SaMnet

Science & Mathematics network
of Australian university educators

Showcase of selected successful Action-Learning Projects recommended for national dissemination

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Developing Threshold Learning Outcomes for Agricultural Science

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Learning and Teaching Academic Standard (LTAS) Statements have recently been published across a number of disciplines and have contributed to the national regulation and quality assurance framework being developed by the Higher Education Standards Panel.
The Science Standards Statement (SSS) contains a statement on the Nature and Extent of Science and articulated Threshold Learning Outcome (TLOs) statements representing the minimum levels of achievement expected of a bachelor level Science graduate. Our project aimed to adapt the SSS, in particular, the TLOs for Science to the Agricultural Science discipline to reflect the discipline-specific attributes and to achieve a measure of national consensus on Agricultural Science TLOs including endorsement from the Australian Council of Deans of Agriculture. We report on the process and outcomes of developing a draft Agricultural Science Standards Statement (AgSSS).

The project method broadly followed that of the national LTAS Science project (2010/11) on a smaller scale. A targeted consultation process through facilitated workshops with teaching academics from the University of Tasmania's School of Agricultural Science provided qualitative data. These data informed the adaptation of the survey used by the LTAS Science Project to include Agricultural Science. The Agricultural Science survey was administered to staff of the Tasmanian Institute of Agriculture and two interstate universities. Key findings are that a statement on the nature and extent of Agricultural Science needs to capture its multi-disciplinary nature and that TLOs should incorporate minimum levels of achievement in vocational knowledge. Project outcomes will contribute to the future renewal and revitalization of the Agricultural Science curriculum and facilitate meeting reporting requirements, such as those required by the Tertiary Education Quality Standards Agency (TEQSA). The process can serve as one model for wider dissemination and adapting the Science TLOs within the University of Tasmania and other universities. The next phase of the project is to define nationally-agreed Agriculture TLOs through a 2-year project that started in August 2013 and is funded by the Office for Learning and Teaching. For further information please visit www.agltas.edu.au .

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Improving cohesion among subjects within a course and introducing inquiry-based learning seems to have improved feedback scores: ANU

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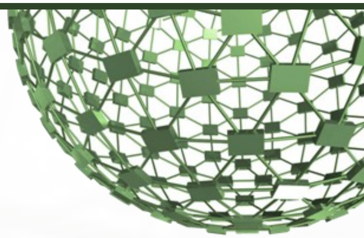

As Robert Hewitt so truly stated ‘Paradoxically, it is at times of chaos that you can make changes. If things are progressing reasonably well, it is harder to convince people to invest effort to improve or change’ (M. Sharma, pers.comm., 2013). So when you have a long-standing, and notionally successful, first year course in human biology, should you risk experimenting with changes or leave well alone? Based on our perceptions that this course was very good, but could be better, our SaMnet project took the former approach, but in a ‘softly, softly’ manner over two iterations.

Our experience of this second-semester course had shown that, because it was divided into four independent content modules, students often just learned the content needed to pass each component without necessarily appreciating the bigger picture. In the SaMnet project, therefore, we sought to improve the overall cohesion and consistency of the four modules, and to introduce new research-led components (to align learning experiences with the university’s goal of ‘research-led teaching’). By making small changes to the teaching approach and assessment criteria for each activity class, to emphasise the inherent links between fundamental concepts, we hoped students would improve their engagement with the course overall and therefore develop greater coherent understanding of some threshold concepts. We also wanted them to emerge with an understanding of the research process and basic scientific research methods to prepare them well for subsequent study.

Inquiry-based learning activities (e.g. hypothesis development, statistical analysis and elementary research skills) were scaffolded throughout the course, replacing some less focused writing tasks. The new course structure was received positively by students, and evaluations in 2012 and 2013 are showing notable shifts in student engagement, although we have not yet fully analysed evaluative data. Certainly the 2012 students appeared to rate the quality of feedback much higher than previously, or than in other Biology courses, and to respond very well to the inquiry-based activities. The SaMnet project provided an important guiding structure to our course development activities, created a team focus, and ensured that we adopted a rigorous approach to review, design, implementation and evaluation.

