Case Study: University of Melbourne (Melbourne, Australia)

University of Melbourne is a multi-campus university based in Melbourne, Australia. It was established in 1853, and is the 2nd oldest university in Australia with a strong focus on research. There are approximately 36,000 students enrolments, both undergraduate and post-graduate.

Science at Melbourne: The Bachelor of Science (BSc) is one of six new-generation degrees at Melbourne started in 2008. The three-year degree program 'provides flexible pathways' with students selecting from 36 possible majors by third year that can lead directly to employment or further graduate studies in engineering, medicine and other graduate health vocation programs, veterinary science, education and scientific research in a range of fields. The degree program is housed within the Faculty of Science although four faculties contribute to the numerous majors on offer. In 2011, the entry score for the BSc was 85 out of a possible 100. Further details on the degree program are outlined in this Information Day video.

Biomedicine at Melbourne: The Bachelor of Biomedicine is one of the six new-generation degrees at Melbourne started in 2008, and is essentially a more structured science degree with an emphasis on biomedical sciences. The program enrols approximately 450 students per year, who can go on to professional health degrees, or on to do post-graduate studies in biomedical research. The program attracts high-achieving students with an entry rank of 98.45 (top 1.5th percentile) in 2010. The Faculty of Medicine, Dentistry and Health Sciences has oversight for the program, although the Faculty of Science contributes substantially towards the program. Further details on the degree program are outlined in this Information Day video that specifically discusses the increasing relevance of QS in Biomedicine.

Mathematics requirements for entry into Science and Biomedicine: Both degree programs require Maths Methods, which is a calculus-based high school subject.

The Melbourne case study focuses on two degree programs: the BSc with a focus on the Biological Sciences majors and the Bachelor of Biomedicine. Both are framed around a model of educational change based on the work of Michael Fullan.

Initiation of Change

"Who prompted need for QS in science and why?"

At the institutional level the Melbourne Model was introduced in 2008 with the introduction of six new-generation degrees. The new Melbourne degrees are intended to align more closely with degrees internationally, in Europe (Bologna process) and the United States that emphasise a more general undergraduate degree that leads to post-graduate qualifications in areas of specialisation.

A 2010 Australian Universities Quality Agency (AUQA) audit, which focused in on the BSc, captured the on-going review process and discusses in the departments that teach into the Life Sciences majors. Questions such as '*why they were doing what they were doing*' were under-way with some academics in the Life sciences indicating that students were graduating under-prepared for the quantitative requirements of the disciplines.

In the Bachelor of Biomedicine, the switch to the Melbourne Model prompted discussions around the program structure and desirable outcomes. The broader environmental phenomena influenced thinking on the curriculum. Advances in the field of Biomedical Sciences and the recognition of the increasing need to apply mathematics and statistics influenced thinking around the need for QS.

Vision for Change

"What do QS in Science look like?"

The University of Melbourne has institutional graduate attributes.

The BSc at Melbourne has further contextualised the institutional graduate attributes into their handbook featuring statements that assume QS:

- *understand the principles of sound project and experimental design, including data analysis*
- *apply outstanding analytical, quantitative and technical skills to problem solving and, where relevant, design*

The Bachelor of Biomedicine has adapted the BSc attributes and the QS that underpin the above statements.

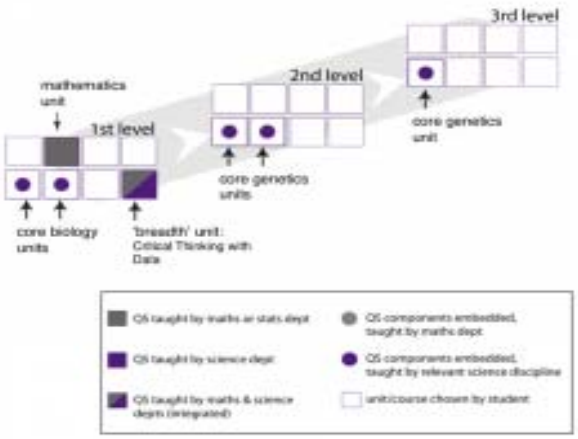
Neither program has explicitly articulated QS standards or mapped them to the curriculum. However, curriculum mapping of graduate attributes is underway in the Life Sciences majors in BSc.

Implementing for Change

"How is need for QS in Science translated into practice?"

The BSc. The BSc has no core, shared units in the degree program. There are 18 Life Sciences majors in the BSc that incorporate QS via core biology units. However, the plethora of majors and the flexible nature of the degree program enable students to mix and match units in the life sciences majors.

Curriculum Structure for building QS: Bachelor of Science, Life Sciences majors with a focus on the genetics major in 2nd and 3rd year. The above diagram shows the 'critical QS pathway', highlighting the requisite units for the major.



