Australian Council of Deans of Science

STEM in Australia: The statistical patterns of university science and technology in the twenty-first century

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The Educational Policy Institute Pty Ltd,
TAPRI & Monash University

A study commissioned by the
Australian Council of Deans of Science 2018

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Chapter 1
Introduction

This study is a continuation of a series carried out by this author commissioned by the Australian Council of Deans of Science (ACDS)[1]. Another report on university science statistics between 2002 and 2009-2010[2] commissioned by the Office of the Chief Scientist, and again conducted by this author, also forms part of the series. The purpose of these reports is to identify and analyse trends in enrolments in science and technology in the Australian university system.

This study differs from these earlier studies in that it has been extended to cover all the so-called STEM areas of science, technology, engineering and mathematics. In the context of Australian higher education, the earlier studies covered only the Natural and Physical Sciences (which includes mathematics) from the national broad *Field of Education* classification, whereas the current study also includes analysis of three other broad Fields of Education: Information Technology, Engineering and Related Technologies, and Agriculture, Environmental and Related Studies.

Between them these studies have covered the period from 1989 to 2015, and they provide the opportunity to review the picture provided by the series as a whole. One would expect the data to provide a clear and unambiguous picture of the way that science enrolments have changed, and what influenced these changes, over this 26-year period, in both broad terms and in detail. The source of data across the period covered in this report is the Commonwealth of Australia 'education department'. This entity has had many names over the years, and for simplicity's sake, it has been described as 'the Department' when being cited as a source. The format of the statistics used has been hard copy published and user-specified statistics, tables generated from data files made available by the Department, and more recently, from an online 'data cube' system called uCube[3].

However, this is not the case; several factors have had an impact on the exact coverage of higher education statistics. Over this period there have been

- structural changes such as the so called 'Melbourne model'
- ambiguity in the way that institutions report the statistics
- changes to the way in which the government collects these statistics
- modifications that it has made to the raw data
- changes to the form in which it releases the data.

These elements make direct interpretation of the data at times dubious and sometimes quite misleading.

It is the purpose of this chapter to provide the reader with an overview of these confounding influences, so that they can be readily identified when they occur in the data analysed in the body of this report, and they should be kept in mind when discussing these statistics generally.

Some influences are more easily discerned than others. For example, in 1989 the university student population increased from about 195,000 in the previous year to over 441,0000. This seemingly

1 Dobson, I. & Calderon, A. (1999). Trends in Science Education: Learning teaching and outcomes 1989 – 1997. ACDS. ISBN 0-7326-2104-6

Dobson, I. (2003). Science at the crossroads? A study of trends in university science from Dawkins to now 1989 – 2002. ACDS. ISBN 0-7326-2250-6.

Dobson, I. (2007). Sustaining science: University science in the twenty-first century. ACDS. ISBN 978-0-9803939-0-3.

2 Dobson, 2012. Unhealthy Science? University Natural and Physical Sciences 2002 20 2009/10. A study commissioned by the Office of the Chief Scientist.

3 Go to http://highereducationstatistics.education.gov.au/

remarkable increase is simply the result of creating the 'unified national system' of universities from an antecedent binary system of universities and teaching-focussed colleges of advanced education[4]. Therefore, 1989 is when Australia's university sector was augmented by the numbers from the pre-Dawkins colleges. In the 1988 Selected Higher Education Statistics, universities' and colleges of advanced education statistics were reported separately, something that was no longer necessary from 1989.[5] By commencing the studies for the ACDS from 1989, this problem was avoided and justifiably focuses on science enrolments in the unified national system.

The 'Melbourne Model'

Less obvious but no less confounding is the effect of the graduate school model adopted by the University of Melbourne, which was phased in from 2008, the so-called 'Melbourne Model', and the University of Western Australia from 2012. Table 1.1 demonstrates the impact on enrolment patterns for the University of Melbourne. It shows that between 2007 and 2015, nearly 3,000 more students were undertaking bachelor's degrees in the Natural and Physical Sciences (+47 per cent), and in Agriculture, Environmental and Related Studies, the growth has been nearly 2,000 students (+256 per cent).

Table 1.1 Enrolments: Students Enrolled in Bachelor's Degrees: University of Melbourne 2007 – 2015*

	2007	2008	2009	2010	2011	2012	2013	2014	2015	Growth No.	Growth %
N&P Sciences	6,416	6,361	6,487	6,853	7,631	8,154	8,499	8,694	9,402	2,986	47%
IT	957	705	477	295	138	50	6	2		-957	-100%
Engineering	3,646	3,334	3,092	2,649	1,847	1,095	565	224	68	-3,578	-98%
Agriculture	763	1,000	1,449	1,892	2,216	2,357	2,476	2,593	2,719	1,956	256%
Subtotal STEM	**11,782**	**11,400**	**11,505**	**11,689**	**11,832**	**11,656**	**11,546**	**11,513**	**12,189**	**407**	**3%**
Architecture	1,710	1,241	792	349	142	42		2		-1,710	-100%
Health	3,277	3,436	3,146	2,664	2,011	1,357	754	157	115	-3,162	-96%
Other	17,221	16,629	15,782	15,034	13,831	12,584	12,309	12,653	13,383	-3,838	-22%
Total	**27,862**	**27,738**	**27,526**	**27,174**	**26,194**	**24,850**	**24,318**	**24,299**	**25,678**	**-2,184**	**-8%**

Source: The Department. uCube.

The dramatic jump in BSc enrolments at the University of Melbourne from 2007 to 2008 is largely due to the transference of undergraduate engineering students into the BSc. In 2007 some 900 or so students commenced engineering degrees. From 2008 all such students enrolled in the BSc. National figures for BSc enrolments are significantly perturbed by this change, and by the counterpart change at The University of Western Australia from 2012.

National undergraduate enrolments in the Engineering and Related Technology Broad Field of Education are also significantly reduced by this change. Overall enrolments in this field, that include postgraduate studies, begin to pick up from 2011 when intending engineers begin to graduate from the BSc and enrol in the appropriate postgraduate engineering courses to obtain professional registration.

4 Until the so-called Dawkins reforms of the late 1980s / early 1990s, Australia had research-oriented universities and teaching-oriented institutions known as colleges of advanced education or institutes of technology. Among Dawkins' reforms was the creation of a unitary system (of universities), effected by a mixture of mergers/takeovers and institutional redesignations.

5 See Department of Employment, Education and Training. Selected Higher Education Statistics – 1988 and Department of Employment, Education and Training. Selected Higher Education Statistics - 1989.

More remarkable, and of greater national impact, is the increase in enrolments in Agriculture, Environmental and Related Studies. Prior to 2008, intending architecture students would have enrolled in a bachelor's degree in the Architecture and Building Broad Field of Education. From 2008 onwards, it appears that many of the University of Melbourne's intending architects enrolled in the newly-created Bachelor of Environments, which was classified by the University as a course in the Agriculture, Environmental and Related Studies Broad Field of Education. This explains the phenomenal growth in Melbourne's contribution to national enrolments in the broad field of Agriculture, Environmental and Related Studies. Perhaps this problem will start to evaporate from 2017, because with respect to the training of future architects, the University announced some time ago that 'The Bachelor of Environments is not accepting applications for 2017 entry'[6]. The programmes to replace the Bachelor of Environments might be linked to a more appropriate Field of Education, one that better reflects the training of architects. Of course, the consistency of the time series has been disrupted forever.

The potential for policy misdirection will be clear from Table 2.1 (in the next chapter). It shows that the nation-wide pattern for Agriculture, Environmental and Related Studies was that it stayed pretty much the same size between 2002 and 2015. However, far from inferring a stable production of expertise in agriculture and environmental science, the increase at University of Melbourne by nearly 2,000 between 2007 and 2015 means that there must have been reciprocal declines elsewhere in the sector. The national aggregate figures mask a significant national shortfall.

An examination of the definitional criteria for the field of Agriculture, Environmental and Related Studies provides a strong argument that the inclusion of future architecture students constitutes a significant misclassification and, from the point of view of policy and transparency of data, a significantly damaging one. It is hard to see how the Bachelor of Environments degree meets the criterion that the '…main purpose of this Broad Field of Education is to develop an understanding of the management and use of natural resources, and the production of primary agricultural products'[7]

A further indication of the impact of the Melbourne Model on the Agriculture, Environmental and Related Studies can be seen below in Table 4.9a. This table shows a remarkable increase in the amount of teaching to students in courses classified as Agriculture, Environmental and Related Studies in subjects in the Architecture and Building Broad Discipline Group from 66 EFTSL to 829 EFTSL (an increase from less than one per cent to just over nine per cent of all teaching to those students). Deeper analysis would show that nearly all of this remarkable change is related to practices at the University of Melbourne.

Table 1.2 shows analogous impacts from The University of Western Australia's adoption of a graduate school model. Most, perhaps all STEM undergraduate teaching has been moved into undergraduate courses in the Natural and Physical Sciences. Perhaps this also explains the decline in bachelor's degree enrolments in Health.

6 See http://edsc.unimelb.edu.au/undergraduate/course-planning/sample-course-plans-bachelor-of-environments

7 See http://heimshelp.education.gov.au/sites/heimshelp/resources/pages/field-of-education-types#Section5

Table 1.2 Enrolments: Students Enrolled in Bachelor's Degrees: University of Western Australia 2011 – 2015*

	2011	2012	2013	2014	2015	Growth No.	Growth %
N&P Sciences	4,809	6,609	7,996	9,046	8,218	3,409	71%
IT	336	241	157	74	32	-304	-90%
Engineering	3,420	2,593	1,949	1,238	638	-2,782	-81%
Agriculture	351	265	157	81	25	-326	-93%
Subtotal STEM	8,916	9,708	10,259	10,439	8,913	-3	0%
Architecture	742	747	724	669	638	-104	-14%
Health	1,909	1,562	1,226	914	576	-1,333	-70%
Other	10,613	10134	9789	9221	8060	-2,553	-24%
Total	18,478	19,392	19,942	19,871	17,368	-1,110	-6%

Source: The Department. uCube.

The critical point is that graduate school-style models change the nature of the national enrolment time series for good. The 'Melbourne Model' has changed what university enrolments mean by dovetailing students into fewer undergraduate degrees, then having those students re-enrol in master's by coursework degrees in order to gain professional accreditation. It is therefore the case that since 2008, the number of undergraduate students in Natural and Physical Sciences programmes has increased, in a sense, 'artificially'. In addition, students who would have previously enrolled only in an undergraduate degree to gain professional standing in say, engineering or architecture, now have a subsequent postgraduate enrolment; as four-year professional undergraduate degrees have been replaced by a three-year BSc, followed by a two-year master's degree.

Major changes to counting and classification

There have been two substantial shifts of definition in the data collection methodology relevant to the period 1989 – 2015. First, from 2001, separate *Field of Study* and *Discipline Group* classifications were replaced by a common classification of *Fields of Education* and *Discipline Groups*.

Second, until 2001 the number of students enrolled at Australian universities had been compiled according to a census methodology based on the number of students enrolled as at 31 March each year. In 2002 a revised methodology counted students enrolled at any stage of the year, rather than on a single date. That is, the 2002 enumeration methodology is based on counting every student enrolled at some time during the year, whereas the previous methodology was based on the count on a single annual census date. It could be argued that the post-2001 methodology is more accurate in one sense, but census date methodologies are more familiar, and easier to comprehend.

The change of methodology, by definition, increased the number of Natural and Physical Sciences students in 2001 by about seven per cent, from 62,000 to more than 66,000. The impact on the other STEM fields of education was an increase of 19 per cent in Information Technology, nine per cent in Engineering and Related Technologies, and about ten per cent in Agriculture, Environmental and related studies.

It is important to appreciate that these two changes (of classification groups and counting methodology) mean that accurate and detailed longitudinal comparisons using hard copy published sources before 2002 are no longer an option.

Modifications to the data

The 2002 change in enrolment enumeration artificially increased the number of people included in counts as 'students' compared with earlier years. In an apparent attempt to 'smooth' out the resulting discontinuity in enrolment time series the Department arbitrarily changed its on-line uCube statistics for 2001 to make these figures consistent with years 2002 and onwards. The uCube system now reports a total of 842,183 students in 2001, whereas the hard-copy published statistics for 2001 show that Australian higher education institutions had 726,418 students[8]. (That is, there is a difference of about 16 per cent in the original 'official' published figure for 2001, compared with the 'new official' published figure for 2001).

For the sake of transparency, the Department's statistics should acknowledge that the 2001 figure now provided is an estimate of what might have been reported under the post 2002 enumeration methodology. In fact, the Department seems to have suppressed the 2001-2 figures by publishing statistical tables on line only from 2004, and the two sets of higher education time series on the Department's website run from 1949 to 2000, and 2003 to 2008, omitting years 2001 and 2002[9].

Changes to the way statistics are reported.

Higher education statistics are compiled by the Department's staff from data files supplied by universities. Until 2011, the Department's staff compiled aggregated data sets which were available to staff and researchers from universities and others, to download from their Departmental website. These data sets enabled a wide range of analyses on universities and their students to be undertaken.

Unfortunately, this system has been abandoned, and replaced with an on-line 'data cube' system, which though excellent in its own right, does not permit statistical analysis to the same level of detail. It would seem that there had been concerns about privacy. In addition, the Department's staff continue to publish a large number of summary tables at a range of levels of detail[10]. More detailed tables can be purchased for a time-based fee.

The higher education system's data integrity relies on universities adhering strictly to the definitions. These are contained in on-line data element dictionaries and glossaries that assist university staff in understanding the scope of what has to be collected. Data elements defined for the student collection include matters relating to the students themselves, such as their sex, date of birth, permanent and semester residence information (collected in the form of postcodes or overseas country codes), and background information on students' country of birth, year of arrival in Australia, language spoken at home, and Indigenous status. The student-sourced information is provided to universities at the time of enrolment. Another set of information on students is generated by universities: students' basis of admission, attendance mode (internal or external or a mixture of the two), attendance type (full-time or part-time), and their liability for, or exemption from, paying fees of various types.

Still more information is provided by universities about the level, duration and name of the courses they offer, and the subjects taught in those courses[11], and the characteristics of the teaching departments

8 See Department of Education, Science and Training. (2002). Selected Higher Education Statistics. Students 2001. No longer available on-line.

9 See The Department. https://www.education.gov.au/selected-higher-education-statistics-time-series-data

10 The Department. See https://www.education.gov.au/student-data

11 In brief, the terminology adopted here is that a 'course' is a study programme, such as BSc, BA, MBA or PhD. The components of courses are 'subjects'. For instance, a first-year student enrolled in a BSc degree might be taking Mathematics 1, Chemistry 1, Physics 1 and Biology A. Some courses, such as PhD may not have any classroom component, and therefore may not be comprised of subjects as such. It is also the case that some students enrol in more than one course.

which teach those subjects. Since 2001, universities have coded the courses they offered so they can be aggregated into *fields of education*. Quoting from the Department's documentation,

> The field of education classification is used to describe the principal subject matter of higher education and VET courses and units of study. This is also referred to as the Australian Standard Classification of Education (ASCED). Its main purpose is to ensure courses, specialisations and units of study with the same or similar vocational emphasis are reliably classified as belonging to the same "field of education". It is used nationally in all administrative and survey collections which incorporate data on education by field.[12].

The subjects that students study within those courses can similarly be coded into 'discipline groups', an identical classification to the field of education classification.

The situation before 2001 for classifying courses and subjects has been written up in earlier studies.[13]

The current Field of Education classification is divided into 12 *broad* fields of education and sub-divided into 83 *narrow* fields of education and 439 *detailed* fields of education. These are expressed with a two-, four- and six-digit code, respectively. Despite this wealth of diversity, the field of education classification is not necessarily of much value at levels of detail beneath the Broad Field of Education (the two-digit level), particularly in bachelor's degrees.

Within the Natural and Physical Sciences, there are 37 six-digit *detailed fields of education* to which universities could classify the science courses in which their students were enrolled, yet about half of 'science' students are enrolled in generalist degrees. The point of this is to show that the mere existence of a classification containing 37 detailed options does not provide real detail of enrolments. Of course, some students ARE reported as being enrolled in more specifically-described courses. These include courses in fields such as medical science, forensic science, food science, and laboratory technology, but the great majority of 'BSc' students have been reported as being enrolled in a generalist degree. Students, particularly those in bachelor's degrees typically enrol in a degree that can only be classified in a general manner. Students enrolled in generalist BSc degrees, for example, might eventually specialise in one or two science majors, but no matter how detailed the field of education classification is, the BSc course can usually be described only in a very general way. First year students often will not know whether they will eventually major in mathematics, chemistry or biology (for example). It is likely, therefore, that the BSc course will be classified by universities in some very 'general' way.

For these reasons, it is necessary to be wary when comparing patterns at different universities, or when comparing trends in Australia with trends in other countries. For instance, statements comparing Australia's university enrolment or graduation patterns compared with other nations need to be taken with a grain of salt, pending knowledge of what is being compared, and what information was supplied by either Australian, or overseas national counting houses. The main point is that although it is useful to aggregate courses according to their content, simply having a highly-detailed classification does not ensure comparability between universities unless identical coding practices are observed by all those universities. Many university courses, particularly at the undergraduate level, are generalist degrees.

12 Department of Education and Training. (n.d.). HEIMS Help.

13 See for example, Dobson, I. (2007). Sustaining science: University science in the twenty-first century. ACDS. ISBN 978-0-9803939-0-3.

Programmes of study that do not lead to a formal degree, diploma or certificate, but which comprise subjects that are part of an award course, are described as non-award courses.

The terminology used in the Field of Education classification is identical to the Discipline Group classification, but the distinction between the two is that 'fields of education' refers to enrolments of students in courses, and 'discipline groups' refers to enrolments in subjects the students study in their courses. Figure 1.1 provides a list of broad fields of education / discipline groups, and Appendix 2 is a list of the field of education / discipline group classification, down to the detailed level for the areas covered in this study.

Figure 1.1: Broad Fields of Education / Broad Discipline Groups). Full descriptions and abbreviated forms used in the text and tables

Code	Full description	Short description used in tables and figures in this study
01	Natural and Physical Sciences	N&P Sciences
02	Information Technology	IT
03	Engineering and Related Technologies	Engineering
04	Architecture & Building	Architecture
05	Agriculture, Environmental and Related Studies.	Agriculture
06	Health	Health
07	Education	Education
08	Management and Commerce	Management
09	Society and Culture	Soc. & Culture
10	Creative Arts	Creative Arts
11	Food, Hospitality and Personal Services	Food, Etc.
12	Mixed Field	Mixed
00	Non-Award	Non-Award

University statistics: yesterday and today

In some respects, Australian higher education statistics are among the best available in the world, even if they are not as good in 2018 as they had been in 2010. The system documentation provides universities with clear guidelines for universities to follow. Data validation computer programmes ensure that inconsistent reporting is kept to a minimum, but some universities, for example, report graduate numbers in more detail than others. Some universities report bachelor's degree civil engineering graduates as '0309 Civil Engineering' whereas others will report all graduates (irrespective of the narrow field of education) as '0300 Engineering and Related Technologies – General', or even '0399 Engineering and Related Technologies nec' ('not elsewhere classified'). In these circumstances, an accurate answer to a question about how many graduates qualified in civil engineering in 20XX can be problematic. Chapter 5 has a detailed analysis of STEM course completions.

Areas of shortcomings and inconsistencies in the detailed application of statistical variables in statistical collections of student data are mentioned elsewhere in this study. Now that people outside the Department no longer have access to data files, it is not possible to check on the consistency of universities' data.

Another consequence of this privacy issue is that in effect, there can now be more than one 'official' figure. Once the figures available via the Department's on-line uCube system are broken down into more detail, there can be minor differences in the figures. The following statement appears in the 'notes' section of uCube:

> The data cube does allow customised tables to be produced with cells containing very small counts. To avoid any risk of disseminating identifiable data, a disclosure control technique called input perturbation has been applied to the data, with the exception of grand totals, whereby small random adjustments are made to cell counts. These adjustments (otherwise known as noise) allow for a greater amount of detailed data to be released and, as such, do not significantly impair the utility of the tabular data for use in broad level analysis. However, the relative impact of perturbation is larger for small cell counts, which therefore should be used with caution. Where unperturbed figures are required, users should consult the Higher Education Statistics published on the department's website.

Private correspondence with the Department also advised that 'Historically there have been some quite large differences between uCube numbers and other published numbers'.

At time of preparation, information for years 2001 to 2015 was available via the aforementioned cross-tabulation program called uCube. Data for 2016 were added to uCube late in 2017. Information in more detail than the 'normal' published data for years 2002 – 2015 was purchased from the Department. The system is that purchasers specify the rows and columns they want in a table. As with the Department's published tables, low-count cells are indicted as '< 5', and other cells in rows and columns are 'not published' ('np'), so that it is not possible to work out the individual cell values by difference from row or column totals. An unfortunate aspect of this 'system', is that there are a couple of fields of education containing sub-degree courses that are scarcely of university-level status taught by few institutions. It is in these fields ('Food, Hospitality and Personal Services', and 'Mixed Fields') that low cell counts are most likely. Unfortunately, it is often the case that a 'np' cell is one that is of specific interest. However, there are ways around these pseudo-privacy inanities, and one can usually work out the values of the cells in which one is interested. Of course, one way to obviate the problem is to order tables that exclude the low-count fields of education. Other published data sources allow for such rows of data to be added back later, if one so wishes.

The source of all the tables produced for this study is identified below each table. The three options all emanate from the Department; they are uCube (the Department's on-line data cube system), published tables, available from the Department's website, and special tables purchased from the Department.

The next chapter presents overall background data to provide a context for the more detailed analysis in Chapters 3, 4 and 5.