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Chemistry to Biology knowledge transfer – mapping of science TLOs

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The project took a successful innovation in chemistry developed by Bedford/O'Brien (active learning based workshops) and attempted to adapt/emulate it in biochemistry dry laboratory sessions to improve student engagement, motivation and pass rates. It involved transfer of pedagogies, philosophies and practices from one disciplinary context to another – referred to as *"knowledge transfer"*. Strategies employed were as follows: 1. academic staff supported each other in deploying and developing the innovation within the new context; 2. professional development training was given to academic staff and part-time teaching staff delivering the new sessions; 3. new active learning activities targeting key TLO's were created in biochemistry based on the chemistry model, students process lecture content in peer groups and make it relevant to themselves while at the same time staff facilitate group work and key skill development; 4. peer assessment and marking check and reinforce key learning objectives and threshold learning outcomes (TLOs); and 5. time was made available for staff and students to reflect on process and improve innovation.

Evaluations of qualitative and quantitative data have provided evidence that the content was embedded further and deeper than previously examined. Secondary effects have been improved student enjoyment and *"buzz"* about the subject content and overall greater student satisfaction among all involved in the subject. Pass and retention rates were improved and associated staff have started to look at other areas and subjects to embed this practice. In addition, it provided a useful framework to look at ways of mapping and benchmarking TLO's associated with group work in different science subjects and levels.

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Beyond the First Year Experience in Science: Identifying the Need for a Supportive Learning and Teaching Environment for Second Year Science Students

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The Second Year (sophomore) Slump is a well-defined phenomenon affecting American undergraduate students in the middle years of their degree. In the Australian context, minimal attention has been given to identifying or addressing potential concerns with the transition and satisfaction of students beyond their first year of study in science degrees. A case study of second year students (n=165) studying a bioscience course is presented. Potential student demographic factors, including low social economic status, non-English speaking background, first in family to attend University (>60%), and Grade Point Average (GPA) progression, were examined. An academic slump based on GPA trend of a decrease of GPA greater than 0.35 was observed for 33% of the student cohort, irrespective of their program of study or background. We surveyed the second year students to identify their concerns in this year of study and their preferences for various support activities. The survey indicated that academic workload/ expectations and work experience were of most concern to students. The survey results were considered in the context of an institutional focus on strategies to enhance student engagement and retention throughout the student lifecycle. We propose that a strategic design approach, with alignment between curricular and co-curricular activities, is more likely to have success in enabling science academic staff to engage and support second year students.

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Change Process for a Laboratory Program

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Conventional science laboratory teaching has frequently been criticised for delivering poor student learning outcomes at great expense. Although many pedagogically valuable practical activities and laboratory curriculum concepts have been described in the literature, their implementation in university teaching programs has been very slow, which suggests that model activities alone are not sufficient for bringing about educational change. Successful laboratory curriculum reform requires the conception of pathways for change. The chemistry laboratory program at La Trobe University, Australia, has entered the second year of a redevelopment project that aims to modernise the curriculum and introduce a skill development focus. A four-year change plan, including a comprehensive evaluation strategy, has been devised. Four factors were identified that enabled the development and implementation of the project, which include: (a) strong backing from the chemistry department, (b) a shared responsibility model for laboratory teaching, (c) synergies with a university-wide curriculum reform process and (d) support from a national learning and teaching peer network. The scale of the project and the difficulty in motivating all stakeholders to actively participate, presented significant challenges for the project.

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Chemistry Vlogs: a Vehicle for Student-Generated Representations and Explanations to Scaffold their Understanding of Structure - Property Relationships

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Students in tertiary-level introductory chemistry courses often don't progress beyond poorly structured mental models of chemical concepts since these novice chemistry learners have little time to construct meaning or acquire representational competence during a 13-week content-rich semester. Additionally, many of these students are unmotivated, enrolled only because chemistry is a program requirement.

To encourage engagement, students were required to create 2-3 minute video blogs (vlogs) in which they explained the structure and properties of a molecule/substance that was personally relevant supported by a representation of the structure as a visual aid. The learning design drew on constructivist theories and aimed to enhance student engagement through developing a personal connection to chemistry. The aim was also to strengthen understanding of chemical structures through external representations and explanations.

Twenty-one students consented to analysis of their vlog content. A relationship was identified between the type of representations students adopted and the depth of their explanation. Students who had created and interacted with their hand-made physical models, using hand gestures to highlight features of their structural representation, produced higher-level explanations of structure-property relationships. Lower-level explanations were associated with students who used static graphical images sourced online. Factors related to chemical vocabulary and misconception diagnosis were also explored during analysis.

