Chapter 6: Summary of outcomes and conclusions

Teaching Improvement Models
At the end of the project it was possible to delineate two models for implementing the curriculum reforms into the targeted units of study within the client faculty professional degree programs. The models can be described as follows:

- **Model 1**: ‘Value adding’ to an existing unit of study
  This model was used by the School of Biological Sciences and the School of Physics to modify existing first year materials so that they better suited the needs of students within their professional programs. In the former case about one-third of an entire unit of study was remodeled with the addition of contextualized material that was delivered to the targeted students in a variety of modes. In the latter case, two-thirds of the components of an existing unit of study were reviewed, remodeled and linked together with common themes to provide cohesion across the unit.

- **Model 2**: Development of small online teaching and learning modules to be used within a number of units of study across various degree programs
  This model was used by the School of Chemistry and the School of Mathematics and Statistics. In the former case the modules were purchased from the University of Melbourne (with Melbourne incorporating Sydney’s desired changes) and put online through WebCT. In the latter case the modules are being written in-house and are being prepared for online presentation using a conversion tool. This conversion tool has also been developed in-house and translates mathematical information, including diagrams and symbols, into html code consistently and reliably. In both cases the modules will be relevant to a number of different units of study for introductory teaching and just-in-time revision.

Sustainability of the teaching innovation within the unit of study

**Biological Sciences** – the material requires maintenance and regular revision as it is closely aligned with the unit of study.

Keeping the EDUH1016 Human Biosciences unit of study compatible with BIOL1003 Human Biology is very difficult because the content is too detailed for the BEd Human Movement and Health Education students, many of whom do not have a science background. Many of the BEd Human Movement and Health Education students, whilst enjoying the subject matter and finding it very relevant, are struggling with the content. Ideally EDUH1016 Human Biosciences should be a stand-alone unit, however funding constraints make this difficult.

**Physics** – the material requires maintenance and regular revision as it is closely aligned with the unit of study.

**Chemistry** – the ChemCAL modules are all stand-alone and will be usable across a range of situations without ongoing maintenance.

**Mathematics and Statistics** – the modules can be used as is, as they relate to general topics.

Portability of the materials resulting from the teaching innovation

**Biological Sciences materials**: these resources are not portable as they are highly specialized.

**Physics materials**: some of these materials, e.g. the coursebook, are highly specialized and so are not portable, however the web-based materials are, and in fact
the Waves module has already been used in PHYS1002 *Physics 1 (Fundamentals)* and the Fluids module in PHYS1003 *Physics 1 (Technological)*.

**Chemistry materials:** the *ChemCAL* modules are portable, and in fact have already been made available to all students studying first year chemistry at The University of Sydney. They could also be used by students for revision in related second and third year units of study, either in the Faculty of Science or client faculties, e.g. AGCH2002 *Agricultural Chemistry 2*. They could also be useful to students joining a degree program in higher years.

**Mathematics and Statistics materials:** the modules are portable and could be used by other Engineering students or Mathematics students and the conversion tool has a wide potential application in the delivery of mathematics via the Web.

**Portability of the Teaching Improvement Models from discipline to discipline**

**Model 1** is portable. In fact, the model has already been adopted by the School of Physics in the creation of a new unit of study EDUH1017 *Sports Mechanics* (to replace PHYS 1002 *Physics 1 (Fundamentals)*), for delivery to students within the same degree program BEd *Human Movement and Health Education*. As the model requires relatively small changes to existing units of study, is self-contained (i.e. requires a minimal amount of outside liaison, and can be implemented in stages, it is seen as a successful model for implementing curriculum reform.

**Model 2** is also portable. As the model requires external collaboration, significant preparation of materials, and cannot be implemented gradually (i.e. it requires complete topics to be available before it can be released to students), it is seen as a more difficult model for implementing curriculum reform. However, because of the large number of students that this model potentially caters for, it is well worth considering although effective project management is essential.