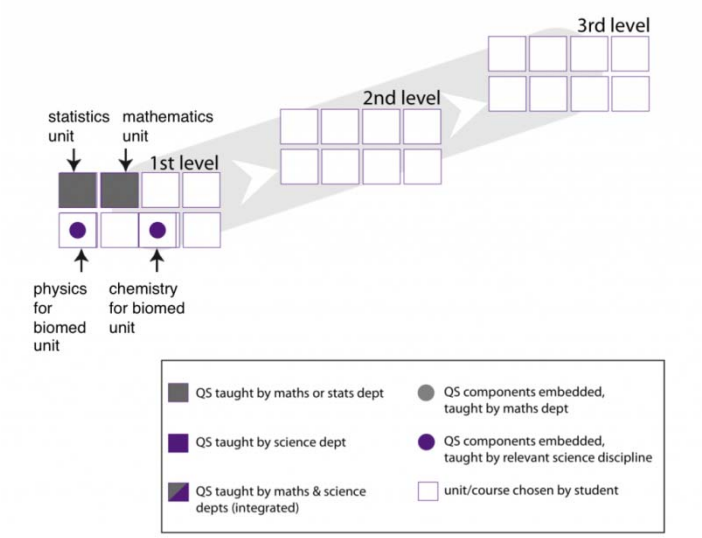
1st level features—for the 18 life sciences majors—two core biology units that both include substantial elements of embedded QS, which are taught by biologists. Prior to the Melbourne Model these majors listed a statistics unit—taught by the statistics department—as pre-requisite for upper level units. This was dropped for a range of reasons. Given that all Science students enter with a calculus-based mathematics requirement, the philosophy is to build on that knowledge base in the context of the discipline with QS provided in context and 'just in time' to increase actual and perceived relevance. It is common for life science major students to choose a mathematics or statistics subject in their first year, and also other science subjects such as Chemistry and Physics in which students' QS are further developed. In addition, a University-wide 'breadth' unit was introduced in 2008, Critical Thinking with Data, that is available to all students.

2nd level features core units in the more specific majors, which varies given the need for QS in the discipline. In the genetics, QS is further embedded in the core units.

3rd level features core units in the genetics majors that further embeds QS in the context of the discipline.

The BSc has no core, shared units in the degree program. There are 29 life sciences majors in the BSc that incorporate QS via core biology units. However, the plethora of majors and the flexible nature of the degree program enable students to mix and match units in the life sciences majors.

Curriculum Structure for building QS: Bachelor of Biomedicine is a far more structured degree program.



1st level features a philosophy of building a strong mathematical and statistical knowledge base along with chemistry and physics units that are underpinned by QS. There are three mathematics units in place (Calculus 1, Calculus 2, and Linear Algebra) with students required to complete one based on the level of high school mathematics and level of proficiency. The statistics unit is designed around experimental design and data analysis with biomedical examples.

2nd level features two required block units that represent 50% of second level units. These units are inherently interdisciplinary although the QS requirements are not substantial. The goal is to introduce some mathematical modelling. Students can select three science units and one 'breadth' unit.

3rd level features two required Biomedicine units although these do not have substantial QS components at present. Students have options to select units based on their major within the program along with 'breadth' units.

Extra Curricular QS: The University of Melbourne has a well-resourced Mathematics and Statistics Learning Centre that provides institutional support for the development of mathematical and statistical knowledge via drop-ins to compliment units run by the mathematics and statistics departments. They also offer enrolment advice for mathematics and statistics units. The Statistical Consulting Centre coordinates the University-wide 'breadth' unit, Critical Thinking with Data, and has developed a series of real world, online case studies that are included in various units called Realstat. Contact Sue Finch for access to Realstat.

Interdisciplinary QS: The University has a hierarchy of committees that focus on curriculum and teaching/learning. At the degree program level, which is cross-faculty, there is a 'Course Committee'.

The overlap in the BSc and the Bachelor of Biomedicine has resulted in a single 'Course Committee' for the two degree programs. At the Faculty level in Science, there is an 'Undergraduate Programs Committee' which can propose the approval of new units to the 'Course Committee'.

Evaluating the Change

"How effective has the change to build QS in Science been?"

Institutional standardised evaluation procedures are in place at the University of Melbourne, including general unit surveys and the Melbourne Student Experience Survey.

Evidence of QS learning outcomes: To date there has been no formal evaluation on the effectiveness of the changes in the curriculum to build QS or other science-specific graduate attributes, in either the Bachelor of Biomedicine or the Life Sciences majors in the BSc.

Thanks to the following people at the University of Melbourne for collaborating with us to document this Case Study, both in the Bachelor of Biomedicine and the Biological Sciences majors in the BSc:

Mark Hargreaves, Professor of Physiology and Director of the Bachelor of Biomedicine until 25 Sept 2012
David Williams, Professor of Physiology and Director of the Bachelor of Biomedicine from 25 Sept 2012
Michelle Livett, Associate Professor of Physics and Director of the Bachelor of Science
Deborah King, Director of the Maths and Stats Learning Centre
Dawn Gleeson, Associate Professor of Genetics
Mary Familari, Lecturer in Biology
Sue Finch, Statistical Consultant, Statistical Consulting Centre, Department Mathematics and Statistics

If you have any questions or comments on the University of Melbourne case study, you are welcome to contact them directly.

This case study is up to date as of October 2011. The interviews to gather this data were conducted in May 2011 with further communications in September 2011.