlying spontaneous ventilation" "Know the pattern of blood flow through the kidney and how this is regulated under different circumstances" "Understand how gastric acid is produced" were counted. There were 119 physiology Learning Objectives, constituting 24% of the basic biomedical science learning expected in the first 2 years of the GEMP. These Learning Objectives were spread across 39 of the 59 weeks, showing that physiology learning was explicitly expected in 66% of the weeks. This is probably an underestimate of the physiology content. There were Learning Objectives such as: "The physiological basis and significance of added heart sounds" and many others relating to pathophysiology which were not included in the count, even though such issues would traditionally have been taught by physiologists in past courses. It is therefore not surprising that, despite the absence of sessions called "Physiology", the staff of the Department of Human Physiology were highly in demand to write PBL cases and participate in supporting sessions. The lack of an explicitly labelled physiology section in the course has not lessened the amount of physiology that the students are required to learn. On the contrary, the high proportion of physiology material in the explicit Learning Objectives emphasises the fundamental role of the discipline in the early stages of medical training.

Finucane, P., Nicholas, T.E., & Prideaux, D. (2001) *Medical Teacher* 23, 76-79.

Using a student-centred approach to enhance understanding of the physiology of metabolism and energy balance

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This study examined the effectiveness of modifications to a physiology laboratory class on metabolism for 2nd year occupational therapy and speech pathology students. The class was designed to create an environment in which the students could identify and address their misconceptions through interactive discussion and have an opportunity to explore and integrate information available to improve their critical thinking skills. By this process it was intended that the students would deepen their understanding of the physiological principles that underlie metabolism, integrating the knowledge they had gained in this and other elements of their course. Further, the class aimed to develop the students' skills in appraising the value of nutritional information they are exposed to and to identify the important factors which influence an individual's metabolic needs. The design incorporated some initial questions, answered individually, a tutorial, a group-based workshop and a final discussion, which specifically included revisiting the initial questions. Care was taken to create a learning environment in which the students were comfortable to discuss their knowledge and ideas openly and confidently. Evaluation of the project, in the form of a questionnaire, showed that the students agreed that the class allowed them to recognise misconceptions, improved their understanding and increased their ability to evaluate information. The results in the end of semester summative examination were improved, with an increase of 37.7% in average marks for this topic compared to the previous cohort.

Student perceptions and use of pre-specified criteria in constructing complex concept maps in physiology

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Constructing quality assessment criteria can be challenging, especially when used for integrated, group-centred, applied learning. In this paper, we describe a project investigating the development and use of criteria in a collaborative assessment task (weighted as 6%). The task involved groups (four students in each) from Second-Year Dentistry working to construct a complex concept map. The students were given a written, simulated, medical history of a patient and were required to construct a concept map illustrating relevant pathophysiological concepts and pharmacological interventions. This paper describes the second phase of this research project aimed at making educational goals of the task more explicit through investigating student and staff understandings of the criteria. The findings from the first phase (Moni, Beswick & Moni, 2005) were used to revise the assessment criteria for the task with the aim of making them more accessible to learners. The new criteria used adopted the language of both staff and students to more clearly represent expectations of each criterion and standard. The new criteria were used for the first time in 2005.

This paper presents data from a cohort survey undertaken to determine students' perceptions about the concept map and the criteria. In addition, two groups of student volunteers were videotaped during a regular, three-hour workshop as they worked to draw their concept map. The aim of this was to capture student interactions as they constructed their concept maps with the support of the new criteria sheet.

Survey data were analysed using non-parametric methodologies. Differences in students' opinions about the assessment task were identified and mapped against their final mark awarded for the task. Evidence was found that for some groups, attitudes towards the assessment task played a role in influencing their final mark. Transcripts were developed from the videotapes and these were analysed using two complementary approaches. First, an inductive strategy was adopted to define emergent categories of behaviour. Second, a deductive strategy was used to explore student behaviours according to how they aligned with principles of effective learning. Most students reported that they found the criteria sheet useful in completing the group concept map. This was more the case for students who had not used a criteria sheet before. However, there was little other evidence (e.g. from video recordings) that most students actually used the criteria sheets to guide the construction of concept maps. Our conclusion was that students perceived the criteria sheet as being more useful for lecturers to mark their work, rather than as a tool to enhance their own learning.

Moni, R.W., Beswick, E. & Moni, K.B. (2005) *Advances in Physiology Education*, in press.

The opinion editorial – a novel assessment task in final year physiology

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Improving the public understanding of science is likely to remain an important challenge to future professional scientists who are our current undergraduates. In this paper, we present the findings from two phases of a study investigating teaching, learning and assessment strategies aimed to improve undergraduates' communication of science to non-professional audiences.

As the first phase in 2004, we developed a "Media Role" model to identify the function of mass media as community gatekeepers of new scientific findings. This conceptual model predicts the potential benefits for all undergraduate science students in adopting styles of writing used by journalists. We then detail a writing task with a novel application for third-year Physiology students – the Opinion Editorial (weighted as 10%) and accompanying Peer Review (weighted as 5%). Survey data from final year students (n = 230) enrolled in the course - Human Physiology and Pharmacology in Disease - were collected before and after the implementation of the Opinion Editorial / Peer review. The task requirements were explicitly taught to the students by a professional journalist. In the assessment task, students adopted the role of journalists to re-write a recent, technical paper (Mattick, 2004), as an Opinion Editorial. This was assessed both by staff and peers using a detailed criteria sheet. After minimal editing, the top-ranked student Opinion Editorial was published in the UQ News. Pre-writing Task and Post-writing Task surveys (5-point Likert scale) were administered to students. Research questions included: (i) How far did writing the Op-Ed give the students a deeper understanding of the role of media and the difficulty in communicating science to the public? (ii) Was writing the Op-Ed challenging and valuable? and (iii) Did the students perceived any changes in their own communication skills? Student surveys were analysed by non-parametric methodologies. Samples of student work (n = 177) were analysed using algorithms to describe surface and conceptual features.

As the second phase in 2005, we describe an intervention to determine the effectiveness of explicitly teaching students how to write an Opinion Editorial. As the pre-instructional assessment task (weighted as 8%), students read a technical article from the course and completed a written assignment intended for a non-professional audience. Work was marked using a criteria sheet. Subsequently, a professional journalist explicitly taught both the construct and features of an Opinion Editorial to the students. As the post-instructional assessment task, students read a different technical article from the course and then re-wrote this as an Opinion Editorial (weighted as 12%). The same criteria sheet was used. On a random basis, students in the course were presented with the first and second submissions of these two tasks. They were required to mark both against pre-specified criteria (weighted as 5%). In a similar manner, the two tasks from volunteering students were presented to members of the public who were asked to complete an associated survey to capture opinions about, and understanding of, the two texts. Analyses of surveys, student results and student work were undertaken. Major findings indicated that the students valued writing to non-professional audiences, and that their final submissions corresponded well to the surface and conceptual features of published Opinion Editorial pieces. However, difficulties in constructing writing because of issues around linguistic competence, were identified. It is evident that more explicit teaching of this type of writing is needed at undergraduate level.

Mattick, J. (2004) *Nature Genetics* **5**, 316.