**Integration into WebCT**

One of the expected outcomes of the project was that each development group would use WebCT to give students access to unit materials prepared. While all four groups have created a web presence, only two have utilized WebCT. Biological Sciences has created a WebCT site while still making use of the existing, well-developed and extensive virtual learning environment (VLE) within First Year Biology. Chemistry adopted a modular system (*ChemCAL*) which has its own student portal with password protection and record keeping, and so their WebCT site simply links to the *ChemCAL* modules. Physics were dealing with a client faculty (Faculty of Agriculture) where WebCT was not widely used for delivery of material within units of study and so this has not been implemented yet. As the material being presented by Mathematics is intended for just-in-time revision across a number of degree programs and not for students enrolled in a specific unit of study it was not yet appropriate to link to it through WebCT. Mathematics and Physics plan to provide student access to their materials via WebCT in 2003.

From our experience, WebCT is an effective tool to use to present a common point of entry to students for all their units of study. It is good for organizing the different materials that a unit coordinator wishes to provide for the students and as a means of managing online discussions and providing flexible access to formative assessment activities. The Biological Sciences model is an appropriate use of WebCT. However, when it comes to the more complex discipline specific materials it is generally better
to link to them, rather than embed them in WebCT (as was the case with the Chemistry materials). If the material consists of a large number of relatively small files (as in the cases of ChemCAL and the mathematics system), the uploading of these to WebCT is cumbersome. With resources that encourage the production of materials tailored to a specific cohort of students (as in the case of the mathematics system) the frequent uploading under WebCT is not practical. In addition, delivering applications that are graphically rich via WebCT has the disadvantage that the available screen size is reduced thus limiting the amount of information that can be seen on one screen. If the resources are to be used by a number of units of study it is easier to maintain one copy outside WebCT than one per unit of study within WebCT.

**Evaluation**
As mentioned in Chapter 1 evaluation for the project has been based on Kirkpatrick’s four-level model.

**Level 1: reaction – have the students accepted the innovations?**

The innovations were assessed using surveys and focus groups. Students from the Faculty of Education (Biological Sciences) and the Faculty of Agriculture (Chemistry and Physics) generally indicated that they liked the innovations and found them useful. The Mathematics innovation has not yet been implemented within any Engineering units of study, so there has been no evaluation of this type done for them.

**Level 2: learning – are there any demonstrated learning outcomes resulting from the innovations?**

Improved learning outcomes have been observed by:

- Biological Sciences – the quality of student posters for the BEd Human Movement and Health Education students in 2001 were outstanding, demonstrating increased understanding and application, which appeared to reflect the improved contextualisation of material delivered.

- Physics – the ‘student time on task’ in the laboratories and workshops and the quality of the mindmaps have been extremely good leading staff to believe that the web exercises and the production of the coursebook have helped improve the learning outcomes. However this has not been measured quantitatively.

The Chemistry group has not conducted any evaluation that focused on improvements in learning outcomes and the Mathematics group is unable to conduct any at this stage as the innovation is not being used by the Engineering students yet.

**Level 3: transfer – has there been any evidence of transfer of knowledge and skills from the first year units of study to subsequent units?**

It was hoped that by contextualizing teaching materials and making the learning experiences more relevant to the professional degree programs that this would have facilitated transfer of knowledge from the unit of study with the innovation to subsequent related units of study and other contexts. In Biological Sciences the innovation was contained within a unit of study, and there was a clearly identifiable related follow-on unit of study and so we were potentially able to look at possible transfer. In Chemistry, although the Agriculture students were able to choose from a
number of first year chemistry units the majority of them studied CHEM1001 Fundamentals of Chemistry 1A and CHEM1002 Fundamentals of Chemistry 1B where the innovation was focussed and there was an identifiable related follow-on unit of study and so again we were potentially able to look for possible transfer. In the case of Physics it was not appropriate to look for transfer because the first year Agriculture students came from three different degree programs and there was no specific related follow-on unit of study in which we could survey the students. We therefore made an attempt to gauge if any transfer had taken place from the Biological Sciences and Chemistry cases. In consultation with the ITL we administered a brief questionnaire to the related second year units of study and looked for evidence of correlation between students’ perceptions and end of semester marks. The results were inconclusive.

**Level 4: value to the organization, including dissemination – has the project produced any benefits for the Faculty and University?**

The benefits to the Faculty and University include:
- the portability of the models from one discipline to another within the institution;
- proposed broad dissemination within the national and international science teaching and learning arena;
- raised staff awareness of the need to make service teaching more responsive to client faculty needs; and
- raised staff awareness of student-centred flexible learning and web-enhanced teaching.