Chapter 2

The sector 2002 – 2015: A summary of nation-wide patterns in learning, teaching and course completions

This chapter is concerned with overall developments (statistically speaking) since the configuration of the sector in its current form from 2002. Looking at the sector in this way provides a contextual starting point for a more detailed examination of the STEM fields and disciplines – science, technology, engineering and mathematics. This chapter examines data for all students, enrolled in courses at all levels, considering a range of variables. The tables produced here have been derived from the Department's web-based uCube 'drag and drop' table builder, from hard-copy or standard tables published by the Department, or from tables purchased from the Department's university statistics section. It should be noted that many of the tables produced via uCube or purchased from the Department do not 'add up' in their raw form, because some students are enrolled more than one course. In other words, a student enrolled simultaneously in a BSc and an engineering degree will produce an enrolment in each of the rows for Natural and Physical Sciences and Engineering but will appear in the year total only once.

The units of measurement in this chapter are first, student enrolments in courses, followed by an analysis of the teaching and learning of science by analysing 'student load', and finishing with a brief examination of course completions since 2002. Definitionally-speaking, and paraphrasing text from the Department's website, a student is 'enrolled' if he or she has been admitted to a programme offered by a higher education provider at the census date, or if that person is still entitled to continue with their studies and has not formally indicated before the census date that they have withdrawn from or deferred their studies[14].

The term 'university' has been used throughout this document, but in fact, not all the students shown in these tables are enrolled at universities. Included in more than 1.4 million higher education enrolments for 2015 are 98,706 students enrolled in courses offered predominantly by private higher education providers. Within this total, nearly half were enrolled in private institutions in New South Wales, and about one-quarter in Victoria. These institutions are a 21st century phenomenon, and growth has been spectacular. In 2002, enrolments courses offered by private institutions totalled just 375 students.

Sector-wide enrolments

The principal focus of this study is the STEM fields, so it would seem appropriate to start with a table that follows changes in enrolments in these Broad Fields of Education between 2002 and 2015. Later chapters follow up with a more detailed examination of what has happened this century in the STEM Fields of Education and Discipline Groups.

Table 2.1 shows enrolments in courses offered by Australian universities and other 'higher education providers' for selected years in the period 2002 to 2015, by Broad Field of Education. Given this study's focus on the STEM areas, the STEM-predominant Fields of Education have been emphasised. In full, with the abbreviated descriptions (as used in most tables) in brackets, these are

14 Department of Education and Training. (n.d.). HEIMS Help. Retrieved from http://heimshelp.education.gov.au/sites/heimshelp/resources/glossary/pages/glossaryterm?title=Enrolment]

01 Natural and Physical Sciences (N&P Sciences) (which includes Mathematics)

02 Information Technology (IT)

03 Engineering and Related Technologies (Engineering) and

05 Agriculture, Environmental and Related Studies (Agriculture).

It should be remembered that because students can be enrolled in more than one course (e.g., BSc / LLB) the *number of enrolments* in any table built up from enrolments by Field of Education will exceed the *number of students*. For example, data for 2015 shown in Table 2.1 indicate that 72,857 of the 1,410,133 students enrolled, were enrolled in more than one course.

Table 2.1 shows that enrolments in courses in these four fields of education increased by 32 per cent, against a sector wide growth rate in course enrolments of 56 per cent. Growth, however, has been restricted to Natural and Physical Sciences and Engineering, that grew by 67 per cent and 73 per cent, respectively. Information Technology declined by 23 per cent, and Information Technology's proportion of all enrolments has declined from seven per cent in 2002, to three per cent in 2015. The proportion made up by student enrolments in courses in Agriculture, Environmental and Related Studies was unchanged over the period. In fact, there has been something of a recovery since a decline in numbers in the early years of the century. However, in a sense, this recovery is illusory, because much of the increase has been occasioned by revised enrolment patterns at the University of Melbourne (see explanation in Chapter 1). Within total STEM enrolments, the proportion made up by Agriculture, Environmental and Related Studies declined from eight to six per cent between 2002 and 2015. Other universities also produced increases in the number of enrolments in Agriculture (e.g., Charles Sturt University +264; UNE +336; Newcastle +259), but there were large decreases at several universities, including the University of Queensland -920; Sydney -543; Curtin -423 and Western Sydney -413. These figures were produced from uCube, but are not shown in the tables here.

Outside the STEM fields, the largest Fields of Education are Management and Commerce, Society and Culture, followed by Health. Of these three, Health has shown the strongest upward trajectory, with its enrolments increasing from eight per cent to 12 per cent between 2002 and 2015.

Figure 2.1 provides a visual representation of this, with Health added. From a system-wide perspective, Health appears to have grown relatively at the expense of the STEM fields. As shown in Table 2.1, STEM, Health and other Fields of Education have all expanded numerically, but the proportion of university enrolments in STEM have declined relative to all Fields of Education.

Table 2.2 and Figure 2.2 show course enrolments by all students according to course level. As shown in the previous table, the overall student population increased by 57 per cent between 2002 and 2015 and undergraduate enrolments continue to be the majority course level, representing about 70 per cent of all students in 2002, but declining relatively. Bachelor's degree numbers increased by nearly 305,000 or 49 per cent between 2002 and 2015. Australian higher education will likely reach 1,000,000 undergraduates within a year or so (more than 979,000 in 2015), with more than 65 per cent of these being enrolled in bachelor's degrees. Non-bachelor's undergraduate programmes have increased from about two per cent in 2002 to four per cent in 2015. The rate of growth (200 per cent) has been spectacular, but off a small base. Enabling courses increased their numbers of enrolments, but fewer students were enrolled in Non-Award students in 2015 compared with 2002.

Table 2.1 Enrolments: All Students by Broad Field of Education. Numbers, Percentage & Growth: 2002 – 2015*

Field of Education§	2002	2007	2012	2015	Growth 2002-2015	2002	2007	2012	2015	Growth 2002-2015
	No.	No.	No.	No.	No.	%	%	%	%	%
N&P Sciences	68,626	77,274	100,768	114,650	46,024	7%	7%	8%	8%	67%
IT	79,026	50,877	50,156	60,769	-18,257	8%	5%	4%	4%	-23%
Engineering	61,269	69,670	92,229	106,283	45,014	6%	6%	7%	7%	73%
Agriculture	18,596	16,220	19,581	18,603	7	2%	1%	1%	1%	0%
Sub-Total – STEM	**227,517**	**214,041**	**262,734**	**300,305**	**72,788**	**24%**	**20%**	**20%**	**20%**	**32%**
Architecture	17,861	22,757	29,563	31,221	13,360	2%	2%	2%	2%	75%
Health	97,282	131,003	184,753	221,255	123,973	10%	12%	14%	15%	127%
Education	89,588	101,842	119,834	130,471	40,883	9%	9%	9%	9%	46%
Management	240,836	304,172	334,726	369,945	129,109	25%	28%	25%	25%	54%
Society & Culture	196,065	223,018	278,851	307,577	111,512	21%	20%	21%	21%	57%
Creative Arts	55,034	68,227	86,924	90,586	35,552	6%	6%	7%	6%	65%
Food, Etc.	151	575	303	627	476	0%	0%	0%	0%	315%
Mixed Field	1,893	3,022	8,977	11,123	9,230	0%	0%	1%	1%	488%
Sub-Total – Non-STEM	**698,710**	**854,616**	**1,043,931**	**1,162,805**	**464,095**	**74%**	**78%**	**79%**	**78%**	**66%**
Non-Award	**22,234**	**22,600**	**18,162**	**19,880**	**-2,354**	**2%**	**2%**	**1%**	**1%**	**-11%**
Total Enrolments	**948,461**	**1,091,257**	**1,324,827**	**1,482,990**	**534,529**	**100%**	**100%**	**100%**	**100%**	**56%**
Total Students	**896,621**	**1,029,846**	**1,257,722**	**1,410,133**	**513,512**	**95%**	**94%**	**95%**	**95%**	**57%**
Combined Courses#	51,840	61,411	67,105	72,857	21,017	5%	6%	5%	5%	41%

Source: The Department. uCube.

* Refer to Chapter 1 for an explanation of factors that have disrupted aspects of the statistical time series.

§ Fields of education in this and subsequent tables are shown in code order, and most have been abbreviated. Refer to Figure 1.1.

\# Number of students enrolled in more than one course.

Figure 2.1 Enrolments: All Students by Broad Field of Education: STEM Fields, Health Fields and All Other Fields 2002 – 2015

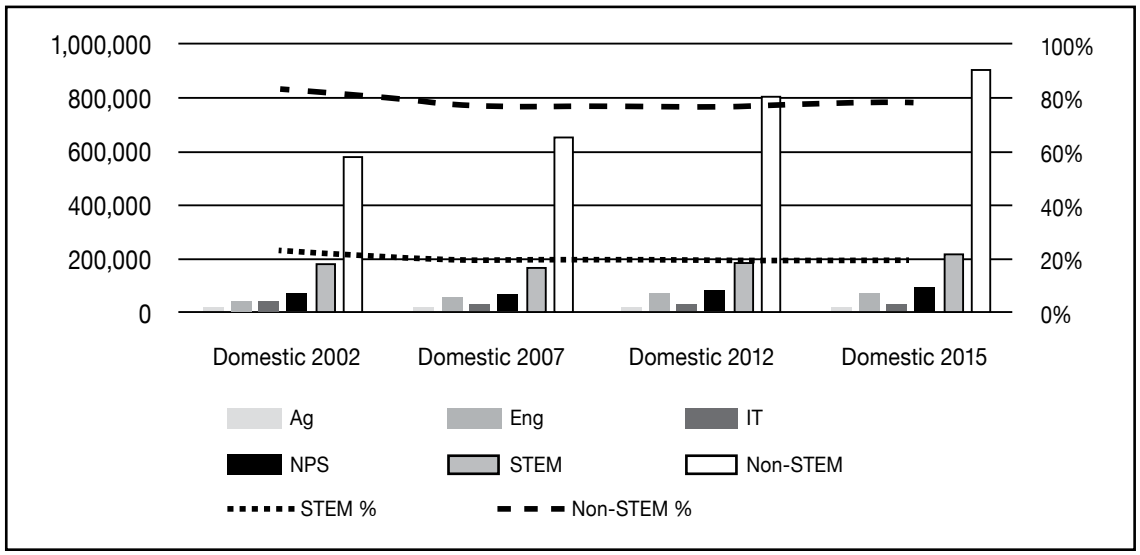


Table 2.2 Enrolments: All Students by Course Level. Numbers, Percentage & Growth: 2002 – 2015 *

Course Level	2002 No.	2007 No.	2012 No.	2015 No.	Growth 2002 – 2015 No.	2002 %	2007 %	2012 %	2015 %	Growth 2002 – 2015 %
Postgraduate										
PhD	34,040	41,427	52,480	57,130	23,090	4%	4%	4%	4%	68%
Masters by Research	10,384	8,951	9,410	8,742	-1,642	1%	1%	1%	1%	-16%
Other Postgraduate	182,572	228,172	266,839	321,455	138,883	20%	22%	21%	23%	76%
Sub-total	226,996	278,550	328,729	387,327	160,331	25%	27%	26%	27%	71%
Undergraduate										
Bachelor	623,453	690,032	849,199	928,449	304,996	70%	67%	68%	66%	49%
Other Undergraduate	16,854	29,668	41,678	50,583	33,729	2%	3%	3%	4%	200%
Sub-total	640,307	719,700	890,877	979,032	338,725	71%	70%	71%	69%	53%
Enabling	7,084	8,771	19,954	23,894	16,810	1%	1%	2%	2%	237%
Non-Award	22,234	22,825	18,162	19,880	-2,354	2%	2%	1%	1%	-11%
Total Students	896,621	1,029,846	1,257,722	1,410,133	513,512	100%	100%	100%	100%	57%

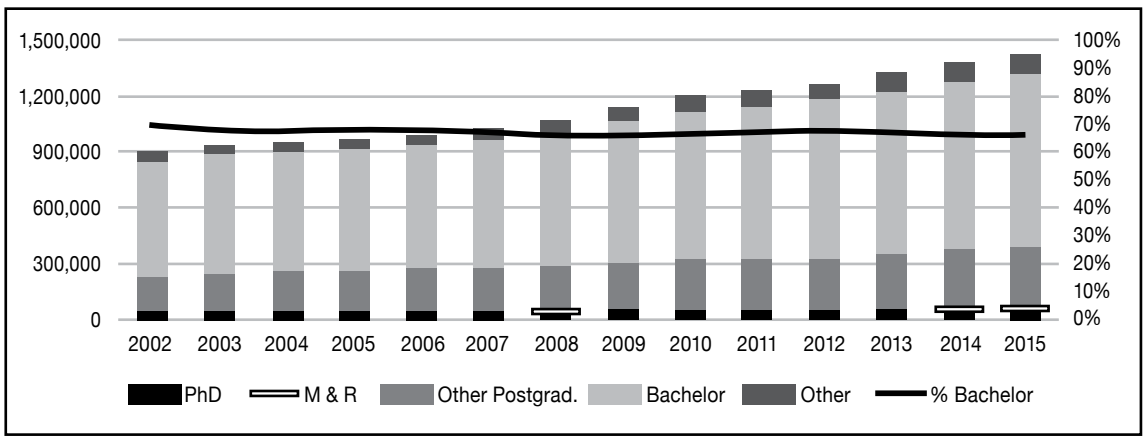
Source: The Department. uCube; Customised Tables.
* Refer to Chapter 1 for an explanation of factors that have disrupted aspects of the statistical time series

After bachelor's degrees, 'other postgraduate' enrolments represent the largest bloc of enrolments. The courses in this category include doctorates by coursework, postgraduate diplomas, master's degrees by coursework and graduate certificates. Enrolments in these programmes have increased from 20 per cent of all university enrolments in 2002 to 23 per cent in 2015. They grew in number by 76 per cent over the period. It can be seen from Table 2.2 and Figure 2.2, that bachelor's degrees and other postgraduate enrolments are the main drivers of enrolment growth, representing over 90 per cent of all enrolments. These will be examined in more detail in Chapter 3.

Higher degree by research enrolments (that is, enrolments in master's degrees by research programmes or PhDs) increased by over 21,000 (+ 68 per cent) over the period, but master's by research enrolments declined by over 1,600 (-16 per cent). The proportion of total enrolments represented by each level changed little over the period. From Table 2.2 it can be seen that higher degrees by research represented about five per cent throughout the period in question. The PhD is an important qualification, because it represents a barrier to entry to many professions, not the least, the academic profession and much of 'science'. It is no longer possible to separate PhD from master's degrees enrolments from statistics available via uCube, but the PhD has been subjected to closer scrutiny in Chapter 3 using purchased tables.

There was also strong growth in enabling courses (+16,810; + 237 per cent).

Figure 2.2 Enrolments: All Students by Course Level 2002 – 2015



Note: M x R refers to master's by research enrolments, but the numbers are so low as to be almost invisible in this graph.

Table 2.3 is a composite table that summarises the system-wide, all course levels situation that shows course enrolments by all students according to gender, citizenship status, attendance type, attendance mode and Indigenous status. Figure 2.3 shows the changes over time in the proportion of women, overseas students, undergraduates, full-time, internal and Indigenous students.

The proportion of women at Australian universities continues to rise. Since 2002, women's proportion of all enrolments has increased from 54 per cent to 55 per cent. The number of women grew by 60 per cent (to over 780,000 in 2015), compared with 54 per cent growth (to 629,693) in the number of men. Women first became the majority gender at Australian universities in 1987[15].

By 2015, the number of international students exceeded 363,000, having grown by 96 per cent since 2002. Over that period, the proportion of overseas students increased from 21 per cent to 26 per cent. One of the main drivers of the trends in higher education enrolments this century has been the increasing number of enrolments by international students. Figure 2.4 enables this to be plainly seen, although expansion was more rapid in the early years of the period under examination. However, this expansion has not been consistent across the Fields of Education, a matter which will be explored in more depth in Chapter 3.

The proportion of students attending university full time has increased over the course of this century, increasing from 64 per cent to 71 per cent. The number of full time enrolments increased by 74 per cent, from 574,374 to over 1,000,000.

Table 2.3 Enrolments: All Students by Gender, Citizenship Status, Attendance Type, Attendance Mode and Indigenous Status. Numbers, Percentage & Growth: 2002 – 2015*

	2002	2007	2012	2015	Growth	2002	2007	2012	2015	Growth
Male#	408,604	463,544	556,540	629,693	221,089	46%	45%	44%	45%	54%
Female#	488,017	566,302	701,182	780,334	292,317	54%	55%	56%	55%	60%
Domestic	711,215	756,571	931,761	1,046,682	335,467	79%	73%	74%	74%	47%
Overseas	185,406	273,275	325,961	363,451	178,045	21%	27%	26%	26%	96%
Full-time	574,374	699,741	882,097	1,000,373	425,999	64%	68%	70%	71%	74%
Part-time	322,247	330,105	375,625	409,760	87,513	36%	32%	30%	29%	27%
Internal	720,150	827,477	983,853	1,048,171	328,021	80%	80%	78%	74%	46%
External	137,018	130,517	169,028	213,632	76,614	15%	13%	13%	15%	56%
Multi-modal	39,453	71,852	104,841	148,330	108,877	4%	7%	8%	11%	276%
Indigenous§	8,871	9,370	12,632	16,156	7,285	1%	1%	1%	2%	82%
Other Domestic§	702,344	747,201	919,129	1,030,526	328,182	99%	99%	99%	98%	47%
Total Students	896,621	1,029,846	1,257,722	1,410,133	513,512	100%	100%	100%	100%	57%

Sources: uCube, except for Indigenous figures, taken from published tables released by the Department: 2002 Selected University Statistics Table 51; 2007 Students Full Year Table 45; 2012 and 2015 Students Full Year Table 6.1

Excludes 106 students for whom there was no information in 2015.

§ Domestic Enrolments; excl. Overseas Students

* Refer to Chapter 1 for an explanation of factors that have disrupted aspects of the statistical time series

More students are enrolling in off-campus or multi-modal programmes than in the past. The proportion of internal (on-campus) enrolments increased by 46 per cent between 2002 and 2015, but the proportion of internally enrolled students declined from 80 per cent to 74 per cent over the period. The number of external students increased by 76,614, or 56 per cent, with multi-modal enrolments increasing spectacularly, by 108,877, or 276 per cent, growing from four per cent of all enrolments in 2002, to 11 per cent in 2015. A multi-modal enrolment is the situation when a unit of study is undertaken partially on an internal mode of attendance and partially on an external mode of attendance. The proportion of external enrolments was 15 per cent at both ends of the period considered here.

15 See Department of Employment, Education and Training (1994). Selected Higher Education Statistics 1993. Table 2.

Indigenous student numbers increased by 82 per cent over the period, but numbers remain low. According to the Australian Bureau of Statistics, in 2011 there were just under 670,000 Indigenous Australians, or three per cent of the total population[16]. However, as a proportion of the university domestic student population, Indigenous students represent just over one per cent.

Figure 2.3 summarises the trends for the groups of students specified in Table 2.3.

Figure 2.3 Enrolments: Proportion of Students with Selected Characteristics: Internal, Undergraduate, Full-time, Female, Overseas and Indigenous Students 2002 – 2015

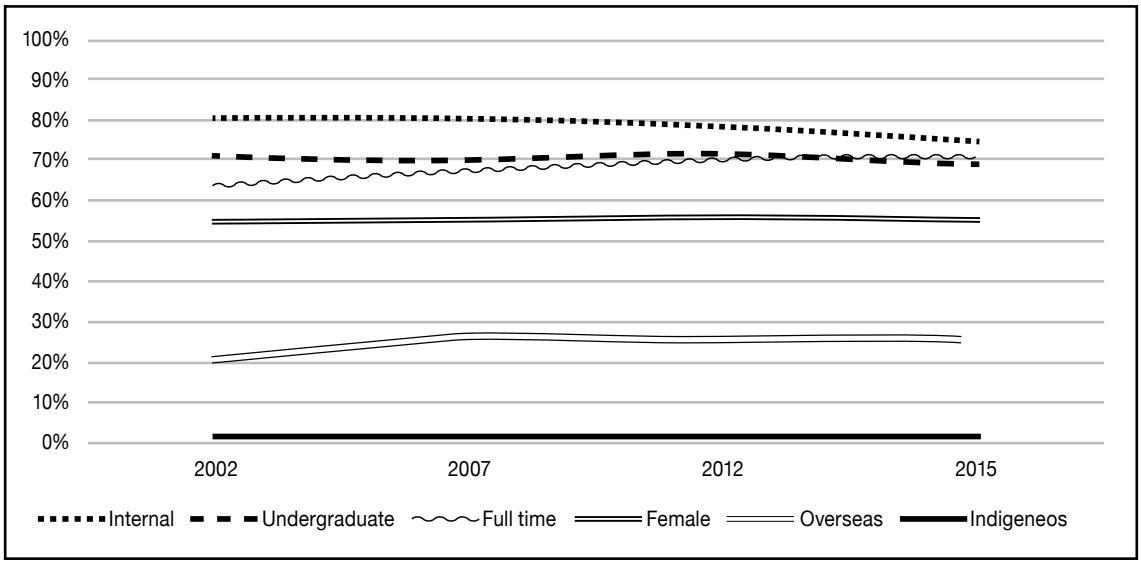


Table 2.4 presents the distribution of university enrolments by state / territory across the sector, over the period 2002 to 2015. A minor imprecision in this distribution is that some universities have enrolments off-shore or in states / territories other than their 'home' state, and the Multi-State institutions (comprising the Australian Catholic University and those non-university private institutions that have campuses in several cities in several states / territories) are spread across states and territories by definition. Perhaps there is a minor inconsistency in the way 'out-of-state' statistics are represented. For example, Central Queensland University students enrolled in campuses in Sydney and Melbourne show as Queensland enrolments. However, the enrolments of students at the Australian Catholic University are located in New South Wales, Victoria and the Australian Capital Territory, but are described officially as 'multi-state'.