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An Inquiry-Based Approach to Laboratory Experiences: Investigating Students' Ways of Active Learning

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It is a common perception amongst students (and faculty) that traditional recipe-based laboratory experiences are generally boring, non-interactive and non-engaging. As a result, such laboratory sessions are unlikely to promote higher order thinking and learning. As a part of the national SaMnet (Science and Mathematics network of Australian University Educators – see http://samnetaustralia.blogspot.com.au/) project, we have developed an "inquiry-based" approach to learning in laboratories, and introduced laboratory experiences which are designed to equip first year physics students with the concepts and skills required to plan and carry out an experiment to investigate a particular problem. Our aim was to motivate and stimulate students' interest, so that they explore experimental activities and design their own experiments. We implemented inquiry based laboratory activities for non-physics majors in semester 2, 2012 at two Australian universities. The students were given five traditional and one inquiry-based laboratory and student perceptions of the new experience were assessed. Students felt they had to do a lot of thinking and analysing for inquiry-based reports and believed that they learnt more in the inquiry-based laboratory than the recipe-based laboratory. We also found that student marks either improved (for laboratory reports) or remained the same (for related examination questions), and conclude that inquiry-based laboratories at worst do not negatively impact on student performance and may actually benefit student learning.

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Intensive mode delivery vs traditional delivery: Evaluating and implementing change in teaching strategies

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In this project we are evaluating learning and teaching strategies in a biology unit offered as an intensive block over three weeks during Macquarie University's shorter session 3. Evaluation of data from the first offering of the unit has informed some changes in the teaching strategy to overcome limitations associated with time that may be detrimental to the learner experience. This change, the introduction of one day on campus a month prior to the intensive session, also aims to establish a more collaborative learning environment for online aspects of the unit that occur prior to the intensive. It was clear from the data that the collaborative learning strategy was of benefit to the learner during the intensive session. A second round of data, that includes additional questions, was gathered in session 3 beginning mid December 2012. We are currently evaluating this literature, analysing data and preparing publications.

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Interdisciplinary Collaboration to Integrate Inquiry-Oriented Learning in Undergraduate Science Practicals

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The benefits of inquiry-oriented learning (IOL) in undergraduate science courses have been validated through a considerable range of studies incorporating observation and examination data, as well as qualitative and quantitative feedback from students and employers. However, IOL initiatives often occur in single subject or discipline areas, meaning that students may experience IOL in isolated or disjunct forms, without the synergies made possible through interdisciplinary collaboration by educators. This paper reports on the progress of an interdisciplinary approach to develop, implement and evaluate IOL practicals in first year biology, chemistry and physics laboratory teaching programs. This initiative, founded on principles of collegiality and mentorship among the team members, has involved professional development of teaching associates (that is, demonstrators), collaboration in the design and branding of inquiry-oriented practicals, and a degree of interdisciplinary alignment of practical assessments. The initiative has generated a more student-centred and coherent approach to enhancement of scientific literacy and a range of associated skills, provided greater clarity and transparency for students, and scaffolded inquiry-oriented approaches throughout the degree.

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Improving the Student Experience of Learning and Teaching in Second Year Biochemistry: Assessment to Foster a Creative Application of Biochemical Concepts

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Biochemistry is an inherently difficult, content-laden discipline that at times struggles to capture the imagination of students. In an attempt to improve engagement and performance in a second year Metabolism course, we implemented a creative, multimedia-based group project. The project provides a creative outlet for students that supplements the didactic lecture content so commonly used in undergraduate biochemistry education. In completing the assessment task, students gained a deeper understanding of their chosen biochemical pathway and were provided with a range of presentations that neatly summarised the range of content considered fundamental to the understanding of metabolism. On the whole, students found this assessment task to be a useful learning and study tool that added a ‘fun’ dimension to the course. The current assessment concept, although directly relevant to the education of biochemists, could easily be translated to any subject where an emphasis is placed on the integration of multiple sets of information to achieve coherent understanding.

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Development of POGIL-Style Classroom Activities for an Introductory Chemistry Course

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Foundations of Chemistry IA (semester 1) and IB (semester 2) courses at the University of Adelaide are undertaken by Level I students pursuing a wide variety of degree programs that require a year of chemistry study. As a consequence, many students who have studied little, or no, chemistry in high school enrol in these courses. We redeveloped these courses for 2012 to cater to students with little or no chemistry background, using group-based Process-Oriented Guided Inquiry Learning (POGIL) style activities to deliver the majority of the course content.

We have been developing POGIL-style activities for all topics within both courses, but particularly in the area of introductory organic chemistry, for which few activities currently exist. Three organic chemistry activities were developed and subsequently tested in workshops run in November 2011 and April 2012. Student volunteers completed a survey consisting of Likert and open-ended questions related to the activities at the conclusion of each workshop. A focus group was also held at the conclusion of the second workshop. Feedback from the workshops and focus groups helped to refine and further develop the activities by suggesting the reorganisation of some questions for a better flow and making them less text-heavy.

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