Portability of Model 1 is demonstrated by the fact that the School of Physics has already adopted the Biological Sciences model and created a new unit of study, EDUH1017 Sports Mechanics for the first year physics component of the BEd Human Movement and Health Education professional degree program. The Mathematics and Statistics conversion tool has a wide potential application in the delivery of mathematics via the Web.

Dissemination of information relating to the project, within the Faculty, the College, the University, and the wider academic community, has so far been in the form of the following published articles:
Further dissemination that is either in progress or planned includes:


Sharma, M. D., Cooper, I. J., Stewart, C. and Sutton, B. *Teaching Service Courses at University: A strategy for engaging students* to be submitted to Science Education.

Taylor, D. A presentation at the annual TeX User Group meeting, July 2003, Hawaii, USA.

A presentation at the UniServe Science 2003 national conference.

A presentation at the Moving Online III 2003.


**Cost effectiveness**

When trying to assess the cost effectiveness of a project of this character it is necessary to consider not only the actual cost involved in development but also the potential number of students served by the innovations.

**Biological Sciences and Physics** – remodeled existing materials to cater for a reasonable number of students (Biological Sciences: 109 in Semester 2, 2001 and 84 in Semester 2, 2002; Physics: 78 in Semester 2, 2001 and 86 in Semester 2, 2002). This model was relatively cost effective.

**Chemistry** – modified existing software to cater for large numbers of students (1596 in Semester 1, 2002). This model was moderately cost effective as many of the software changes identified by Sydney were done in Melbourne.

**Mathematics** – writing software and content from scratch to cater for potentially very large numbers of students (Engineering: 2011 in 2002; Mathematics: 1272 in 2002). Although the innovation is nearing completion, to date it has not been made available to the target students and so the short-term view might be to consider it expensive. However, in the long-term this state-of-the-art application and its development have the potential to be of international significance.

**Reflections on external project management**

Having a project manager who was external to the groups carrying out the innovations has assisted in: collaboration; keeping the innovations on task, within budget and within an acceptable overrun of time; evaluation; reporting; and dissemination.

Scheduling meetings with development groups was quite difficult. Academics are so busy, particularly during teaching time, that it was almost impossible to get a whole team together at any one time. This was also exacerbated by key academics not being available owing to their being on study leave.
More active participation from the client faculties and continued regular communication may have:

- provided more opportunities for collecting examples that were rich in professional content and application;
- led to improved understanding of the needs of client faculties;
- assisted in the recognition by students that the innovation is an integral part of their professional degree program; and
- provided opportunities for increased cross referencing to (and within) other related units of study.

When the project commenced we invested considerable effort in thinking about how we were going to evaluate the innovations. Using four levels of evaluation (based on Kirkpatrick’s model) to monitor the success of the project has provided a very good framework for cyclic development. Some levels have applied well to the development groups whereas other levels have been more appropriate to apply at the big picture level. Regular evaluation has also assisted the development groups to remain focused on the project objectives, work towards deadlines and deliver materials which have improved the teaching and student learning experiences in units of study delivered to client faculties.

All development groups will continue to improve their respective innovations in 2003. In particular, Mathematics will be trialing their materials with MATH1002 Linear Algebra and MATH2001 Vector Calculus and Complex Variables (both units of study include a significant percentage of Engineering students) during the Summer School, January 2003 and then implementing it within third year Engineering in Semester 1, 2003.

Conclusions

Impact on the Faculty and the University
The project is expected to strengthen the move to:

- a stronger culture of understanding of the needs of incoming first year students;
- a Faculty-wide use of WebCT for both delivery of unit materials (e.g. unit outlines, lecture notes, teaching modules) and communication with students; and
- a closer alignment between faculty offerings and client requirements.

The project is expected to lead to:

- high quality web-based modules with the benefit of providing just-in-time revision resources for students in higher years;
- an increase in student performance at the first year level, with a flow on to increased participation in higher years within the client program; and
- transferability of approaches to delivery across disciplines.