There was strong growth in university enrolments in all states and territories. Victoria had over 152,000 additional enrolments in 2015 than in 2002, an increase of 67 per cent. The proportion of enrolments in Victoria increased by about two per cent over the period (from 25 per cent to 27 per cent), whereas the share of enrolments in New South Wales and Queensland dropped slightly. However, New South Wales remains the state with more university students than any other. In 2015, New South Wales and Victoria together had 58 per cent of the nation's university students.

16 ABS. (n.d.). 3238.0.55.001 - Estimates of Aboriginal and Torres Strait Islander Australians, June 2011. Retrieved from http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/3238.0.55.001June%202011?OpenDocument

Table 2.4 Enrolments: All Students by State / Territory. Numbers, Percentage & Growth: 2002–2015*

State/ Territory	%§	2002	2007	2012	2015	Growth	2002	2007	2012	2015	Growth
NSW	32%	289,727	321,482	390,715	430,458	140,731	32%	31%	31%	31%	49%
Victoria	25%	228,397	266,721	326,072	380,990	152,593	25%	26%	26%	27%	67%
Queensland	20%	170,990	192,344	222,972	242,814	71,824	19%	19%	18%	17%	42%
WA	7%	88,632	106,176	134,367	140,452	51,820	10%	10%	11%	10%	58%
SA	11%	60,496	72,917	84,292	96,669	36,173	7%	7%	7%	7%	60%
Tasmania	2%	15,734	19,576	25,572	32,269	16,535	2%	2%	2%	2%	105%
NT	1%	6,450	6,694	10,268	11,938	5,488	1%	1%	1%	1%	85%
ACT	2%	24,285	26,160	36,316	39,660	15,375	3%	3%	3%	3%	63%
Multi-State		11,910	17,776	27,148	34,883	22,973	1%	2%	2%	2%	193%
Total Students	100%	896,621	1,029,846	1,257,722	1,410,133	513,512	100%	100%	100%	100%	57%

Source: The Department. uCube.

* Refer to Chapter 1 for an explanation of factors that have disrupted aspects of the statistical time series

§ %: Distribution of Australian Population, by State. Source: ABS 3101.0 Australian Demographic Statistics September 2016 http://www.abs.gov.au/ausstats/abs@.nsf/mf/3101.0

Column 2 of Table 2.4 also allows for a comparison of state and territory populations compared with their proportion of university students. On the basis of these gross figures, it would appear that university students in the states of Victoria and Western Australia and the ACT are slightly over-represented, and slightly under-represented in New South Wales and South Australia.

Table 2.5 summarises university enrolments by university. Institutions with fewer than 10,000 enrolments and private providers have been wound into the 'Other Institutions' row. Monash University is the nation's largest in terms of the size of its student body, and in 2015, had about 10,000 more students than RMIT. Swinburne University of Technology and RMIT grew the most between 2002 and 2015, adding 22,787 (+159 per cent) and 21,833 (+57 per cent) students, respectively. Monash, the University of Melbourne, Deakin University, the University of Tasmania and the Australian Catholic University also grew by 18-19,000. Only Central Queensland University shrank over the period, by 1,463 enrolments, or seven per cent. 'Other Institutions' demonstrated the most spectacular growth (of more than 102,000), due largely to creation and growth of private higher education in the 21st century.

Recent years have seen changes in the situation for some universities. For example, Monash's Gippsland Campus was transferred to Federation University Australia in 2014, and it is in the process of doing the same with its Berwick Campus. There have also been occasional rumblings about Deakin University and its campus in the regional city of Warrnambool, with suggestions in 2016 about closure of the campus[17], with a later indication that this was not going to occur[18].

17 ABC. Retrieved from http://www.abc.net.au/news/2016-03-11/deakin-university-considering-closing-warrnambool-campus/7240682

18 ABC. Retrieved from http://www.abc.net.au/news/2016-09-20/deakin-university-looks-set-to-remain-in-warrnambool/7862002

Table 2.5 Enrolments: All Students by University. Numbers, Percentage & Growth: 2002–2015*, Ranked by Total Enrolments in 2015

University	2002	2007	2012	2015	Growth 2002 – 2015	2002	2007	2012	2015	Growth 2002 – 2015
	No.	No.	No.	No.	No.	%	%	%	%	%
Monash	51,974	55,760	63,027	70,104	18,130	6%	5%	5%	5%	35%
RMIT	38,222	43,251	54,857	60,055	21,833	4%	4%	4%	4%	57%
Melbourne	39,316	44,221	49,341	58,839	19,523	4%	4%	4%	4%	50%
Sydney	42,260	46,921	52,487	58,579	16,319	5%	5%	4%	4%	39%
U NSW	42,314	42,883	50,695	53,995	11,681	5%	4%	4%	4%	28%
Deakin	33,041	34,257	42,782	51,799	18,758	4%	3%	3%	4%	57%
U Queensland	37,517	37,936	46,646	50,835	13,318	4%	4%	4%	4%	35%
Curtin	33,241	40,381	46,868	50,625	17,384	4%	4%	4%	4%	52%
QUT	39,196	39,349	44,258	48,469	9,273	4%	4%	4%	3%	24%
Griffith	30,967	36,410	41,996	46,019	15,052	3%	4%	3%	3%	49%
Western Syd.	35,345	32,779	40,128	44,831	9,486	4%	3%	3%	3%	27%
UTS	29,255	32,220	36,118	40,727	11,472	3%	3%	3%	3%	39%
Macquarie	27,209	32,194	38,837	40,173	12,964	3%	3%	3%	3%	48%
Charles Sturt	39,781	33,775	38,364	40,093	312	4%	3%	3%	3%	1%
Swinburne	14,375	18,705	27,379	37,162	22,787	2%	2%	2%	3%	159%
La Trobe	24,921	28,648	33,626	35,718	10,797	3%	3%	3%	3%	43%
Newcastle	23,463	26,965	35,046	35,429	11,966	3%	3%	3%	3%	51%
Tasmania	13,759	18,148	25,445	32,193	18,434	2%	2%	2%	2%	134%
ACU	11,910	15,265	24,050	31,715	19,805	1%	1%	2%	2%	166%
Wollongong	18,738	22,275	29,021	31,652	12,914	2%	2%	2%	2%	69%
U SA	30,647	34,343	33,351	31,500	853	3%	3%	3%	2%	3%
U SQ	24,330	24,385	26,901	27,764	3,434	3%	2%	2%	2%	14%
Victoria	19,483	20,930	25,542	27,142	7,659	2%	2%	2%	2%	39%
Edith Cowan	23,863	23,208	26,859	26,940	3,077	3%	2%	2%	2%	13%
Adelaide	16,195	20,157	25,721	26,869	10,674	2%	2%	2%	2%	66%
U WA	15,910	18,657	25,098	25,152	9,242	2%	2%	2%	2%	58%
Flinders	13,654	15,733	21,366	24,335	10,681	2%	2%	2%	2%	78%
Murdoch	12,774	15,338	22,733	23,288	10,514	1%	1%	2%	2%	82%
ANU	11,972	15,404	20,060	22,460	10,488	1%	1%	2%	2%	88%
U NE	18,219	17,409	20,165	21,992	3,773	2%	2%	2%	2%	21%
James Cook	13,228	15,569	20,847	21,656	8,428	1%	2%	2%	2%	64%
CQU	21,744	21,060	18,565	20,281	-1,463	2%	2%	1%	1%	-7%
Canberra	10,422	10,756	16,162	17,110	6,688	1%	1%	1%	1%	64%
Federation	6,632	12,174	12,429	15,109	8,477	1%	1%	1%	1%	128%
Southern Cross	11,988	14,652	14,882	14,618	2,630	1%	1%	1%	1%	22%
U SQ	3,956	6,582	9,786	12,520	8,564	0%	1%	1%	1%	216%
Charles Darwin	5,634	5,961	10,243	11,924	6,290	1%	1%	1%	1%	112%
Notre Dame	2,844	6,244	10,315	11,758	8,914	0%	1%	1%	1%	313%
Other Inst'ns	6,322	48,941	75,726	108,703	102,381	1%	5%	6%	8%	1619%
Total Students	896,621	1,029,846	1,257,722	1,410,133	513,512	100%	100%	100%	100%	57%

Source: The Department. uCube.

* Refer to Chapter 1 for an explanation of factors that have disrupted aspects of the statistical time series

As noted earlier, one of the changes since the start of the 21st century has been the establishment of private higher education institutions. Table 2.6 shows that there were nearly 99,000 students enrolled in these institutions in 2015, representing seven per cent of all enrolments. The incidence of enrolments

in the STEM fields is lower than the overall pattern, however, having risen to three per cent of all STEM enrolments by 2015.

Table 2.6 Enrolments: Students Enrolled in Courses at Non-University Higher Education Institutions 2002 – 2015, Ranked by Total Enrolments in 2015

	All Fields of Education				STEM Fields of Education			
	2002	2007	2012	2015	2002	2007	2012	2015
NSW#	283	18,115	33,367	46,887		708	1,130	2,587
Victoria§	95	7,387	15,499	23,474	95	849	1,522	2,823
South Australia*		2,684	3,854	13,058		117	438	821
Queensland§		5,705	7,395	9,264		77	742	917
Multi-State§		2,511	3,098	3,168				
Western Australia§		2,348	2,494	2,689		371	502	759
ACT§		0	94	90			70	90
Tasmania§		94	127	76				
Total	378	38,844	65,928	98,706	95	2,122	4,404	7,997
Students at All Institutions	896,621	1,029,846	1,257,722	1,410,133	221,319	208,428	257,436	294,475
Non-University %	0%	4%	5%	7%	0%	1%	2%	3%

Source: The Department. uCube.
NSW: described as Non-University Higher Education Institutions (excluding Avondale)
* SA: described as Private Universities and Non-University Higher Education Institutions
§ All other states / territories described as Non-University Higher Education Institutions

STEM enrolments shown differ from those shown in Table 2.1 because multiple enrolments are not included (due to a quirk of UCube)

Student load: teaching and learning

So far, student enrolments in *courses* have been considered. This section examines the *subjects* studied by students as part of the courses they are enrolled in. Whereas *enrolments* measure the number of individuals enrolled in a course, some of whom will be attending full-time and others part-time, student load is a measurement of the number of '*equivalent*' full-time students, dubbed 'equivalent full-time student load' (EFTSL). A full year's work is designated as being 1.000 EFTSL. A student enrolled in four equally-sized subjects that represent a 'normal' year's work would therefore generate 1.000 EFTSL. If another student were to be enrolled in only two such subjects, they would generate 0.500 EFTSL. The concept is therefore important because not all students take a full-year's work in their studies. Therefore, the total student load will always be less than the total enrolments, the latter being a headcount. In 2015, the 1.4 million enrolments generated an equivalent full-time count of just over 1.0 EFTSL. This indicates, therefore that the 'average' student is about 71 per cent full time. Examining EFTSL also provides a metric for the *amount of teaching* being provided.

Subjects are classified into *discipline groups*. The nominal classification is the same as the field of education classification which is used to classify courses, but if the term 'discipline group' is used, it is referring to the subjects that students are enrolled in. Refer to Appendix 1 for a full listing of broad, narrow and detailed Fields of Education / Discipline Groups.

Looking at overall broad patterns of teaching, Table 2.7 summarises the distribution of student load by Broad Discipline Group. It shows that the amount of teaching non-STEM disciplines increased by 66 per cent over the period, compared with an increase of 44 per cent in STEM teaching. In the main, this difference exists because of the decline in Information Technology. The amount of Engineering teaching increased by 93 per cent, and in the Natural and Physical Sciences, the increase was 66 per cent. The teaching of Agriculture, Environmental and Related Studies, the smallest of the 'traditional' university disciplines is quite low, but it increased from 8,931 EFTSL to nearly 13,000 EFTSL over the period.

Among other disciplines, growth was the most spectacular in Health, which increased by 142 per cent, or 81,473 EFTSL. This means that in 2015, subjects in the Health disciplines were being taught to more than 81,000 more equivalent full-time students in 2015 compared with the situation in 2002. The next-largest discipline in terms of growth was Management and Commerce (+78,244 EFTSL, or +68 per cent), followed by Society and Culture (+69,369 EFTSL, or +41 per cent).

Table 2.7 Student Load: All Students by Broad Discipline Group. Numbers, Percentage & Growth: 2002 – 2015

Discipline Group	2002	2007	2012	2015	Growth 2002 – 2015	2002	2007	2012	2015	Growth 2002 – 2015
	No.	No.	No.	No.	No.	%	%	%	%	%
N&P Sciences	73,764	85,713	109,903	122,373	48,609	12%	12%	12%	12%	66%
IT	55,272	37,952	38,431	45,848	-9,424	9%	5%	4%	5%	-17%
Engineering	36,985	41,872	59,872	71,249	34,264	6%	6%	7%	7%	93%
Agriculture	8,931	9,092	12,079	12,964	4,033	1%	1%	1%	1%	45%
Sub-total STEM	**174,952**	**174,629**	**220,285**	**252,434**	**77,482**	**28%**	**24%**	**24%**	**25%**	**44%**
Architecture	12,089	15,070	19,173	20,224	8,135	2%	2%	2%	2%	67%
Health	57,521	81,618	117,350	138,994	81,473	9%	11%	13%	14%	142%
Education	51,525	58,840	70,855	75,569	24,044	8%	8%	8%	8%	47%
Education	51,525	58,840	70,855	75,569	24,044	8%	8%	8%	8%	47%
Management	114,409	149,770	175,979	192,653	78,244	18%	21%	19%	19%	68%
Society & Culture	169,106	191,444	224,995	238,475	69,369	27%	26%	25%	24%	41%
Creative A.	46,621	52,961	71,449	79,800	33,179	7%	7%	8%	8%	71%
Food etc.	120	388	662	1,402	1,282	0%	0%	0%	0%	1068%
Mixed Field	407	1,172	2,345	2,826	2,419	0%	0%	0%	0%	594%
Sub-total Non-STEM	**451,798**	**551,263**	**682,808**	**749,943**	**298,145**	**72%**	**76%**	**76%**	**75%**	**66%**
Total	**626,749**	**725,892**	**903,094**	**1,002,378**	**375,629**	**100%**	**100%**	**100%**	**100%**	**60%**

Source: The Department. uCube.

Figure 2.4 compares teaching in STEM and non-STEM disciplines, abd shows the proportion ot total teaching made up by STEM subjects.

Figure 2.4 Student Load: EFTSL in STEM and non-STEM Disciplines, and STEM % of Total – 2002 – 2015

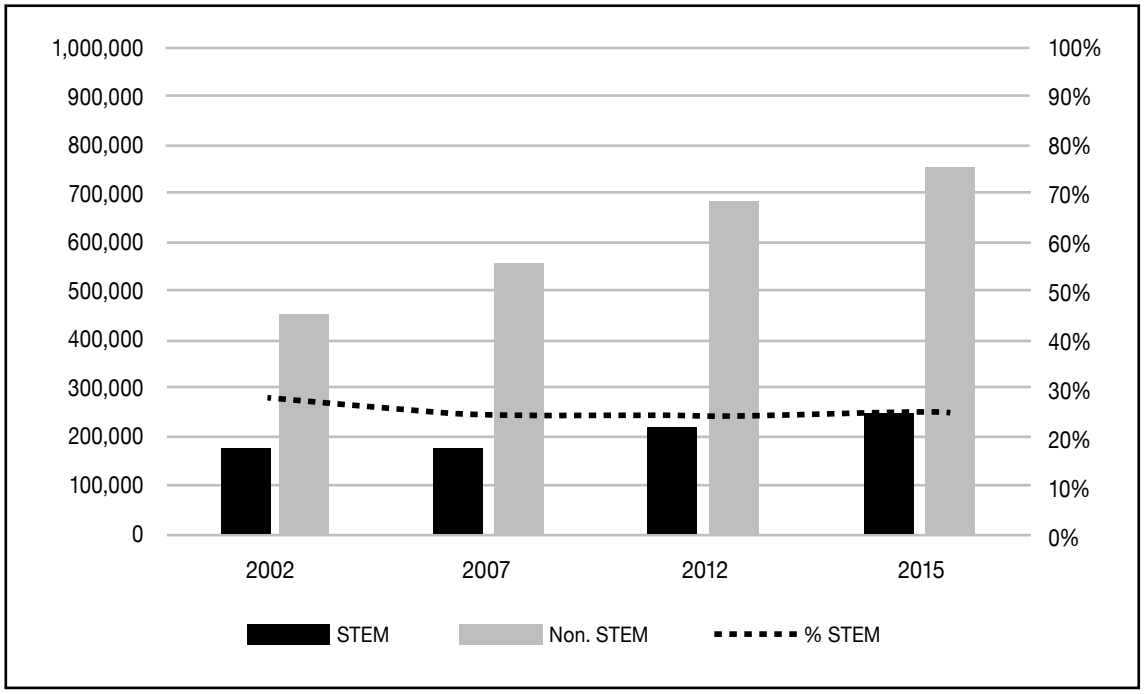


Table 2.8 examines the distribution of student load by level of course. In parallel with patterns relating to enrolments, there has been quite strong growth across most levels of course, with teaching in bachelor's degrees, the most numerous course level, increasing by 47 per cent between 2002 and 2015. Strong growth was also the case in courses at the other postgraduate level.

Table 2.8 Student Load: All Students by Level of Course. Numbers, Percentage & Growth: 2002 – 2015

	2002 No.	2007 No.	2012 No.	2015 No.	Growth 2002 – 2015 No.	2002 %	2007 %	2012 %	2015 %	Growth 2002 – 2015 %
Postgraduate										
PG by Research	30,797	34,659	42,195	46,100	15,303	5%	5%	5%	5%	50%
Other PG	85,753	114,811	139,342	181,448	95,695	14%	16%	15%	18%	112%
Subtotal	116,549	149,470	181,538	227,548	110,999	19%	21%	20%	23%	95%
Undergraduate										
Bachelor's	486,561	541,311	671,670	717,533	230,972	78%	75%	74%	72%	47%
Other UG	11,849	20,955	29,774	35,171	23,322	2%	3%	3%	4%	197%
Subtotal	498,409	562,266	701,444	752,705	254,296	80%	77%	78%	75%	51%
Enabling	3,195	4,925	11,170	13,274	10,079	1%	1%	1%	1%	315%
Non-Award	8,595	9,230	8,942	8,851	256	1%	1%	1%	1%	3%
Total	626,749	725,892	903,094	1,002,378	375,629	100%	100%	100%	100%	60%

Source: The Department. uCube.

Looking at growth in student load by gender (Table 2.9), proportions and growth stayed the same across the period. The male to female ratio has been about 45:55 since 2002, and there has been growth of about 60 per cent in enrolments by both men and women. This figure is in contrast with the growth patterns in course enrolments: the number of male students increased by 54 per cent, compared with growth of 60 per cent among female students. Among the possible reasons for this is that male students are perhaps more likely to be enrolled full-time. For example, in 2015, 73 per cent of male students were enrolled full-time, compared with 69 per cent of female students (calculated from uCube).

Comparing domestic with overseas students' student load (also Table 2.9), the proportion of total EFTSL in teaching domestic students decreased from 80 per cent to 73 per cent of the total. The growth in student load taught to overseas students increased by 111 per cent, cf. 47 per cent to domestic students.

Table 2.9 Student Load: All Students by Gender and Citizenship Status. Numbers, Percentage & Growth: 2002 – 2015

	2002 No.	2007 No.	2012 No.	2015 No.	Growth 2002 – 2015 No.	2002 %	2007 %	2012 %	2015 %	Growth 2002 – 2015 %
Gender										
Male	282,808	325,894	401,534	451,495	168,687	45%	45%	44%	45%	60%
Female	343,941	399,998	501,555	550,769	206,828	55%	55%	56%	55%	60%
No Information			5	115	115	0%	0%	0%	0%	
Citizenship Status										
Domestic	498,272	529,025	660,335	731,025	232,753	80%	73%	73%	73%	47%
Overseas	128,476	196,867	242,759	271,354	142,878	20%	27%	27%	27%	111%
Total	626,749	725,892	903,w094	1,002,378	375,629	100%	100%	100%	100%	60%

Source: The Department. uCube.

Finally, in this summary of student load, Table 2.10 presents a distribution of the 'liability status' of students, that is how students pay for, or are supported, in their university studies. Commonwealth Supported Students (i.e., domestic, subsidised students, paying HECS / HELP) are the largest group, representing 61 per cent of the total in 2015 (down from 68 per cent in 2002), but the number of these increased by over 181,000 EFTSL over the period. The next largest group covers overseas students, with an increase of nearly 143,000 EFTSL, or 111 per cent. The number of fee-paying domestic students more than doubled between 2002 and 2015.

Table 2.10 Student Load: All Students by Liability Status. Numbers, Percentage & Growth: 2002 – 2015

	2002 No.	2007 No.	2012 No.	2015 No.	Growth 2002 – 2015 No.	2002 %	2007 %	2012 %	2015 %	Growth 2002 – 2015 %
Commonwealth supported	425,584	429,281	548,084	606,691	181,107	68%	59%	61%	61%	43%
Domestic fee-paying	46,111	74,535	85,087	96,369	50,258	7%	10%	9%	10%	109%
Other domestic	26,578	25,208	27,163	27,964	1,386	4%	3%	3%	3%	5%
Overseas fee-paying	128,476	196,867	242,759	271,354	142,878	20%	27%	27%	27%	111%
Total	626,749	725,892	903,094	1,002,378	375,629	100%	100%	100%	100%	60%

Source: The Department. uCube.

Course completions: higher education outputs 2002 – 2015

A successfully obtained qualification is the usual goal of university study, and Table 2.11 summarises sector-wide course completions by Broad Field of Education between 2002 and 2015. The table shows that the number of qualifications awarded increased by 62 per cent, from over 206,000 to nearly 335,000. Because some students have enrolled in more than one course, the number of courses completed therefore exceeds the number of people, as was the case with enrolments counts involving the Field of Education classification. In 2002, 5,771 persons were granted two awards, and by 2015, this number had risen to 9,760. Course completions are a lagging indicator, but the growth in completions is a function of the growth in enrolments.

Looking at the progress of awards in STEM Fields of Education, the rate of growth between 2002 and 2015 was 31 per cent, compared with growth in all Fields of Education of 62 per cent. However, there was strong growth in Engineering (+9,217, or +85 per cent) and in Science (+10,061, or +72 per cent). There were 5,001 fewer awards in Information Technology, and with completions in Agriculture (a relatively small field), there was a growth over the period of ten per cent, but there had been a decline in the number of students completing courses of three per cent. The proportion of STEM course completions declined from 23 per cent of all completions in 2002 to 19 per cent in 2015. In the intervening year 2012, the proportion got to as low as 17 per cent.

Table 2.11 Award Course Completions: All Students by Broad Field of Education. Numbers, Percentage & Growth: 2002–2015*

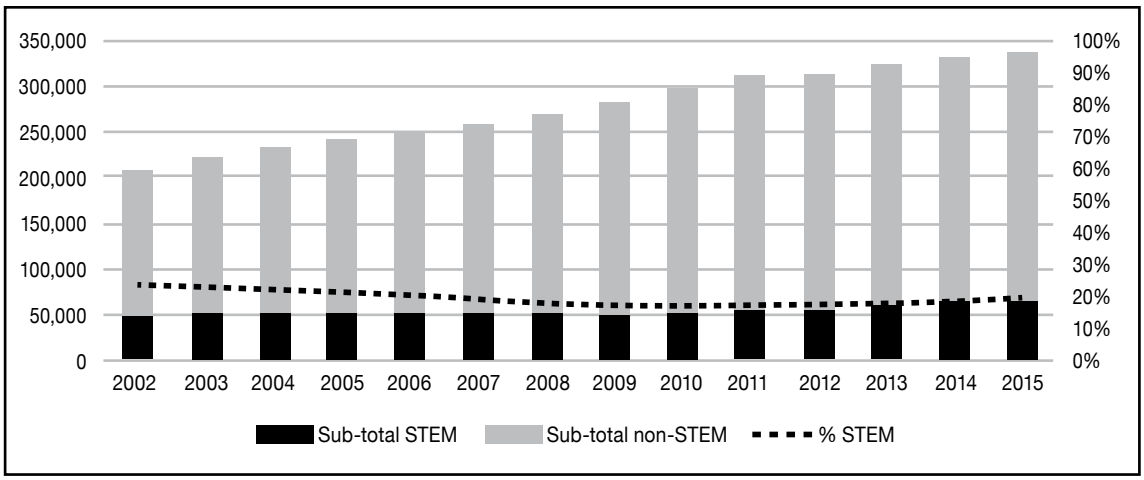
	2002 No.	2007 No.	2012 No.	2015 No.	Growth 2002 – 2015 No.	2002 %	2007 %	2012 %	2015 %	Growth 2002 – 2015 %
STEM FoE										
N&P Sciences	14,021	17,142	20,393	24,082	10,061	7%	7%	7%	7%	72%
IT	18,491	14,350	11,799	13,490	-5,001	9%	6%	4%	4%	-27%
Engineering	10,895	12,998	16,965	20,112	9,217	5%	5%	5%	6%	85%
Agriculture	3,963	3,510	4,501	4,375	412	2%	1%	1%	1%	10%
Sub-total STEM	**47,370**	**48,000**	**53,658**	**62,059**	**14,689**	**23%**	**19%**	**17%**	**19%**	**31%**
Other FoE										
Architecture	4,186	4,762	6,736	7,276	3,090	2%	2%	2%	2%	74%
Health	23,869	30,599	41,939	49,875	26,006	12%	12%	14%	15%	109%
Education	23,423	27,315	29,329	30,720	7,297	11%	11%	9%	9%	31%
Management	57,428	80,450	97,251	99,884	42,456	28%	32%	31%	30%	74%
Society & Culture	37,927	47,569	59,109	63,522	25,595	18%	19%	19%	19%	67%
Creative Arts	12,271	16,274	21,007	21,175	8,904	6%	6%	7%	6%	73%
Food Etc.	41	218	64	85	44	0%	0%	0%	0%	107%
Sub-total Non-STEM	**159,145**	**207,187**	**255,435**	**272,537**	**113,392**	**77%**	**81%**	**83%**	**81%**	**71%**
Total Awards	**206,515**	**255,187**	**309,093**	**334,596**	**128,081**	**100%**	**100%**	**100%**	**100%**	**62%**
Total Awardees	**200,744**	**247,526**	**299,474**	**324,836**	**124,092**	**97%**	**97%**	**97%**	**97%**	**62%**
Combined Awardees	**5,771**	**7,661**	**9,619**	**9,760**	**3,989**	**3%**	**3%**	**3%**	**3%**	**69%**

Source: The Department. uCube.
FoE = Broad Field of Education
* Refer to Chapter 1 for an explanation of factors that have disrupted aspects of the statistical time series

Among other broad Fields of Education, the big movers in course completions were Health (+26,006, or 109 per cent) and Management and Commerce (+42,456, or 74 per cent).

Figure 2.5 summarises the situation with course completions since 2002, comparing STEM and non-STEM Fields of Education. The modest increase in STEM course completions is clear (left axis), as is the declining proportion of all completions represented by STEM graduates (right axis). However, there has been growth in the past few years in the number of course completers in Engineering and the Natural and Physical Sciences, with more modest growth in Agriculture, Environmental and related Studies, and the decline in the number of completions in Information Technology.

Figure 2.5 Course Completions: STEM and non-STEM Compared 2002 -2015



Looking at course completions by level of course (Table 2.12), the largest growth occurred in bachelor's degrees (+53,229; +42 per cent), followed by other postgraduate completions (+50,907; +81 per cent). Completions of bachelor's degrees declined from 63 per cent of the total, to 55 per cent between 2002 and 2015. At the same time non-research postgraduate award numbers increased from 34 per cent to 38 per cent of the total. Postgraduate by research completions increased by 71 per cent, but their proportion of all completion stayed at three per cent across the period examined.

Table 2.12 Award Course Completions: All Students by Level of Course. Numbers, Percentage & Growth: 2002–2015*

Course Level	2002 No.	2007 No.	2012 No.	2015 No.	Growth 2002 – 2015 No.	2002 %	2007 %	2012 %	2015 %	Growth 2002 – 2015 %
Postgraduate										
PG Research	6,012	7,461	9,089	10,252	4,240	3%	3%	3%	3%	71%
Other Postgraduate	62,936	85,300	103,859	113,843	50,907	31%	34%	35%	35%	81%
Subtotal	**68,948**	**92,761**	**112,948**	**124,095**	**55,147**	**34%**	**37%**	**38%**	**38%**	**80%**
Undergraduate										
Bachelor	126,691	143,830	171,844	179,920	53,229	63%	58%	57%	55%	42%
Other Undergraduate	5,105	10,935	14,682	20,821	15,716	3%	4%	5%	6%	308%
Subtotal	**131,796**	**154,765**	**186,526**	**200,741**	**68,945**	**66%**	**63%**	**62%**	**62%**	**52%**
Total	**200,744**	**247,526**	**299,474**	**324,836**	**124,092**	**100%**	**100%**	**100%**	**100%**	**62%**

Source: The Department. uCube.
* Refer to Chapter 1 for an explanation of factors that have disrupted aspects of the statistical time series

Figure 2.6 provides a summary graph of the number of course completions between 2002 and 2015 (plotted against the left axis, and the proportion of these completions by course level on the right. Annual completions increased from about 200,000 per year in 2002 to over 325,000 per year by 2015. The lines on the graph indicate a decline in the proportion of the total made up by undergraduate completions and the reciprocal increase in the proportion of completions in courses at the other postgraduate level. It can be seen that as the overall number of course completions increased each year, the proportion of undergraduate qualifications awarded each year was declining slightly, as the number of Other Postgraduate awards was increasing. The proportion of higher degrees by research was about the same across the period.

Figure 2.6 Course Completions: All Students in All Course Levels - 2002–2015

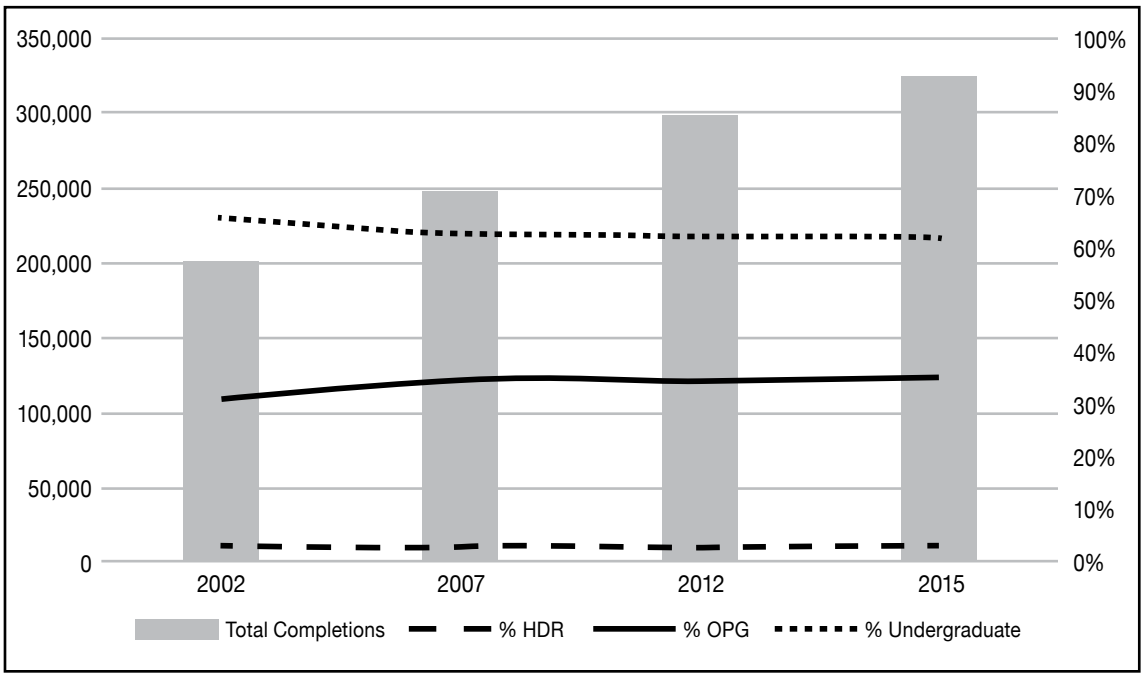


Table 2.13 examines the distribution of system-wide course completions by gender and citizenship status. Women represented 57 per cent of all course completions in 2015, up from 55 per cent in 2002. The number of female completers increased by 66 per cent (+73,340) compared with a 57 per cent increase among men (+50,572).

As was the case with enrolment trends, there has been strong growth in the number of overseas students completing university qualifications. The number of international completions more than doubled between 2002 and 2015, and the rate of increase far outstripped that for domestic students. The international proportion of course completions increased from 25 per cent in 2002, to 33 per cent in 2015. It should be noted, however, that in 2009, the proportion of all course completions made up by overseas students was nearly 36 per cent.

Table 2.14 shows the number of course completions by university within state / territory. In 2015, the 'Top 10' universities in terms of their numbers of course completers (ranked) were Melbourne, Monash, RMIT, Sydney, the University of Queensland, Queensland University of Technology, Curtin, Griffith, Deakin and University of Technology Sydney. It should also be noted that taken together, the non-university institutions produced around 26,367 course completers in 2015, and this would rank them at the top if this group is taken to be a single entity. In terms of growth between 2002 and 2015, RMIT, Melbourne, Sydney and Griffith each increased their 'output' by more than 4,000.

Table 2.13 Award Course Completions: All Students by Gender and by Citizenship Status. Numbers, Percentage & Growth: 2002–2015*

	2002 No.	2007 No.	2012 No.	2015 No.	Growth 2002 – 2015 No.	2002 %	2007 %	2012 %	2015 %	Growth 2002 – 2015 %
Male	89,352	109,176	128,219	140,104	50,752	45%	44%	43%	43%	57%
Female	111,392	138,350	171,255	184,732	73,340	55%	56%	57%	57%	66%
Domestic	151,551	165,833	194,369	217,911	66,360	75%	67%	65%	67%	44%
Overseas	49,193	81,693	105,105	106,925	57,732	25%	33%	35%	33%	117%
Total	200,744	247,526	299,474	324,836	124,092	100%	100%	100%	100%	62%

Source: The Department. uCube.

* Refer to Chapter 1 for an explanation of factors that have disrupted aspects of the statistical time series

Figure 2.7 Course Completions: All Students by Gender and by Citizenship Status, 2002 – 2015

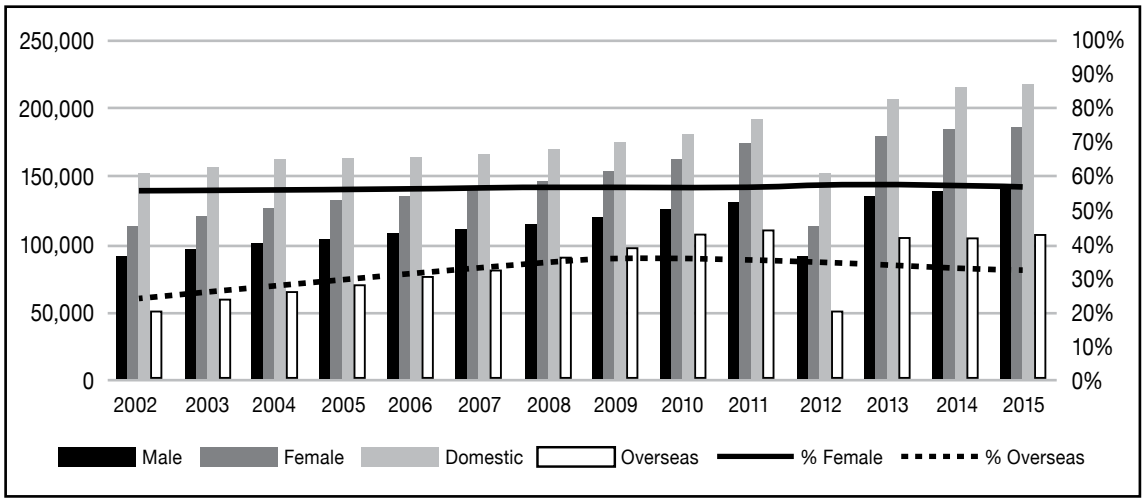


Table 2.14 Award Course Completions: All Students by State / Territory and Institution. Numbers, Percentage & Growth: 2002–2015*

	2002 No.	2007 No.	2012 No.	2015 No.	Growth 2002 – 2015 No.	2002 %	2007 %	2012 %	2015 %	Growth 2002 – 2015 %
ACT										
ADFA	427				-427	0%	0%	0%	0%	-100%
ANU	2,650	4,269	6,247	6,044	3,394	1%	2%	2%	2%	128%
Canberra	2,827	2,919	4,179	3,972	1,145	1%	1%	1%	1%	41%
Non-Uni			23	12	12	0%	0%	0%	0%	
Sub-total	5,904	7,188	10,449	10,028	4,124	3%	3%	3%	3%	70%
NSW										
Avondale	161	237	334	306	145	0%	0%	0%	0%	90%
C. Sturt	7,433	7,712	7,474	9,245	1,812	4%	3%	2%	3%	24%
Macquarie	5,936	8,161	8,902	9,332	3,396	3%	3%	3%	3%	57%
Southern Cross	2,680	2,607	3,318	2,589	-91	1%	1%	1%	1%	-3%
UNE	2,892	3,689	3,354	3,594	702	1%	1%	1%	1%	24%
Newcastle	4,518	5,601	6,827	7,287	2,769	2%	2%	2%	2%	61%
Sydney	8,780	12,250	13,526	13,642	4,862	4%	5%	5%	4%	55%
U NSW	9,008	9,261	11,593	11,963	2,955	4%	4%	4%	4%	33%
U TS	7,607	8,325	9,273	9,650	2,043	4%	3%	3%	3%	27%
Wollongong	4,053	5,927	6,920	6,664	2,611	2%	2%	2%	2%	64%
WSU	9,600	8,145	8,311	8,970	-630	5%	3%	3%	3%	-7%
Non-Uni	164	5,036	10,054	13,349	13185	0%	2%	3%	4%	8040%
Sub-total	62,832	76,951	89,886	96,591	33759	31%	31%	30%	30%	54%

	2002 No.	2007 No.	2012 No.	2015 No.	Growth 2002 – 2015 No.	2002 %	2007 %	2012 %	2015 %	Growth 2002 – 2015 %
NT										
Batchelor	85	75	85		-85	0%	0%	0%	0%	-100%
Charles Darwin	921	909	1,598	1,562	641	0%	0%	1%	0%	70%
Sub-total	**1,006**	**984**	**1,683**	**1,562**	**556**	**1%**	**0%**	**1%**	**0%**	**55%**
Queensland										
Bond	5	1,126	1,755	1,636	1631	0%	0%	1%	1%	32620%
CQU	5,837	6,618	4,587	4,027	-1810	3%	3%	2%	1%	-31%
Griffith	6,305	8,707	11,026	10,580	4275	3%	4%	4%	3%	68%
James Cook	2,026	2,913	3,966	4,469	2443	1%	1%	1%	1%	121%
QUT	8,813	9,448	10,318	11,669	2856	4%	4%	3%	4%	32%
U Qld	8,286	8,688	10,713	12,077	3791	4%	4%	4%	4%	46%
U SQ	3,666	5,195	4,827	4,616	950	2%	2%	2%	1%	26%
Sun. Coast	634	1,238	1,541	2,010	1376	0%	1%	1%	1%	217%
Non-Uni		1,094	1,452	1,999	1999	0%	0%	0%	1%	
Sub-total	**35,572**	**45,027**	**50,185**	**53,083**	**17511**	**18%**	**18%**	**17%**	**16%**	**49%**
SA										
Flinders	3,453	4,152	5,170	5,497	2044	2%	2%	2%	2%	59%
Adelaide	4,128	5,229	6,344	6,719	2591	2%	2%	2%	2%	63%
Torrens				81	81	0%	0%	0%	0%	
U SA	6,348	8,452	8,635	7,454	1106	3%	3%	3%	2%	17%
Non-Uni		625	1,086	3,005	3005	0%	0%	0%	1%	
Sub-total	**13,929**	**18,458**	**21,235**	**22,756**	**8827**	**7%**	**7%**	**7%**	**7%**	**63%**
Tasmania										
AMC	933	344			-933	0%	0%	0%	0%	-100%
U Tasmania	3,111	4,152	5,089	6,040	2929	2%	2%	2%	2%	94%
Non-Uni		3	21	8	8	0%	0%	0%	0%	
Sub-total	**4,044**	**4,499**	**5,110**	**6,048**	**2004**	**2%**	**2%**	**2%**	**2%**	**50%**
Victoria										
Deakin	6,699	7,615	9,790	10,471	3772	3%	3%	3%	3%	56%
Federation	2,105	3,240	2,264	3,833	1728	1%	1%	1%	1%	82%
La Trobe	6,178	7,679	9,033	8,719	2541	3%	3%	3%	3%	41%
Monash	13,166	15,427	17,085	16,944	3778	7%	6%	6%	5%	29%
RMIT	7,790	8,428	15,640	16,387	8597	4%	3%	5%	5%	110%
Swinburne	2,936	3,616	5,380	6,914	3978	1%	1%	2%	2%	135%
Melbourne	11,226	13,139	16,509	18,113	6887	6%	5%	6%	6%	61%
Divinity	53	251	266	404	351	0%	0%	0%	0%	662%
Victoria U	4,103	4,034	5,419	6,792	2689	2%	2%	2%	2%	66%
Non-Uni	25	2,028	4,698	6,481	6456	0%	1%	2%	2%	25824%
Sub-total	**54,281**	**65,457**	**86,084**	**95,058**	**40777**	**27%**	**26%**	**29%**	**29%**	**75%**
Western Australia										
Curtin	8,079	9,829	10,549	10,882	2803	4%	4%	4%	3%	35%
Edith Cowan	4,961	5,689	6,164	5,503	542	2%	2%	2%	2%	11%
Murdoch	2,880	2,948	4,518	5,593	2713	1%	1%	2%	2%	94%
Notre Dame	516	918	2,119	2,512	1996	0%	0%	1%	1%	387%
U WA	3,960	4,194	5,483	7,369	3409	2%	2%	2%	2%	86%
Non-University		1,141	713	1,138	1138	0%	0%	0%	0%	
Sub-total	**20,396**	**24,719**	**29,546**	**32,997**	**12601**	**10%**	**10%**	**10%**	**10%**	**62%**

	2002 No.	2007 No.	2012 No.	2015 No.	Growth 2002 – 2015 No.	2002 %	2007 %	2012 %	2015 %	Growth 2002 – 2015 %
Multi-State										
ACU	2,780	3,838	4,719	6,141	3361	1%	2%	2%	2%	121%
Non-Uni		405	577	572	572	0%	0%	0%	0%	
Sub-total	2,780	4,243	5,296	6,713	3933	1%	2%	2%	2%	141%
Total – Australia	200,744	247,526	299,474	324,836	124092	100%	100%	100%	100%	62%

Source: The Department. uCube.
* Refer to Chapter 1 for an explanation of factors that have disrupted aspects of the statistical time series

The institutions described as 'non-university' are mainly small private providers.

The next three chapters provide more detailed information on the students enrolled in programmes in the STEM Fields of Education, with Chapter 3 focussing on student enrolments Chapter 4 provides an in-depth examination of Student load (EFTSL), looking both at the patterns of teaching of the STEM disciplines, and the students to which that teaching has been provided. In doing so, it is possible to see how the composition of the degrees in the STEM Broad Fields of Education has changed. Chapter 5 looks at STEM course completions in considerable detail, including PhDs in the Natural and Physical Sciences.

Chapter 3

STEM Enrolments: Ups and downs in the 21st century

The main purpose of this chapter is to present the results of a closer examination of STEM enrolments since 2002. The Deans of Science were also interested in hearing about what has been happening in terms of the production of future medical practitioners, but such questions are less easy to answer, because medical practitioner training is buried within the 'Health' broad Field of Education, along with other types of 'medicine'. Nonetheless, some information for examining this group of students has been provided in tables towards the end of this chapter.

As shown in Table 3.1, the number of STEM enrolments increased by nearly 73,000, an increase of 32 per cent. These figures need to be compared with the growth of over 464,000, or 66 per cent, in non-STEM fields of education. Non-Award course enrolments declined over the period, but these represented only one or two per cent of all enrolments. However, growth in STEM enrolments has been slower than in non-STEM fields, declining from 24 per cent to 20 per cent of the total.

Looking at the STEM fields individually, Table 3.1 reveals the changes that have occurred, and Figure 3.1 is a graph of the enrolments in each of the four STEM fields between 2002 until 2015. Enrolments in programmes in the Natural and Physical Sciences have been reasonably steady, and increased by 67 per cent over the period, more than 46,000. In 2015, enrolments in the Natural and Physical Sciences increased from being 30 per cent of STEM enrolments, to 38 per cent.

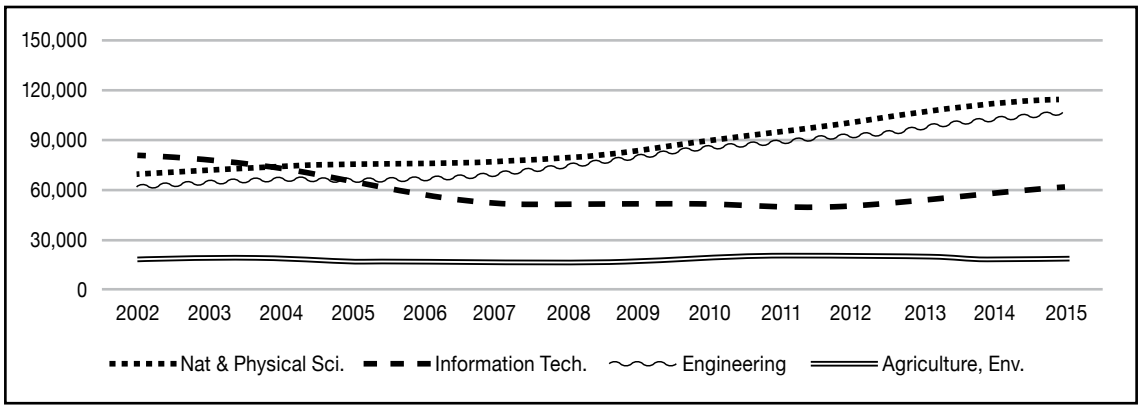
Enrolments in Information Technology have also recovered somewhat since the steady decline from the situation (the peak) in 2002. In the period 2002 to 2015, Enrolments in Information Technology dropped from over 79,000 in 2002, to around 50,000 in the years 2007-2012, but by 2015, they had risen again to over 60,000. Information Technology enrolments have declined by 23 per cent, but the decline from 2002 to 2007 was nearly 37 per cent. There were more enrolments in Information Technology courses in 2002 than in the other STEM fields, but enrolment losses have changed this situation. The relative decline in the place of Information Technology within the STEM fields has been considerable: in 2002, Information Technology enrolments represented 35 per cent of all STEM enrolments, but in 2015, the proportion had declined to 20 per cent.

Table 3.1 Enrolments: All Students by Broad Field of Education. Numbers, Percentage & Growth: 2002–2015*

Field of Education	2002 No.	2007 No.	2012 No.	2015 No.	Growth 2002 – 2015 No.	2002 %	2007 %	2012 %	2015 %	Growth 2002 – 2015 %
STEM										
N&P Sciences	68,626	77,274	100,768	114,650	46,024	7%	7%	8%	8%	67%
IT	79,026	50,877	50,156	60,769	-18,257	8%	5%	4%	4%	-23%
Engineering	61,269	69,670	92,229	106,283	45,014	6%	6%	7%	7%	73%
Agriculture	18,596	16,220	19,581	18,603	7	2%	1%	1%	1%	0%
Subtotal	227,517	214,041	262,734	300,305	72,788	24%	20%	20%	20%	32%
Non-STEM	698,710	854,616	1,043,931	1,162,805	464,095	74%	78%	79%	78%	66%
Non-Award	22,234	22,600	18,162	19,880	-2,354	2%	2%	1%	1%	-11%
Total Enrolments	948,461	1,091,257	1,324,827	1,482,990	534,529	100%	100%	100%	100%	56%
Total Students	896,621	1,029,846	1,257,722	1,410,133	513,512	95%	94%	95%	95%	57%

Source: The Department. uCube.
* Refer to Chapter 1 for an explanation of factors that have disrupted aspects of the statistical time series

Figure 3.1 Enrolments by Broad Field of Education: STEM Fields 2002 – 2015



Engineering and Related Technologies enrolments have grown more than other the STEM fields, increasing by over 45,000, or 73 per cent between 2002 and 2015. It increased its relative presence from 27 per cent to 35 per cent.

As an extension to Table 3.1, Table 3.2 demonstrates what has happened in enrolment patterns within the STEM fields of education by re-basing the distribution according to STEM enrolments rather than enrolments in all fields of education. The Natural and Physical Sciences increased their relative presence from 30 per cent to 38 per cent between 2002 and 2015. At the same time, enrolments in Engineering and Related Technologies courses increased from 27 per cent to 35 per cent. Information Technology enrolments, the largest group within STEM in 2002 declined from 35 per cent to 20 per cent of STEM enrolments. Enrolments in Agriculture, Environmental and Related Technologies courses declined in the early part of the 2000s but recovered by 2015 to be at about the same level as they had been in 2002. The proportion of these enrolments of all STEM enrolments declined from about eight per cent to six per cent. However, comments in Chapter 1 concerning the consistency of the statistical time series should be borne in mind.

Table 3.2 Enrolments: STEM Students by Broad Field of Education. Numbers, Percentage & Growth: 2002–2015*

Field of Education	2002	2007	2012	2015	Growth 2002 – 2015	2002	2007	2012	2015	Growth 2002 – 2015
	No.	No.	No.	No.	No.	%	%	%	%	%
N&P Sciences	68,626	77,274	100,768	114,650	46,024	30%	36%	38%	38%	67%
IT	79,026	50,877	50,156	60,769	-18,257	35%	24%	19%	20%	-23%
Engineering	61,269	69,670	92,229	106,283	45,014	27%	33%	35%	35%	73%
Agriculture	18,596	16,220	19,581	18,603	7	8%	8%	7%	6%	0%
Total Enrolments	227,517	214,041	262,734	300,305	72,788	100%	100%	100%	100%	32%

Source: The Department. uCube.

* Refer to Chapter 1 for an explanation of factors that have disrupted aspects of the statistical time series

Male and female students

Looking at STEM and non-STEM enrolment patterns by gender, it can be seen from Table 3.3 that women have a strong majority overall, comprising about 55 per cent of all enrolments in 2015. However, the female presence in STEM programmes was a relatively modest 32 per cent, whereas they made up 61 per cent of the enrolments in the non-STEM fields. The proportions involved did not really change between 2002 and 2015, but the number of women in STEM programmes increased by 21,755 or 29 per cent. It should also be noted that although women make up 32 per cent of all STEM enrolments, they make up around half of enrolments in Agriculture and Natural and Physical Sciences,

but only 17 and 19 per cent of Engineering and Information Technology enrolments, respectively. These fields of education continue to be the ones to which women are least attracted. The female proportion of enrolments in Engineering has scarcely increased this century, even if the proportion had been much lower in the past. The proportion has gone backwards in Information Technology. Expansion in STEM enrolments, then, was predominantly male, with an extra 50,995 students between 2002 and 2015. However, the number of women in STEM increased by nearly 22,000, including an extra 8,024 in Engineering. The proportion of women undertaking STEM programmes is clearly much lower than their proportion of non-STEM programmes.

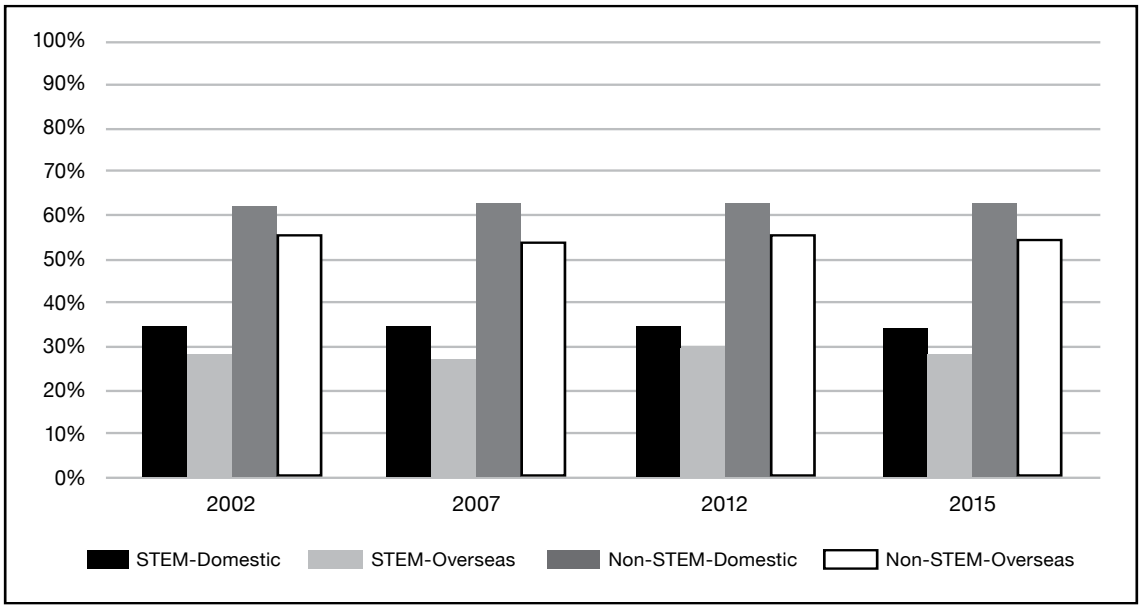
Table 3.3 Enrolments: All Students by Gender. Number and Percentage: 2002 & 2015*

	2002				2015#				Growth 2002 – 2015		
	Male No.	Female No.	Total No.	Female %	Male No.	Female No.	Total No.	Female %	Male No.	Female No.	Total No.
STEM											
N&P Sciences	32,701	35,925	68,626	52%	57,687	56,952	114,650	50%	24,986	21,027	46,024
IT	59,159	19,867	79,026	25%	49,259	11,506	60,769	19%	-9,900	-8,361	-18,257
Engineering	51,449	9,820	61,269	16%	88,437	17,844	106,283	17%	36,988	8,024	45,014
Agriculture	10,029	8,567	18,596	46%	8,950	9,650	18,603	52%	-1,079	1,083	7
Subtotal	153,338	74,179	227,517	33%	204,333	95,952	300,305	32%	50,995	21,773	72,788
Non-STEM	269,232	429,478	698,710	61%	452,430	710,293	1,162,805	61%	183,198	280,815	464,095
Non-Award	10,578	11,656	22,234	52%	8,215	11,658	19,880	59%	-2,363	2	-2,354
Total Enrolments	433,148	515,313	948,461	54%	664,978	817,903	1,482,990	55%	231,830	302,590	534,529
Total Students	408,604	488,017	896,621	54%	629,693	780,334	1,410,133	55%	221,089	292,317	513,512

Source: The Department. uCube.
Excl. 106 students for whom there was no information on gender in 2015.
* Refer to Chapter 1 for an explanation of factors that have disrupted aspects of the statistical time series

Of course, another aspect of the uptake of STEM programmes is that within the main growth area, that is, overseas students, the proportion of women is lower. Figure 3.3 provides a visual comparison. The solid columns represent domestic female students in STEM and non-STEM fields of education, and the patterned bars represent overseas female students. Even though the proportion of female domestic students in STEM is relatively low (being about 32 per cent, as opposed to about 61 per cent in non-STEM courses).

Figure 3.2 Proportion of Female Students Enrolled in Courses in STEM and non-STEM Fields of Education



Domestic and overseas students

A major driver of growth in Australian higher education has been derived from expansion in the numbers of overseas students, nearly all of whom pay full-cost tuition fees. Table 3.4 considers all students enrolled in all levels of course, according to whether they are domestic or overseas students. As noted earlier, the great majority of university students are enrolled in bachelor's degrees or other postgraduate programmes. As was shown in Table 2.2, these degrees had enrolments of more than 928,000 and 321,000, respectively, representing about 89 per cent of all enrolments. Because of the relative size of these two levels of course, they will be subjected to more detailed analysis later. Doctoral education is also important, so that will also be looked at, even though the numbers are much smaller.

Table 3.4 Enrolments: All Students by Citizenship Status. Number and Percentage: 2002 & 2015*

	2002				2015				Growth		
	Domestic No.	Overseas No.	Total No.	OS %	Domestic No.	Overseas No.	Total No.	OS %	Domestic No.	Overseas No.	Total No.
STEM											
N&P Sciences	61,602	7,024	68,626	10%	96,048	18,602	114,650	16%	34,446	11,578	46,024
IT	46,945	32,081	79,026	41%	31,146	29,623	60,769	49%	-15,799	-2,458	-18,257
Engineering	47,584	13,685	61,269	22%	68,067	38,216	106,283	36%	20,483	24,531	45,014
Agriculture	17,392	1,204	18,596	6%	14,571	4,032	18,603	22%	-2,821	2,828	7
Subtotal	173,523	53,994	227,517	24%	209,832	90,473	300,305	30%	36,309	36,479	72,788
Non-STEM	573982	124728	698710	18%	899,502	263,303	1,162,805	23%	325,520	138,575	464,095
Non-Award	12,731	9,503	22,234	43%	7,075	12,805	19,880	64%	-5,656	3,302	-2,354
Total Enrolments	760,236	188,225	948,461	20%	1,116,409	366,581	1,482,990	25%	356,173	178,356	534,529
Total Students	711,215	185,406	896,621	21%	1,046,682	363,451	1,410,133	26%	335,467	178,045	513,512

Source: The Department. uCube.

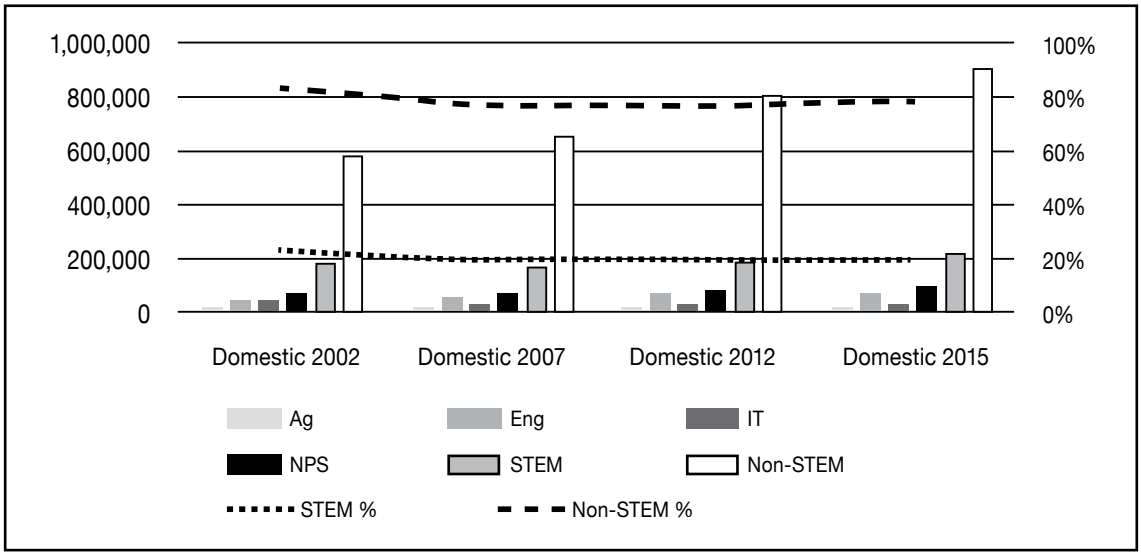
* Refer to Chapter 1 for an explanation of factors that have disrupted aspects of the statistical time series

From Table 3.4 it can be calculated that domestic student numbers increased by 47 per cent and overseas student numbers increased by 96 per cent between 2002 and 2015 (see also Table 2.3). Overseas students therefore increased from about 21 to 26 per cent of the total. This growth was greater in the STEM fields (in which fields of education the proportion increased from 24 to 30 per cent of all STEM enrolments). In non-STEM fields, the proportion of overseas student enrolments increased from 18 to 23 per cent. However, changes within the STEM fields varied between fields. In 2015, Overseas students represented 16 per cent of students in the Natural and Physical Sciences field, 22 per cent of those in the Agriculture, Environmental and Related Studies field, 36 per cent in Engineering and Related Technologies and 49 per cent in Information Technology. In 2002, the equivalent proportions had been ten per cent, six per cent, 22 per cent and 41 per cent, respectively. In Information Technology, even though the proportion of overseas students increased, the overall number did not, because of the progressive decline in enrolments in that field of education. Overseas students have a relatively lower presence in the non-STEM fields of education, but their numbers increased from just under 125,000 to over 263,000, an increase of 111 per cent. Domestic students in non-STEM fields rose by around 326,000, or 56 per cent. The pattern of presence of overseas students in STEM, therefore is based predominantly on the attractiveness of information technology and engineering, rather than interest in agriculture or general science.

The contents of Table 3.4 are re-presented in Figures 3.3 and 3.4, for domestic students and overseas students, respectively. The columns represent enrolments in the individual STEM fields and all non-STEM fields, to be measured against the left axis. The dotted lines, to be measured against the right axis, represent the percentage of overall STEM enrolments and non-STEM enrolments.

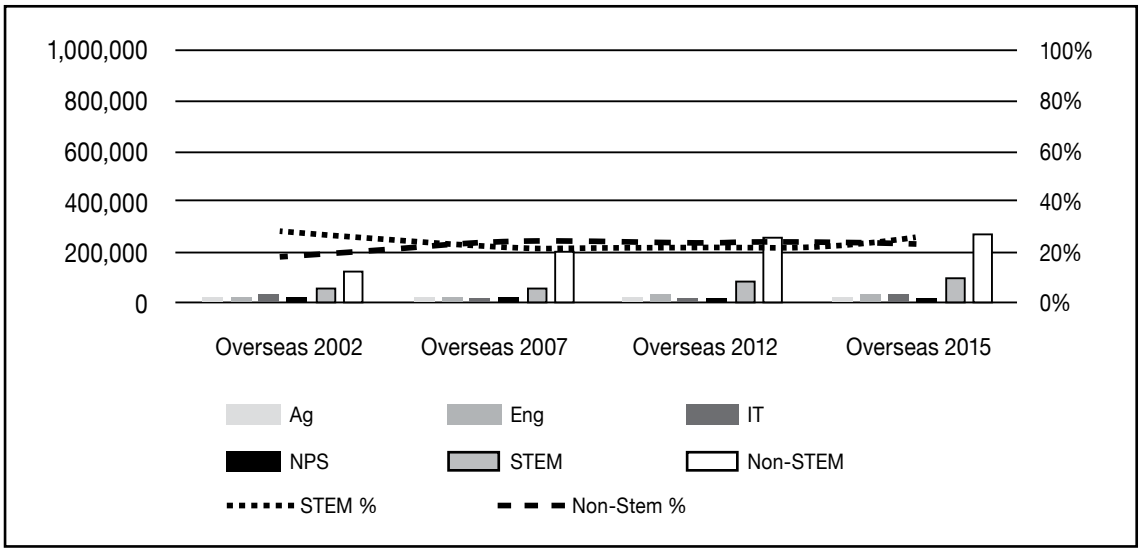
The situation for domestic students made clear by the graph is that a much higher proportion of non-STEM students are domestic: around 80 per cent. This contrasts with the STEM situation, where the proportion of domestic students is around 20 per cent.

Figure 3.3 All Domestic Students: STEM Fields of Education and Non-STEM Fields 2002 - 2015



For overseas students, the pattern is different. The proportion of students in both STEM and non-STEM fields alike is about 20 per cent. Almost half of all overseas students were enrolled in Management and Commerce courses in 2015.

Figure 3.4 All Overseas Students: STEM Fields of Education and Non-STEM Fields 2002 – 2015



Looking more closely at individual universities, Table 3.5 shows enrolments divided into STEM and Other than STEM courses, ranked by the numerical increase in STEM enrolments. The most growth in enrolments in STEM courses occurred at the University of Melbourne, but five universities increased by more than 5,000 enrolments (plus the catch-all 'Other Institutions': an amalgam of smaller universities and private providers).

Table 3.5 Enrolments: All Students by Institution by STEM and Other than STEM Fields of Education: 2002 and 2015* (Ranked according to extent of growth in STEM enrolments)

	STEM				Other than STEM				STEM % of Total	
University	2002 No.	2015 No.	Growth No.	Growth %	2002 No.	2015 No.	Growth No.	Growth %	2002 No.	2015 No.
Melbourne	12,470	19,636	7,166	57%	29,547	39,210	9,663	33%	30%	33%
U NSW	13,863	20,444	6,581	47%	29,552	36,955	7,403	25%	32%	36%
U WA	5,543	11,411	5,868	106%	11,241	14,050	2,809	25%	33%	45%
U Qld	11,509	16,603	5,094	44%	27,335	36,516	9,181	34%	30%	31%
Curtin	6,498	11,511	5,013	77%	27,050	39,413	12,363	46%	19%	23%
UTS	8,144	11,910	3,766	46%	21,759	30,217	8,458	39%	27%	28%
Sydney	10,200	13,402	3,202	31%	33,299	47,324	14,025	42%	23%	22%
Adelaide	5,674	8,823	3,149	55%	10,804	18,646	7,842	73%	34%	32%
RMIT	11,970	15,071	3,101	26%	26,728	45,665	18,937	71%	31%	25%
Deakin	5,148	8,072	2,924	57%	28,409	44,656	16,247	57%	15%	15%
Swinburne	7,059	9,967	2,908	41%	7,693	28,180	20,487	266%	48%	26%
Federation	1,538	4,409	2,871	187%	5,184	10,740	5,556	107%	23%	29%
Macquarie	3,803	5,994	2,191	58%	23,493	35,248	11,755	50%	14%	15%
Griffith	5,412	7,462	2,050	38%	25,831	38,963	13,132	51%	17%	16%
Murdoch	3,693	5,704	2,011	54%	9,615	18,479	8,864	92%	28%	24%
ANU	3,529	5,363	1,834	52%	9,381	17,862	8,481	90%	27%	23%
U Tasmania	3,692	5,399	1,707	46%	10,401	26,949	16,548	159%	26%	17%
Monash	17,601	19,208	1,607	9%	36,679	54,058	17,379	47%	32%	26%
Newcastle	4,738	6,218	1,480	31%	18,889	29,479	10,590	56%	20%	17%
La Trobe	4,088	5,228	1,140	28%	21,230	30,723	9,493	45%	16%	15%
WSydney	6,584	7,681	1,097	17%	28,887	37,546	8,659	30%	19%	17%
UNE	2,207	3,263	1,056	48%	16,156	19,050	2,894	18%	12%	15%
Wollongong	6,901	7,900	999	14%	12,205	23,978	11,773	96%	36%	25%
Sunshine C.	924	1,822	898	97%	3,157	10,972	7,815	248%	23%	14%
Flinders	2,723	3,556	833	31%	10,931	21,110	10,179	93%	20%	14%
QUT	9,525	10,351	826	9%	30,438	39,303	8,865	29%	24%	21%
U Canberra	1,885	2,560	675	36%	8,701	14,850	6,149	71%	18%	15%
James Cook	3,232	3,847	615	19%	10,157	18,057	7,900	78%	24%	18%
Charles Darwin	861	1,264	403	47%	4,860	10,690	5,830	120%	15%	11%
Charles Sturt	6,049	6,443	394	7%	34,005	33,670	-335	-1%	15%	16%
USQ	6,802	7,084	282	4%	17,702	20,827	3,125	18%	28%	25%
Edith Cowan	3,978	4,032	54	1%	20,121	23,022	2,901	14%	17%	15%
Southern Cross	1,493	1,401	-92	-6%	10,564	13,250	2,686	25%	12%	10%
U SA	5,364	5,196	-168	-3%	25,647	26,383	736	3%	17%	16%
Victoria U	5,045	3,178	-1,867	-37%	14,526	24,037	9,511	65%	26%	12%
CQU	7,981	4,130	-3,851	-48%	14,107	16,301	2,194	16%	36%	20%
Other Inst.	3,593	8,932	5,339	149%	17,656	143,331	125,675	712%	17%	6%
Total Enrolments	221,319	294,475	73,156	33%	701,553	1,141,106	439,553	64%	24%	21%

Source: The Department. uCube.
* Refer to Chapter 1 for an explanation of factors that have disrupted aspects of the statistical time series

Table 3.6 demonstrates that one of the changes in the pattern of enrolments this century has been a form of 'bracket creep', from undergraduate to postgraduate. Although there was little change in the proportion of postgraduate by research enrolments, there was a considerable transfer between the undergraduate and non-research 'other' postgraduate categories. Within the STEM fields of education, the slippage between Undergraduate and Other Postgraduate was about ten per cent in Agriculture,

Environmental and Related Studies, and smaller amounts in the other STEM fields of education. In Agriculture, there was also a relative shift between Postgraduate by Research (PGR) and Other Postgraduate (OPG) programmes. There was also slippage in the non-STEM fields of education, but to less an extent than in the STEM fields. Undergraduate (UG) enrolments in non-STEM programmes declined from 73 per cent to 71 per cent of all enrolments between 2002 and 2015, compared with a decline from 79 per cent to 75 per cent in STEM undergraduate enrolments. It should be noted that undergraduate enrolments in the Natural and Physical Sciences remain high: 82 per cent in 2015, down from 84 per cent in 2002.

Table 3.6 Enrolments: All Students by Level of Course, STEM and non-STEM Fields of Education: 2002 and 2015*

2002	PGR No.	OPG No.	UG No.	Enabling/ Non-Aw No.	Total No.	PGR %	OPG %	UG %	Enabling/ Non-Aw %	Total %
STEM										
N&P Sciences	7,942	3,255	57,367	62	68,626	12%	5%	84%	0%	100%
IT	1,318	20,200	57,490	18	79,026	2%	26%	73%	0%	100%
Engineering	4,600	6,948	49,625	96	61,269	8%	11%	81%	0%	100%
Agriculture	2,000	2,403	14,119	74	18,596	11%	13%	76%	0%	100%
Subtotal	15,860	32,806	178,601	250	227,517	7%	14%	79%	0%	100%
Non-STEM	28,572	149,797	513,507	6,834	698,710	4%	21%	73%	1%	100%
Non-Award				22,234	22,234				100%	100%
Total	44,424	182,572	640,307	7,084	896,621	5%	20%	71%	1%	100%
2015	**PGR No.**	**OPG No.**	**UG No.**	**Enabling/ Non-Aw No.**	**Total No.**	**PGR %**	**OPG %**	**UG %**	**Enabling/ Non-Aw %**	**Total %**
STEM										
N&P Sciences	13,411	7,301	93,560	378	114,650	12%	6%	82%	0%	100%
IT	2,441	18,403	39,917	8	60,769	4%	30%	66%	0%	100%
Engineering	9,252	17,171	79,690	170	106,283	9%	16%	75%	0%	100%
Agriculture	2,726	3,525	12,350	2	18,603	15%	19%	66%	0%	100%
Subtotal	27,830	46,400	225,517	558	300,305	9%	15%	75%	0%	100%
Non-STEM	38,042	276,748	824,679	23,336	1,162,805	3%	24%	71%	2%	100%
Non-Award				19,880	19,880				100%	100%
Total	65,872	321,455	979,032	23,894	1,410,133	5%	23%	69%	2%	100%
Growth	**PGR No.**	**OPG No.**	**UG No.**	**Enabling/ Non-Aw No.**	**Total No.**	**PGR %**	**OPG %**	**UG %**	**Enabling/ Non-Aw %**	**Total %**
STEM										
N&P Sciences	5,469	4,046	36,193	316	46,024	69%	124%	63%	510%	67%
IT	1,123	-1,797	-17,573	-10	-18,257	85%	-9%	-31%	-56%	-23%
Engineering	4,652	10,223	30,065	74	45,014	101%	147%	61%	77%	73%
Agriculture	726	1,122	-1,769	-72	7	36%	47%	-13%	-97%	0%
Subtotal	11,970	13,594	46,916	308	72,788	75%	41%	26%	123%	32%
Non-STEM	9,470	126,951	311,172	16,502	464,095	33%	85%	61%	241%	66%
Non-Award				-2,354	-2,354				-11%	-11%
Total	21,448	138,883	338,725	16,810	513,512	48%	76%	53%	237%	57%

Source: The Department. uCube. PGR: Postgraduate by Research; OPG: Other postgraduate; UG: Undergraduate
* Refer to Chapter 1 for an explanation of factors that have disrupted aspects of the statistical time series

Drilling down

The largest bloc of students is enrolled in bachelor's degrees, followed by other postgraduate (OPG) courses, and both of these deserve closer scrutiny. The PhD as the major research degree is also

important, particularly in STEM (and more particularly in the Natural and Physical Sciences). These have also been examined, even if the numbers are small compared with bachelor's and OPG numbers. The training of future medical practitioners is also of interest to deans of science, and there are few tables concerning this group

Bachelor's degree enrolments

Table 2.2 (above, p. 12) showed that bachelor's degree enrolments declined from about 70 per cent to about 65 per cent. That table also showed that most of this relative decline came about as the result of increased enrolments in Other Postgraduate courses (which increased from 20 to 23 per cent of all enrolments).

Table 3.7 shows that the number of enrolments in bachelor's degree courses expanded from 675,254 to nearly one million, a rate of growth of over 48 per cent. By comparison, STEM enrolments increased by 23 per cent, and non-STEM enrolments by 57 per cent. Within STEM, Science enrolments increased by over 35,000, (+62 per cent), and Engineering by nearly 25,000 enrolments (+52 per cent), but IT enrolments declined by more than 20,000 (-35 per cent), and Agriculture stayed roughly the same between 2002 and 2015.

Table 3.7 Enrolments: Bachelor's Degree Students by STEM Fields and Non-STEM -2002 – 2015*

	2002 No.	2007 No.	2012 No.	2015 No.	Growth 2002–2015 No.	2002 %	2007 %	2012 %	2015 %	Growth 2002–2015 %
STEM										
N&P Sciences	56,579	62,030	80,938	91,936	35,357	8%	8%	9%	9%	62%
IT	57,161	33,831	33,724	36,935	-20,226	8%	5%	4%	4%	-35%
Engineering	48,197	51,852	66,357	73,143	24,946	7%	7%	7%	7%	52%
Agriculture	11,961	10,333	12,293	11,999	38	2%	1%	1%	1%	0%
Subtotal	173,898	158,046	193,312	214,013	40,115	26%	21%	21%	21%	23%
Non-STEM	501,356	592,956	721,562	785,600	284,244	74%	79%	79%	79%	57%
Total Enrolments	675,254	751,002	914,874	999,613	324,359	100%	100%	100%	100%	48%
Total Students	623,453	690,032	849,199	928,449	304,996	92%	92%	93%	93%	49%

Source: The Department. uCube.

* Refer to Chapter 1 for an explanation of factors that have disrupted aspects of the statistical time series

Tables 3.8 and 3.9 consider patterns of enrolments by female and male students and domestic and overseas students, respectively. Women have been in the majority among university enrolments since the mid-1980s, and at the bachelor's degree level, their proportion has not changed over the course of the 21st Century.

As shown in Table 3.8, the number of women increased by nearly 170,000 over the period, compared to an increase of about 135,000 in the number of men. The patterns varied between STEM and non-STEM, and also within STEM fields of education. The proportion of women in STEM at the bachelor's degree level stayed the same (33 per cent) between 2002 and 2015, due largely to the low presence of women in Engineering and IT (16 per cent in both cases in 2015). The proportion of women in IT declined from 24 per cent in 2002. Even in Science, the proportion of women declined, from 54 per cent to 50 per cent, but nonetheless, there were nearly 12,000 more female Science bachelor's degree students in 2015 compared with in 2002. The proportion of both women and men in STEM programmes declined over the period.

Table 3.8 Enrolments: Bachelor's Degree Students by Gender 2002 – 2015*

	2002				2015#				Growth		
	Male No.	Female No.	Total No.	Female %	Male No.	Female No.	Total No.	Female %	Male No.	Female No.	Total No.
STEM											
N&P Sciences	26,088	30,491	56,579	54%	45,948	45,981	91,936	50%	19,860	15,490	35,357
IT	43,180	13,981	57,161	24%	31,090	5,841	36,935	16%	-12,090	-8,140	-20,226
Engineering	40,626	7,571	48,197	16%	61,642	11,501	73,143	16%	21,016	3,930	24,946
Agriculture	6,182	5,779	11,961	48%	5,689	6,307	11,999	53%	-493	528	38
Subtotal	116,076	57,822	173,898	33%	144,369	69,630	214,013	33%	28,293	11,808	40,115
Non-STEM	178,728	322,628	501,356	64%	295,606	489,939	785,600	62%	116,878	167,311	284,244
Total Enrol.	294,804	380,450	675,254	56%	439,975	559,569	999,613	56%			
Total Students	270,273	353,180	623,453	57%	405,466	522,917	928,449	56%	135,193	169,737	304,996

Source: The Department. uCube.
Excl. 66 students for whom there was no information on gender in 2015
* Refer to Chapter 1 for an explanation of factors that have disrupted aspects of the statistical time series

Table 3.9 shows that the proportion of overseas students in all bachelor's degrees increased from 17 per cent to 19 per cent during the period examined, having increased from about 111,000 to more than 180,000. Overseas students are more likely to be enrolled in STEM courses: in 2015, 24 per cent of overseas bachelor's degree students were enrolled in STEM courses, cf. 21 per cent of domestic students. The reciprocal students (76 per cent and 79 per cent) were enrolled in non-STEM programmes. However, the proportion of overseas students in STEM courses had been 32 per cent in 2002. Among Other Postgraduate enrolments, 23 per cent of overseas students were enrolled in STEM courses, compared with nine per cent of domestic students. There are distributional differences within STEM programmes. At the bachelor's degree level, patterns follow the overall pattern, with higher proportions of enrolments in Engineering and Information Technology. This is to be expected, because bachelor's degree enrolments represent 66 per cent of all university enrolments.

Table 3.9 Enrolments: Bachelor's Degree Students by Citizen/Resident Status 2002 – 2015*

	2002				2015				Growth		
	Domestic No.	Overseas No.	Total No.	Overseas %	Domestic No.	Overseas No.	Total No.	Overseas %	Domestic No.	Overseas No.	Total No.
STEM											
N&P Sciences	51,988	4,591	56,579	8%	81,694	10,242	91,936	11%	29,706	5,651	35,357
IT	36,435	20,726	57,161	36%	24,755	12,180	36,935	33%	-11,680	-8,546	-20,226
Engineering	38,684	9,513	48,197	20%	52,737	20,406	73,143	28%	14,053	10,893	24,946
Agriculture	11,644	317	11,961	3%	10,419	1,580	11,999	13%	-1,225	1,263	38
Subtotal	138,751	35,147	173,898	20%	169,605	44,408	214,013	21%	30,854	9,261	40,115
Non-STEM	425,541	75,815	501,356	15%	647,370	138,230	785,600	18%	22,1829	62,415	284,244
Total Enrol.	564,292	110,962	675,254	16%	816,975	182,638	999,613	18%			
Total Stud.	515,307	108,146	623,453	17%	748,106	180,343	928,449	19%	232,799	72,197	304,996

Source: The Department. uCube.
* Refer to Chapter 1 for an explanation of factors that have disrupted aspects of the statistical time series

Another way to examine enrolment trends is to look at the numbers of students commencing university studies. This is particularly relevant to bachelor's degrees, because they are the single largest course-level bloc of university enrolments, and bachelor's degree students study for three or four years in order to complete most offerings at the bachelor's level. Table 3.10 shows enrolments by students commencing bachelor's degrees over the past few years. The rough pattern with commencing enrolments is that of the number that commence, some will 'drop out' or change university or course, and those that 'survive' the first year will continue for another two or more years until completing the course.

Table 3.10 Enrolments: Commencing Bachelor's Degree Students by Broad Field of Education. Numbers, Percentage & Growth: 2002–2015*

Broad Field of Education	2002 No.	2007 No.	2012 No.	2015 No.	Growth No.	Growth %
N&PS	19,670	20,374	30,387	32,118	12,448	63%
IT	20,421	10,427	12,205	13,589	-6,832	-33%
Engineering	14,149	15,334	18,864	21,437	7,288	52%
Agriculture	4,006	3,325	4,310	4,005	-1	0%
Subtotal – STEM	58,246	49,460	65,766	71,149	12,903	22%
Non-STEM	169,701	202,230	252,609	279,529	109,828	65%
Total	212,640	234,154	299,387	329,026	116,386	55%

Source: The Department. uCube.
* Refer to Chapter 1 for an explanation of factors that have disrupted aspects of the statistical time series

Table 3.10 shows overall growth in commencing bachelor's degree enrolments of 55 per cent, comprising 65 per cent growth in non-STEM courses, and 22 per cent in STEM courses. Within STEM courses, the well-documented decline in Information Technology enrolments is evident, with no change in Agriculture, Environmental and Related Studies, and growth in both Engineering and Related Technologies and Natural and Physical Sciences. However, these patterns need closer examination, in light of the introduction of a graduate school model at two universities. Although the rate of growth in Engineering and Related Technologies programmes has been quite strong, it has been lower than the sector-wide growth. However, a possible explanation for this is that by 2015, the University of Melbourne had 800 fewer commencing enrolments in Engineering, and nearly 500 fewer at the University of Western Australia[19]. If we assume that future engineers at these two universities enrol in a course such as BSc, it could indicate that up to 1,300 of the increase in Natural and Physical Sciences enrolments was effectively produced by the change in engineering arrangements at these two universities. If future medical practitioner enrolments also saw a transfer of students from 'medicine' within the Health Broad Field of Education to a science or bioscience degree within the Natural and Physical Sciences Broad Field of Education, it is possible that an additional 700 or so students per year have been added to the number commencing Natural and Physical Sciences courses at the bachelor's degree level.

According to Table 3.10, there was no growth in bachelor's degree commencements in Agriculture, Environmental and Related Studies. However, by producing a uCube table of the appropriate student population, it can be seen that bachelor's degree commencements in Architecture and Building courses declined from 545 in 2002 (and a peak of 602 in 2007) to zero since 2013. If many of these students had enrolled in Melbourne's Bachelor of Environments, classified as being a programme within the Agriculture, Environmental and Related Studies Broad Field of Education, then it indicates an overall decline in 'traditional' agriculture, forestry and environmental science enrolments elsewhere in the system. The point is that even though the time series suggests a steady-state situation, in reality, there has likely been a down turn in this Broad Field of Education.

Other Postgraduate (OPG) enrolments

Enrolments in OPG course increased from over 182,000 in 2002, to over 323,000 in 2015 (+140,545; +77 per cent). This growth was greater in non-STEM fields of education, in which growth of 90 per cent was experienced. In comparison, STEM enrolments at this level increased by only 10 per cent.

19 These two numbers were produced by the Department's on-line uCube system, by creating a table of commencing, bachelor's degree enrolments by Broad Field of Education, since 2002.

The proportion of enrolments in STEM declined from 18 per cent in 2002, to 14 per cent in 201, with the greatest relative loss occurring in IT (from 11 per cent to six per cent). IT still produced more OPG enrolments than the other STEM fields of education, but the number declined by 1,797 over the period. Refer to Table 3.11.

Table 3.11 Enrolments: Other Postgraduate Students by STEM Fields and Non-STEM - 2002 – 2015*

	2002	2007	2012	2015	Growth 2002 – 2015	2002	2007	2012	2015	Growth 2002 – 2015
	No.	No.	No.	No.	No.	%	%	%	%	%
STEM										
N&P Sciences	3,255	5,209	6,974	7,301	4,046	2%	2%	3%	2%	3%
IT	20,200	13,978	12,324	18,403	-1,797	11%	6%	5%	6%	-1%
Engineering	6,948	9,389	11,692	17,171	10,223	4%	4%	4%	5%	7%
Agriculture	2,403	2,714	3,953	3,525	1,122	1%	1%	1%	1%	1%
Subtotal	32,806	31,290	34,943	46,400	13,594	18%	14%	13%	14%	10%
Non-STEM	149,797	197,323	233,326	276,748	126,951	82%	86%	87%	86%	90%
Total Enrolment	182,603	228,613	268,269	323,148	140,545	100%	100%	100%	100%	77%
Total Students	182,572	228,172	266,839	321,455	138,883					76%

Source: The Department. uCube.
* Refer to Chapter 1 for an explanation of factors that have disrupted aspects of the statistical time series

Table 3.12 examines gender distributions in OPG courses. Whereas the proportion of women in all OPG courses increased from 49 per cent to 55 per cent, among STEM courses the increase was more or less the same over the period. The proportion of women was considerably higher in the relatively small Agriculture and Natural and Physical Sciences fields of education. Engineering and IT have much lower proportions of women, but the female presence is higher than in bachelor's degrees.

Table 3.12 Enrolments: Other Postgraduate Students by Gender 2002 – 2015*

	2002				2015#				Growth		
	Male No.	Female No.	Total No.	Female %	Male No.	Female No.	Total No.	Female %	Male No.	Female No.	Total No.
STEM											
N&P Sciences	1,800	1,455	3,255	45%	3,697	3,602	7,301	49%	1,897	2,147	4,046
IT	14,745	5,455	20,200	27%	13,789	4,614	18,403	25%	-956	-841	-1,797
Engineering	5,740	1,208	6,948	17%	13,910	3,259	17,171	19%	8,170	2,051	10,223
Agriculture	1,249	1,154	2,403	48%	1,653	1,872	3,525	53%	404	718	1,122
Subtotal	23,534	9,272	32,806	28%	33,049	13,347	46,400	29%	9,515	4,075	13,594
STEM %	25%	10%	18%		22%	7%	14%				
Non-STEM	68,956	80,841	149,797	54%	113,062	163,668	276,748	59%	44,106	82,827	126,951
Total Enrolments	94,290	91,568	185,858	49%	149,808	180,617	330,449	55%			
Total Students	92,477	90,095	182,572	49%	145,335	176,098	321,455	55%	52,858	86,003	138,883

Source: The Department. uCube.
\# Incl. 22 students for whom no information on gender was provided
* Refer to Chapter 1 for an explanation of factors that have disrupted aspects of the statistical time series

Table 3.13 summarises the relative presence of domestic and overseas students in OPG courses. Whereas about 19 per cent of the bachelor's degree students in 2015 were overseas students, among OPG courses, the proportion was 38 per cent. This proportion had increased from 33 per cent in 2002, indicating the strong attractiveness of programmes at this level, and particularly within the STEM fields of education. In fact, 61 per cent of enrolments in STEM OPG courses in 2015 were by overseas students, up from 47 per cent in 2002. In Engineering and IT, the proportions of overseas students were 60 per cent and 77 per cent, respectively.

Table 3.13 Enrolments: Other Postgraduate Students by Citizen/Resident Status 2002 – 2015*

	2002				2015				Growth		
	Male No.	Female No.	Total No.	Female %	Male No.	Female No.	Total No.	Female %	Male No.	Female No.	Total No.
STEM											
N&P Sciences	2,269	986	3,255	30%	4,510	2,791	7,301	38%	2,241	1,805	4,046
IT	9,211	10,989	20,200	54%	4,228	14,175	18,403	77%	-4,983	3,186	-1,797
Engineering	3,909	3,039	6,948	44%	6,865	10,306	17,171	60%	2,956	7,267	10,223
Agriculture	1,908	495	2,403	21%	2,346	1,179	3,525	33%	438	684	1,122
Subtotal	17,297	15,509	32,806	47%	17,949	28,451	46,400	61%	652	12,942	13,594
STEM %	14%	26%	18%		9%	23%	14%				
Non-STEM	105,300	44,497	149,797	30%	181,769	94,979	276,748	34%	76,469	50,482	126,951
Total Enrolments	122,597	60,006	182,603	33%	199,718	123,430	323,148	38%			
Total Students	122,569	60,003	182,572	33%	198,860	122,595	321,455	38%	76,291	62,592	138,883

Source: The Department. Purchased Tables & uCube.
* Refer to Chapter 1 for an explanation of factors that have disrupted aspects of the statistical time series

PhD Enrolments

The PhD degree has always been important in the STEM fields, particularly in 'science'. Many research jobs are STEM-related (and particularly science-related) and a PhD degree represents a barrier-to-entry for many careers in science. For this reason, it is important for the PhD to be considered as a discrete course level, despite the fact that PhDs make up only about four per cent of all enrolments.

Table 3.14 summarises enrolment patterns for PhDs between 2002 and 2015. PhD enrolments have represented about four per cent of all enrolments for the whole period since 2002, and during that time, the proportion of PhDs in STEM fields of education increased from 37 per cent to 44 per cent. The number of STEM enrolments at the PhD level nearly doubled, from 12,730 to 24,960. At the same time, enrolments in non-STEM fields increased by 51 per cent, to 32,170 by 2015. Within STEM fields, enrolments in Science represented almost half in 2015, down from about 53 per cent in 2002. The strongest proportionate growth was demonstrated in Engineering, with an increase of 138 per cent over the period.

Table 3.14 Enrolments: PhD Students by STEM Fields and Non-STEM -2002 – 2015

	2002	2007	2012	2015	Growth 2002–2015	2002	2007	2012	2015	Growth 2002–2015
	No.	No.	No.	No.	No.	%	%	%	%	%
STEM										
N&P Sciences	6,839	8,677	10,648	12,242	5,403	20%	21%	20%	21%	79%
IT	1,000	1,537	1,935	2,217	1,217	3%	4%	4%	4%	122%
Engineering	3,374	4,340	6,959	8,035	4,661	10%	10%	13%	14%	138%
Agriculture	1,517	1,869	2,504	2,466	949	4%	5%	5%	4%	63%
Subtotal	12,730	16,423	22,046	24,960	12,230	37%	40%	42%	44%	96%
Non-STEM	21,317	25,004	30,434	32,170	10,853	63%	60%	58%	56%	51%
Total Enrol.	34,047	41,427	52,480	57,130	23,083	100%	100%	100%	100%	68%
Total Students	34,040	41,427	52,480	57,130	23,090	100%	100%	100%	100%	68%

Source: The Department. Purchased Tables.

Table 3.15 examines the gender differences among PhD enrolments. In 2015, women made up 39 per cent of STEM PhD enrolments, compared with 59 per cent of PhD enrolments in non-STEM fields. However, the overall STEM result is held back by the lower proportions of women in Engineering and Information Technology (26 per cent and 27 per cent, respectively). It should be noted, however, that the percentage of women in PhDs in Engineering and Related Technologies and Information

Technology is greater than is the case for bachelor's degree students (see Table 3.2). In Agriculture and Natural and Physical Sciences, women made up nearly half of all PhD enrolments. Looking at growth between 2002 and 2015, 41 per cent of the expansion of enrolments in the STEM fields was by women, compared with 68 per cent in the non-STEM fields.

Table 3.15 Enrolments: PhD Students by Gender 2002 & 2015

	2002				2015				Growth		
	Male No.	Female No.	Total No.	Female %	Male No.	Female No.	Total No.	Female %	Male No.	Female No.	Total No.
STEM											
N&P Sciences	3,709	3,130	6,839	46%	6,367	5,875	12,242	48%	2,658	2,745	5,403
IT	756	244	1,000	24%	1,609	608	2,217	27%	853	364	1,217
Engineering	2,675	699	3,374	21%	5,969	2,066	8,035	26%	3,294	1,367	4,661
Agriculture	875	642	1,517	42%	1,254	1,212	2,466	49%	379	570	949
Subtotal	8,015	4,715	12,730	37%	15,199	9,761	24,960	39%	7,184	5,046	12,230
Non-STEM	9,658	11,659	21,317	55%	13,086	19,084	32,170	59%	3,428	7,425	10,853
Total Enrolments	17,673	16,374	34,047	48%	28,285	28,845	57,130	50%	10,612	12,471	23,083
Total Students	17,673	16,374	34,047	48%	28,285	28,845	57,130	50%	10,612	12,471	23,083

Source: The Department. Purchased Tables & uCube.

Table 3.16 shows the remarkable expansion in PhD enrolments by overseas students. In 2002, overseas students made up 17 per cent of STEM PhDs, and 15 per cent of enrolments in non-STEM fields. In 2015, the equivalent figures were 47 per cent and 24 per cent, respectively. Fifty-five per cent of all PhD enrolments in Engineering in 2015 were by overseas students, and in Information Technology, 53 per cent. Even in the Natural and Physical Sciences, the proportion was 41 per cent. The fact of this expansion presents an intriguing policy issue, because particularly in the STEM fields, nearly half of this future intellectual elite are from overseas. Considerable resources need to go into providing this doctoral training, and a couple of perspectives can be brought out of this fact. Although most foreign PhD students are fee paying, teaching to students at this level needs to be provided by relatively senior scholars. This can be contrasted by the large proportion of undergraduate teaching which is done by junior and often casually-employed academics[20]. Another point is that many foreign PhD graduates will leave Australia after their training, by visa requirements or by choice, meaning that considerable effort is put into educating elite, qualified students who will not be able to add anything to Australia's human resources.

Table 3.16 Enrolments: PhD Students by Citizen/Resident Status 2002 & 2015

	2002				2015				Growth		
	Domestic No.	Overseas No.	Total No.	Overseas %	Domestic No.	Overseas No.	Total No.	Overseas %	Domestic No.	Overseas No.	Total No.
STEM											
N&P Sciences	5,876	963	6,839	14%	7,242	5,000	12,242	41%	1,366	4,037	5,403
IT	808	192	1,000	19%	1,048	1,169	2,217	53%	240	977	1,217
Engineering	2,620	754	3,374	22%	3,617	4,418	8,035	55%	997	3,664	4,661
Agriculture	1,250	267	1,517	18%	1,260	1,206	2,466	49%	10	939	949
Subtotal	10,554	2,176	12,730	17%	13,167	11,793	24,960	47%	2,613	9,617	12,230
Non-STEM	18,132	3,185	21,317	15%	24,568	7,602	32,170	24%	6,436	4,417	10,853
Total Enrolments	28,686	5,361	34,047	16%	37,735	19,395	57,130	34%	9,049	14,034	23,083
Total Students	28,679	5,361	34,040	16%	37,735	19,395	57,130	34%	9,056	14,034	23,090

Source: The Department. Purchased Tables & uCube.

20 NTEU (n.d.). Casuals and Insecure work. Retrieved from https://www.nteu.org.au/policy/workforce_issues/insecure_work

Students enrolled in a Course leading to provisional registration as a medical practitioner

The aim of this section is to follow the development of enrolments in programmes to produce an initially-registered medical work force. It is possible to use the higher education statistics system to a certain extent, because there is a field in the higher education collection that if completed correctly by universities, should enable a closer look at the group of students in question.

Table 3.17 summarises what is available from the system, and the material of interest is 'Course leading to provisional registration as a medical practitioner', which have represented about one per cent of the total across the period in question, but their number increased strongly, by 118 per cent. The period in question saw the creation of several new medical schools, and well as the rebadging of medicine as a postgraduate course over the years at some universities.

Table 3.17 Enrolments: All Students by Special Course Status, 2002 – 2015

'Special Course'	2002	2015	Growth 2002–2015	
			No.	%
General Nursing Course Required for initial registration	23,826	57,876	34,050	143%
Course providing initial teacher training	58,821	85,458	26,637	45%
Course leading to provisional registration as a medical practitioner	**8,243**	**18,008**	**9,765**	**118%**
Course leading to provisional registration as a veterinary practitioner		3,118	3,118	
Course leading to provisional registration as a dental practitioner		2,712	2,712	
Course of study in clinical psychology		2,653	2,653	
Australian Maritime College Special Course	1,339		-1,339	-100%
Not a course of special interest	804,392	1,240,308	435,916	54%
Total	**896,621**	**1,410,133**	**513,512**	**57%**
Not a course of special interest – %	90%	88%	85%	

Source: The Department: uCube.
* Refer to Chapter 1 for an explanation of factors that have disrupted aspects of the statistical time series

Tables 3.18 and 3.19 relate only to the 'medical practitioner' row, in order to demonstrate what has happened this century in the university training of medical students. Figures for the years shown have been taken directly from uCube, and therefore represent exactly what has been reported to the Department by universities.

Table 3.18 presents enrolments by 'medical practitioner students', by course level, gender and citizenship status. The table shows that there has been a switch from these students being undergraduates, to becoming postgraduates. By 2015, a quarter of the cohort of students were enrolled as postgraduates. The gender distribution indicates that the proportion of women slightly exceeds 50 per cent, but the proportion of women in 2007 had been 55 per cent. Finally, Table 3.18 indicates that the proportion of overseas students has increased from 16 per cent at the start of the century, to 20 per cent by 2015.

Table 3.18 Enrolments: Medical Practitioner Students by Broad Field of Education, Course Level, Gender and Citizenship Status

	2002	2007	2012	2015	Growth 2002 – 2015	
	No.	No.	No.	No.	No.	%
Postgraduate			644	4,442	4,442	
Undergraduate	8,243	12,156	16,093	13,566	5,323	65%
% Postgraduate	0%	0%	4%	25%		
Male	3,934	5,463	8,120	8,795	4,861	124%
Female	4,309	6,693	8,617	9,213	4,904	114%
% Female	52%	55%	51%	51%		

	2002 No.	2007 No.	2012 No.	2015 No.	Growth 2002 – 2015 No.	%
Domestic	6,909	9,753	13,542	14,487	7,578	110%
Overseas	1,334	2,403	3,195	3,521	2,187	164%
% Overseas	16%	20%	19%	20%		
Total	8,243	12,156	16,737	18,008	9,765	118%

Source: The Department – uCube.

* Refer to Chapter 1 for an explanation of factors that have disrupted aspects of the statistical time series

Table 3.19 examines the distribution of 'medical practitioner' students according to university within State/Territory. On the basis of these figures, Queensland has increased its share of the medical practitioner pie the most, with an additional 3,191 enrolments, or 277 per cent between 2002 and 2015. This is against the national increase of 118 per cent. Within Queensland, it would appear that Bond University and Griffith University have started to train such students. However, the pattern at Griffith is odd, with there being no enrolments in courses leading to provisional registration as a medical practitioner in 2012, but with enrolments in all other years since they first reported such students in 2005. James Cook increased the number of these students by 982, or 414 per cent. Monash also seemed to expand its training in this area considerable this century, by 1,582 students, or 182 per cent. The table shows a decline in enrolments since 2007, but this is a reflection of the way that university now trains its medical practitioner students.

Enrolments by 'medical practitioner' students in the state of Western Australia show a couple of interesting patterns. First, the University of Notre Dame enrolled its first students in 2005, and by 2015, had enrolments by 879 such students. The other matter relates to the University of Western Australia. As outlined in Chapter 1, UWA moved to a graduate school-style model from 2012. Therefore, there would be a decline in the number of 'medical practitioner' enrolments from that year, as future intending medical practitioners enrolled in say, a BSc for three years, prior to commencing a postgraduate pre-registration medical degree. Under such circumstances, 2015 was perhaps the first year that postgraduate enrolments would be accepted into the new course.

Looking at other patterns of enrolment around the country, equivalent enrolments to those at UWA can be seen in the enrolment pattern at the University of Melbourne. Looking at ANU, it would seem that this university also started to train medical practitioners during the period, starting with an apparent intake of 80 in 2004, with the total population of these students peaking at around 370.

Table 3.19 Enrolments: Medical Practitioner Students by State / Territory and University. Growth 2002 -2015.

	2002 No.	2007 No.	2012 No.	2015 No.	Growth 2002 – 2015 No.	%
New South Wales						
UNE			322	342	342	
Newcastle	424	530	694	713	289	68%
Sydney	891	1,088	1,195	1,192	301	34%
UNSW	1,137	1,341	1,615	1,673	536	47%
Wollongong		79	326	329	329	
WSU		104	599	617	617	
Total	2,452	3,142	4,751	4,866	2,414	98%
Victoria						
Deakin			536	545	545	
Monash	868	1,421	2,378	2,450	1,582	182%
Melbourne	1,477	1,798	1,294	1,412	-65	-4%
Total	2,345	3,219	4,208	4,407	2,062	88%

	2002 No.	2007 No.	2012 No.	2015 No.	Growth 2002 – 2015 No.	 %
Queensland						
Bond		234	412	456	456	
Griffith		350		603	603	
James Cook	224	534	993	1,152	928	414%
U Queensland	926	1,366	1,875	2,130	1,204	130%
Total	1,150	2,484	3,280	4,341	3,191	277%
Western Australia						
Notre Dame Australia		256	838	879	879	
UWA	770	961	1,106	947	177	23%
Total	770	1,217	1,944	1,826	1,056	137%
South Australia					No.	%
Flinders	359	435	572	651	292	81%
Adelaide	775	834	1,036	976	201	26%
Total	1,134	1,269	1,608	1,627	493	43%
Tasmania						
Tasmania	392	488	571	570	178	45%
Total	392	488	571	570	178	45%
ACT						
ANU		337	375	371	371	
Total		337	375	371	371	
Total	8,243	12,156	16,737	18,008	9,765	118%

Source: The Department – uCube.
* Refer to Chapter 1 for an explanation of factors that have disrupted aspects of the statistical time series

The next chapter examines student load patterns for the STEM fields of education and for courses leading to provisional registration as a medical practitioner.

Chapter 4

STEM Student Load: STEM Teaching and learning in the 21st century

The system for counting students and measuring what they study at university can be examined in more detail by considering 'equivalent full-time student load' (EFTSL), which is built up from the subjects that students take as part of the course they are enrolled in. (See also Chapter 1). This measure therefore allows us to consider what is being taught by Australian universities, and the students it is being taught to. A full-time student enrolled in a 'normal' work load for a student in a given degree or diploma will produce an EFTSL of 1.000. The typical way that student load is reported is according to which disciplines are taught, but neither the Department's standard tables, nor its uCube on-line cross tabulation software allow a researcher to see which *groups of students* are being taught. Although it is useful to know how much mathematics (for example) is being taught, it is also helpful and useful from a planning perspective to know which students are receiving that teaching, and particularly if the proportion is changing over time. The type of question that can be answered if information is made available in that way includes the one asked by the ACDS last century, when they wanted to know how the 'average' BSc had changed over time. As was revealed at the time, the proportion of the enabling sciences (chemistry, mathematics and physics) in the 'average' BSc had declined, while the proportion of biological sciences and non-science subjects had increased.[21] Before the data files were removed from the Department's website, it was possible to undertake such analysis without purchasing tables from the Department.

'Student Load' (EFTSL) is calculated by summing the weights attributable to the subjects that students enrol in (e.g., a subject that constituted ten per cent of a full year's work is weighted as 0.100 EFTSL), and there are two aspects of this. First, by summing the weights in all 'chemistry' subjects, for example, it is possible to calculate how much 'chemistry' is taught. Second, by filtering this information, it is possible see how much 'chemistry' is taught to students in different courses at various course levels, and further, to establish whether there have been variations in these patterns according to other variables, such as whether students are female or male, domestic or overseas, or commencing or continuing their programmes (to pick the binary populations analysed in this study). In line with the Field of Education classification, Discipline Groups can be *broad* (two-digit), *narrow* (four digit), or *detailed* (six digit). Very little information is reported below the two-digit level, which is the extent of detail available via uCube.

Teaching STEM 2002 – 2015

Starting with the overall situation, Table 4.1 shows the distribution of student load according to the discipline of the subjects that are being taught, first at the level of Broad Discipline Groups. One minor issue with tables in this chapter is that the nature of the detail of what is being examined means that it was necessary to construct them from purchased tables. Unfortunately, there are minor differences between some of these purchased tables and what the figures produced in the Department's formal publications, and its on-line cross-tabulation system uCube show. In order to have a consistent set of numbers in this chapter, arguably the main chapter in this study, it is necessary for all the numbers in this chapter to tally internally. That said, the differences are not great. A comparison with

21 See Dobson, I. & Calderon, A. (1999). Trends in Science Education: Learning teaching and outcomes 1989 – 1997. ACDS. ISBN 0-7326-2104-6

Table 2.7, for instance, shows that the figure generated by uCube for teaching in the Natural and Physical Sciences in 2015 was 122,373 EFTSL, whereas in Table 4.1, the figure that ought to be identical, is 122,397 EFTSL. Of course, it is a mystery how some of the slippage has occurred between STEM and non-STEM disciplines. The so-called privacy issue is about the potential for identifying individuals, yet student load is not a measure of individuals. For example, the 8,704 EFTSL shown in 2002 for Agriculture, Environmental and Related Studies is not 8,704 people. It is perhaps ten or 20 times that number, because it is the aggregation of every subject in this discipline being taken at any level, at every university teaching in this discipline, to every student enrolled in a course in any field. And these myriad 'agriculture' students are enrolled at 38 or so universities, across Australia.

Table 4.1 shows that teaching in STEM disciplines (to all students, at all course levels) increased by 44 per cent, from 174,550 EFTSL in 2002 to 252,128 EFTSL, with Natural and Physical Sciences and Engineering and Related Technologies providing most of that growth. The table also shows that teaching in Agriculture, Environmental and Related Studies also increased quite strongly (+45 per cent), but this Broad Discipline Group is quite small. Information Technology teaching declined by over 9,000 EFTSL, or 17 per cent. Growth of teaching in non-STEM disciplines exceeded that in STEM disciplines by a considerable margin.

Table 4.1 Student Load: All Students by Broad Discipline Group. Numbers, Percentage & Growth: 2002 – 2015

Discipline Group	2002 EFTSL	2007 EFTSL	2012 EFTSL	2015 EFTSL	Growth 2002–2015 EFTSL	2002 %	2007 %	2012 %	2015 %	Growth 2002–2015 %
STEM										
N&P Sciences	73,735	85,722	110,027	122,397	48,662	12%	12%	12%	12%	66%
IT	55,237	37,821	38,238	45,750	-9,487	9%	5%	4%	5%	-17%
Engineering	36,874	41,809	59,802	71,201	34,327	6%	6%	7%	7%	93%
Agriculture	8,704	8,850	11,688	12,780	4,076	1%	1%	1%	1%	47%
Subtotal	174,550	174,202	219,755	252,128	77,578	28%	24%	24%	25%	44%
Non-STEM	452,198	551,689	683,339	750,252	298,054	72%	76%	76%	75%	66%
TOTAL	626,749	725,892	903,094	1,002,378	375,629	100%	100%	100%	100%	60%

Source: The Department: Purchased Tables.

Within each *broad* discipline group are *narrow* discipline groups, and within each of those, detailed discipline groups. The next set of tables provide information down to the detailed level for the four Broad Discipline Groups that make up STEM. Tables 4.2 to 4.5 have been split into two sections to facilitate identifying any trends.

Table 4.2 concerns the Natural and Physical Sciences Broad Discipline Group, starting with Table 4.2a, which shows the *narrow* discipline groups in that Broad Discipline Group. Overall, teaching in the Natural and Physical Sciences to students in all courses at all levels increased by 48,661 EFTSL, or 66 per cent, with considerable variation within the narrow discipline groups. The largest of the narrow discipline groups is Biological Sciences, teaching in which also increased by the most: by 17,936 EFTSL, or 59 per cent. There was also strong growth in Mathematical Sciences: +11,920 EFTSL, or 58 per cent. Growth in the teaching of Chemical Sciences was 52 per cent, followed by 41 per cent growth in Physics and Astronomy and 34 per cent in Earth Sciences. The largest proportionate growth occurred in 'Other Natural and Physical Sciences'. More will be mentioned about this in the commentary below concerning *detailed* discipline groups.

Table 4.2b drills down even further. Although having information at this level would provide excellent and detailed information for descriptive, reporting and planning purposes, a brief examination of this table reveals a number of unfortunate glitches. These glitches arise from the manner in which some universities (and perhaps the Department) have interpreted instructions for coding subjects to

discipline groups. The point of conjecture arises from whether or not universities should have codes any subjects to the '00' (i.e., to 010500 in the case of Chemical Sciences). There has been an apparent decline of 41 per cent of subjects in this category, with increases in the other three values available. It would seem, therefore that some universities coded chemistry subjects that were not specifically '010501 Organic Chemistry' or '010503 Inorganic Chemistry' as '010599 Chemical Sciences not elsewhere classified', whereas others have coded such subjects as '010500 Chemical Sciences'. In 2007, which happens to be one of the years examined in this report, and one for which I still have the data sets withdrawn by the Department in 2011, two-thirds of the student load coded as 010500 Chemical Sciences was reported by just seven universities, with the Universities of Sydney (699 EFTSL), Melbourne (647 EFTSL) and Monash University (631 EFTSL) being the largest 'contributors'.

Given this situation, one would be inclined to aggregate 010500 and 010599 for the Chemical Sciences Broad Discipline Group to create a set of numbers fully comparable across the sector. However, there is no equivalent catchall category within the *narrow* discipline group Physics and Astronomy. One wonders why this should be the case. Perhaps this situation is of little importance, but if that is so, why does the Department continue to collect information from universities at this level of detail? Why not simply collect information at the Narrow Discipline Group level? At the very least, the Department should request that universities examine their propensity to code subjects to '019999 Other Natural and Physical Sciences – nec' ('not elsewhere classified'). Is there no other place within the more than 30 other detailed discipline groups for these apparently unclassifiable subjects to be linked?

Bearing in mind these provisos, a couple of changes at the detailed discipline level should be noted. Within Biological Sciences, Human Biology has presented the largest numerical increase: +10,709 EFTSL, or 138 per cent. Biological Sciences nec also increased handsomely: +4,426 FTSL, or 193 per cent. Of course, much of this increase could be due to the decline of 3,311 EFTSL in 010900 Biological Sciences.

The 'Other Natural and Physical Sciences' narrow discipline group requires further examination. The first thing is that detailed disciplines 019900 and 019999 together increased by about 200 per cent. One has to wonder what these 'other natural and physical sciences' subjects are that cannot be fitted into the 30 or so categories for the specific narrow discipline groups (such as Physics and Astronomy), plus the five specific detailed disciplines that exist within 'Other Natural and Physical Sciences'. It is also interesting to see that in 2015, Australian universities were providing training for 688 equivalent full-time forensic sciences (up from 193 EFTSL in 2002). Some might see this number as being in excess of potential demand. According to the ABC: 'Forensics is a highly specialised career and there are only a few employment opportunities in the occupation'.[22]

Finally, a further indicator of change in university statistics that has nothing to do with policy changes etc, is that the '00' codes, such as 010100 for Mathematical Sciences and the equivalents for all narrow discipline groups except 'Other Natural and Physical Sciences' declined over the course of this century to the tune of 8,225 EFTSL. If one were still permitted to have access to the data files that were freely available for data from the early 1990s until 2009, we could work out where these changes had occurred, and perhaps why. Of course, the Department is in a position to do such work, but with few exceptions over the years, they have shown little interest in undertaking deeper analysis of the rich data demanded from universities. This is a pity, because the Department's personnel are now the only ones with the capacity to research into some matters.

Commentary on the other STEM Broad Discipline Groups will be briefer than for Natural and Physical Sciences, given the variability inherent with aspects of the figures at the detailed discipline group level.

22 See http://www.abc.net.au/science/forensic/wannabe.htm

Table 4.2 Student Load: All Students in Natural & Physical Sciences Subjects by Narrow and Detailed Discipline Groups. Numbers, Percentage & Growth: 2002 – 2015

Natural and Physical Sciences	2002 EFTSL	2007 EFTSL	2012 EFTSL	2015 EFTSL	Growth No.	Growth %
(a) Narrow Discipline Groups						
Mathematical Sciences	20,519	22,808	29,187	32,439	11,920	58%
Physics & Astronomy	4,994	5,251	6,173	7,056	2,062	41%
Chemical Sciences	7,621	8,789	10,812	11,588	3,967	52%
Earth Sciences	3,897	3,956	5,540	5,232	1,334	34%
Biological Sciences	30,512	36,242	44,212	48,448	17,936	59%
Other N&P SCIENCES	6,192	8,677	14,102	17,634	11,442	185%
N&P SCIENCES	73,735	85,722	110,027	122,397	48,661	66%
(b) Detailed Discipline Groups						
010100 Mathematical Sciences	4,680	1,774	963	759	-3,921	-84%
010101 Mathematics	8,587	10,943	16,137	17,574	8,987	105%
010103 Statistics	6,569	9,335	10,890	12,845	6,276	96%
010199 Maths. Sciences nec	683	755	1,197	1,261	578	85%
Subtotal	**20,519**	**22,808**	**29,187**	**32,439**	**11,920**	**58%**
010300 Physics & Astronomy	1,146	154	116	137	-1,010	-88%
010301 Physics	3,580	4,769	5,457	6,146	2,566	72%
010303 Astronomy	267	328	600	773	506	189%
Subtotal	**4,994**	**5,251**	**6,173**	**7,056**	**2,062**	**41%**
010500 Chemical Sci.	4,450	4,855	5,874	6,164	1,714	39%
010501 Organic	897	1,050	1,132	1,277	380	42%
010503 Inorganic	280	463	364	317	38	14%
010599 Chemical Sci. nec	1,994	2,420	3,442	3,830	1,836	92%
Subtotal	**7,621**	**8,789**	**10,812**	**11,588**	**3,967**	**52%**
010700 Earth Sciences	1,353	1,083	1,444	1,174	-180	-13%
010701 Atmospheric Sciences	119	188	280	274	155	130%
010703 Geology	937	1,097	1,722	1,841	903	96%
010705 Geophysics	84	161	260	238	154	183%
010707 Geochemistry	29	26	58	43	15	51%
010709 Soil Science	228	227	269	273	46	20%
010711 Hydrology	217	229	304	296	79	36%
010713 Oceanography	99	105	136	116	17	17%
010799 Earth Sciences nec	831	840	1,068	977	145	18%
Subtotal	**3,897**	**3,956**	**5,540**	**5,232**	**1,334**	**34%**
010900 Biological Sciences	9,490	5,328	6,557	6,379	-3,111	-33%
010901 Biochemistry	3,498	5,626	6,616	7,112	3,613	103%
010903 Botany	813	796	756	673	-140	-17%
010905 Ecology & Evol.	1,798	1,667	1,982	2,075	278	15%
010907 Marine Science	590	689	747	679	89	15%
010909 Genetics	1,183	1,817	1,984	2,252	1,069	90%
010911 Microbiology	1,923	2,457	2,731	2,805	881	46%
010913 Human Biology	7,766	12,949	16,295	18,475	10,709	138%
010915 Zoology	1,155	1,277	1,293	1,277	122	11%
010999 Biol. Sci. nec	2,296	3,635	5,250	6,722	4,426	193%
Subtotal	**30,512**	**36,242**	**44,212**	**48,448**	**17,936**	**59%**

Natural and Physical Sciences	2002 EFTSL	2007 EFTSL	2012 EFTSL	2015 EFTSL	Growth No.	Growth %
019900 Other N&P Sciences	674	500	1,048	1,898	1,224	182%
019901 Medical Science	1,273	2,231	4,557	5,856	4,583	360%
019903 Forensic Science	193	425	612	688	495	256%
019905 Food Sci. & Biotec.	1,074	1,044	1,266	1,414	339	32%
019907 Pharmacology	1,515	2,507	3,159	3,504	1,990	131%
019909 Laboratory Tech.	182	246	246	333	151	83%
019999 N&P SCIENCES nec	1,281	1,725	3,216	3,941	2,660	208%
Subtotal	6,192	8,677	14,102	17,634	11,442	185%
Subtotal N&P Sciences	73,735	85,722	110,027	122,397	48,661	66%

Source: The Department: Purchased Tables. Nec: 'not elsewhere classified'

Table 4.3 examines the teaching of Information Technology subjects to all students at all levels. Only narrow discipline group Other Information Technology increased over the period with the exception of 020111 Data Structures, which has managed to increase by one EFTSL since 2002. Of course, as was the case with the Natural and Physical Sciences, the 'Other' category of Information Technology disciplines increased handsomely, in an otherwise declining market. Universities were apparently unable to classify some Information Technology subjects more specifically than 'IT nec / Other IT'.

Table 4.3 Student Load: All Students in Information Technology Subjects by Narrow and Detailed Discipline Groups. Numbers, Percentage & Growth: 2002 – 2015

Information Technology	2002 EFTSL	2007 EFTSL	2012 EFTSL	2015 EFTSL	Growth No.	Growth %
(a) Narrow Discipline Groups						
Computer Science	26,818	15,297	15,387	18,521	-8,297	-31%
Information Systems	21,258	16,324	14,926	17,020	-4,238	-20%
Other IT	7,160	6,201	7,925	10,208	3,048	43%
Subtotal IT	55,237	37,821	38,238	45,750	-9,487	-17%
(b) Detailed Discipline Groups						
020100 Computer Science	6,224	2,590	2,594	3,101	-3,123	-50%
020101 Formal Lang. Theory	200	152	149	187	-13	-7%
020103 Programming	8,951	4,089	4,543	6,277	-2,674	-30%
020105 Computational Theory	492	240	261	349	-143	-29%
020107 Compiler Construction	62	28	15	16	-45	-74%
020109 Algorithms	354	285	405	553	199	56%
020111 Data Structures	575	350	322	576	1	0%
020113 Networks & Comm.	4,333	2,491	1,984	2,987	-1,346	-31%
020115 Computer Graphics	1,382	1,671	1,840	1,157	-225	-16%
020117 Operating Systems	1,325	892	668	717	-608	-46%
020119 Artificial Intelligence	673	622	710	435	-238	-35%
020199 Computer Science nec	2,247	1,887	1,896	2,166	-81	-4%
Subtotal	26,818	15,297	15,387	18,521	-8,297	-31%
020300 Information Systems	6,014	3,771	3,833	4,276	-1,737	-29%
020301 Conceptual Modelling	615	1,257	1,355	558	-57	-9%
020303 Database Management	3,731	2,292	2,118	2,386	-1,345	-36%
020305 Sys Analysis & Design	4,473	2,748	2,176	2,974	-1,499	-34%
020307 Decision Support Sys.	830	970	539	754	-75	-9%
020399 Information Sys. nec	5,597	5,285	4,906	6,072	476	9%
Subtotal	21,258	16,324	14,926	17,020	-4,238	-20%

Information Technology	2002 EFTSL	2007 EFTSL	2012 EFTSL	2015 EFTSL	Growth No.	Growth %
029900 Other IT	439	636	767	1,073	634	144%
029901 Security Science	1,013	935	1,081	1,344	331	33%
029999 IT nec	5,709	4,630	6,077	7,792	2,083	36%
Subtotal	7,160	6,201	7,925	10,208	3,048	43%
Subtotal IT	55,237	37,821	38,238	45,750	-9,487	-17%

Source: The Department: Purchased Tables. Nec: 'not elsewhere classified'

Table 4.4 relates to the Engineering and Related Technologies Broad Discipline Group. In the first part of the table, it can be seen that rates of growth by narrow discipline group varied from six per cent (Electrical and Electronic Engineering, and 214 per cent in Civil Engineering, averaging 93 per cent overall. In numeric terms, growth varied from 46 EFTSL in the miniscule Automotive Engineering narrow group, to 10,249 EFTSL in Civil Engineering. Perhaps it is known within the engineering profession why the growth in Civil Engineering has been quite so spectacular. In the case of the largest narrow discipline group: Electrical and Electronic Engineering, perhaps the modest expansion was related to the decline in the numbers of students enrolled in Information Technology courses. Strong growth was also demonstrated by Mechanical and Industrial Engineering and Process and Resources Engineering. As with other discipline groups, the category 'Other Engineering and Related Technologies' expanded by nearly 9,000 EFTSL (+197 per cent). To repeat the question asked twice already relating to the expansion of the 'Other' narrow discipline groups, why is it that a taxonomy that contains something like 80 options within engineering-related detailed discipline groups is it possible for there to be so much expansion in the 'Other…' category?

Table 4.4 Student Load: All Students in Engineering and Related Technologies Subjects by Narrow and Detailed Discipline Group. Numbers, Percentage & Growth: 2002 – 2015

Engineering and Related Technologies	2002 EFTSL	2007 EFTSL	2012 EFTSL	2015 EFTSL	Growth No.	Growth %
(a) Narrow Discipline Groups						
0301 Manufacturing Eng.	1,154	1,420	1,720	1,963	810	70%
0303 Process Eng.	3,705	5,117	7,563	8,636	4,931	133%
0305 Automotive Eng.	33	54	94	79	46	137%
0307 Mechanical Eng	5,281	7,049	9,963	12,222	6,941	131%
0309 Civil	4,791	6,632	12,503	15,040	10,249	214%
0311 Geomatic Eng.	1,330	1,485	1,904	1,959	628	47%
0313 Elect. & Elect. Eng.	14,491	11,854	12,794	15,367	876	6%
0315 Aerospace	1,267	1,263	2,081	1,872	605	48%
0317 Maritime	304	423	451	652	348	115%
0399 Other	4,517	6,512	10,729	13,411	8,894	197%
Subtotal Eng. & Rel. Tech.	36,874	41,809	59,802	71,201	34,327	93%
(b) Detailed Discipline Groups						
030100 Manufacturing	244	241	125	298	55	22%
030101 Manufacturing	737	883	955	1,064	328	44%
030103 Printing	1	37	235	149	148	19924%
030105 Textile Making	28	64	114	116	88	320%
030107 Garment Making		9	97	138	138	
030113 Cabinet Making	6	2	19	17	10	160%
030115 Furn. Upholstery						
030199 Manufacturing nec	139	184	176	182	43	31%
Subtotal	1,154	1,420	1,720	1,963	810	70%

Engineering and Related Technologies	2002 EFTSL	2007 EFTSL	2012 EFTSL	2015 EFTSL	Growth No.	Growth %
030300 Process & Res. Eng.	346	62	131	221	-125	-36%
030301 Chemical Eng.	1,570	2,333	3,441	4,210	2,640	168%
030303 Mining Eng.	496	928	1,521	1,801	1,305	263%
030305 Materials Eng.	867	1,361	1,983	1,785	918	106%
030307 Food Proc.	114	78	103	195	81	71%
030399 Process & ResEng. nec	312	354	384	424	113	36%
Subtotal	3,705	5,117	7,563	8,636	4,931	133%
030500 Auto. Engineering	2		2	3	1	83%
030501 Auto. Engineering	15	48	80	71	56	370%
030503 Vehicle Mechanics			5	1	1	
030505 Auto. Electrics	5				-5	-100%
030511 Panel Beating					0	
030599 Auto. Eng. nec	11	6	6	4	-7	-63%
Subtotal	33	54	94	79	46	137%
030700 Mechanical	1,604	832	324	386	-1,218	-76%
030701 Mechanical Eng.	2,876	5,253	8,160	10,214	7,338	255%
030703 Industrial Eng.	322	332	643	1,103	781	243%
030705 Toolmaking	2	1			-2	-100%
030707 Metal Fitting,	.	4	10			
030711 Boiler making	3	2	2		-3	-100%
030713 Metal Casting	2	4	4	3	1	66%
030717 Plant	42	74	48	42	1	2%
030799 Mechanical Eng. nec	431	546	771	474	44	10%
Subtotal	5,281	7,049	9,963	12,222	6,941	131%
030900 Civil Eng.	1,851	1,565	2,461	3,801	1,950	105%
030901 Construction	183	507	1,288	1,667	1,484	812%
030903 Structural	975	2,077	3,570	3,722	2,747	282%
030905 Building Services	43	75	215	416	374	878%
030907 Water and Sanitary	295	546	1,048	1,101	806	273%
030909 Transport	221	331	613	817	596	269%
030911 Geotechnical	389	630	1,280	1,385	995	256%
030913 Ocean	25	64	124	102	77	310%
030999 Civil nec	810	835	1,903	2,029	1,219	151%
Subtotal	4,791	6,632	12,503	15,040	10,249	214%
031100 Geomatic Engineering	257	289	385	422	165	64%
031101 Surveying	535	603	658	722	187	35%
031103 Mapping Science	149	144	271	227	79	53%
031199 Geomatic nec	390	449	590	587	198	51%
Subtotal	1,330	1,485	1,904	1,959	628	47%
031300 Electrical & Electronic Eng.	4,262	1,822	1,421	2,334	-1,928	-45%
031301 Electrical Eng.	2,433	3,377	4,563	4,966	2,533	104%
031303 Electronic Eng.	2,414	1,780	1,733	2,112	-302	-13%
031305 Computer Eng.	3,293	2,795	2,702	3,085	-208	-6%
031307 Communications	1,397	1,284	1,110	1,267	-130	-9%
031309 Comm. Equip	64	3			-64	-100%
031311 Powerline		11	13	9	9	
031313 Elect. Fitting	23	27	42	58	35	150%
031315 Refrigeration					0	
031317 Electronic Serv.	22	1		2	-20	-91%
031399 Elec. & Elec. nec	582	754	1,210	1,534	952	164%
Subtotal	14,491	11,854	12,794	15,367	876	6%

Engineering and Related Technologies	2002 EFTSL	2007 EFTSL	2012 EFTSL	2015 EFTSL	Growth No.	Growth %
031500 Aerospace	192	25	44	28	-164	-85%
031501 Aerospace Eng.	308	657	705	554	247	80%
031503 Aircraft Maint.	5	6	27	22	17	376%
031505 Aircraft Op.	641	379	828	1,009	369	58%
031507 Air Traffic Cont.	9	8	75	87	78	827%
031599 Aerospace nec	113	188	403	172	59	52%
Subtotal	1,267	1,263	2,081	1,872	605	48%
031700 Maritime	.	4	13	4		
031701 Maritime Eng.	53	109	166	122	70	133%
031703 Marine Const.	3	30	30	12	9	329%
031705 Marine Craft Op.	55	199	119	237	182	330%
031799 Maritime nec	194	80	123	277	84	43%
Subtotal	304	423	451	652	348	115%
039900 Other Eng.	1,377	2,079	3,366	3,768	2,392	174%
039901 Env. Eng.	492	596	866	876	384	78%
039903 Biomedical En.	317	472	571	813	497	157%
039905 Fire Technology	72	68	59	76	4	5%
039907 Rail Operations		15	9			
039909 Cleaning				2	2	
039999 Other Eng. nec	2,259	3,283	5,858	7,875	5,616	249%
Subtotal	4,517	6,512	10,729	13,411	8,894	197%
Subtotal Engineering	36,874	41,809	59,802	71,201	34,327	93%

Source: The Department: Purchased Tables. Nec: 'not elsewhere classified'

Table 4.5 replicates the information above for the Agriculture, Environmental and Related Studies Broad Discipline Group. As the table shows, only the Agriculture and Environmental Studies narrow discipline groups expanded to any extent during the period under consideration. Proving to be an exception to the rule, Other Agriculture, Environmental and Related Studies narrow discipline group did not expand over the period.

The second section of the table further demonstrates the variability in how universities have coded the subjects they teach. For example, 050100 Agriculture declined by 502 EFTSL, but 050101 Agricultural Science expanded by 881 EFTSL. Overall, the Agriculture narrow discipline group expanded by 690 EFTSL. Overall, Environmental Studies increased by 3,774 EFTSL.

Table 4.5 Student Load: All Students in Agriculture, Environmental and Related Studies Subjects by Narrow and Detailed Discipline Group. Numbers, Percentage & Growth: 2002 - 2015

Agriculture, Environmental and Related Studies	2002 EFTSL	2007 EFTSL	2012 EFTSL	2015 EFTSL	Growth No.	Growth %
(a) Narrow Discipline Groups						
Agriculture	3,128	2,616	3,407	3,818	690	22%
Horticulture & Viticulture	461	367	347	316	-145	-31%
Forestry Studies	156	149	148	163	8	5%
Fisheries Studies	353	277	254	272	-80	-23%
Environmental Studies	3,581	4,573	6,838	7,355	3,774	105%
Other Agriculture, Env	1,026	869	694	855	-171	-17%
Subtotal Agriculture, Env	8,704	8,850	11,688	12,780	4,075	47%

Agriculture, Environmental and Related Studies	2002 EFTSL	2007 EFTSL	2012 EFTSL	2015 EFTSL	Growth No.	Growth %
(b) Detailed Discipline Groups						
050100 Agriculture	1,186	641	804	683	-502	-42%
050101 Agricultural Science	689	977	1,032	1,570	881	128%
050103 Wool Science	9	7	12	14	5	58%
050105 Animal Husbandry	916	749	1,142	1,120	204	22%
050199 Agriculture nec	328	242	417	431	103	31%
Subtotal	3,128	2,616	3,407	3,818	690	22%
050300 Hort. & Viticulture	33	25	1		-33	-100%
050301 Horticulture	178	180	92	127	-51	-28%
050303 Viticulture	250	162	254	189	-61	-24%
Subtotal	461	367	347	316	-145	-31%
050500 Forestry Studies	8	0	3	2	-6	-76%
050501 Forestry Studies	148	148	146	162	14	9%
Subtotal	156	149	148	163	8	5%
050700 Fisheries Studies	4	18	31	28	24	650%
050701 Aquaculture	309	224	157	163	-145	-47%
050799 Fisheries Studies nec	40	35	66	82	41	102%
Subtotal	353	277	254	272	-80	-23%
050900 Environmental Studies	745	1,163	2,016	2,004	1,259	169%
050901 Land, Parks	742	923	784	781	39	5%
050999 Environmental nec	2,093	2,487	4,039	4,570	2,477	118%
Subtotal	3,581	4,573	6,838	7,355	3,774	105%
059900 Other Agriculture, Env	642	382	136	138	-504	-79%
059901 Pest &Weed Control	95	52	65	72	-23	-24%
059999 Agriculture, Env nec	289	436	493	645	356	123%
Subtotal	1,026	869	694	855	-171	-17%
Subtotal Agriculture, Env.	8,704	8,850	11,688	12,780	4,075	47%

Source: The Department: Purchased Tables. Nec: 'not elsewhere classified'

STEM: women and men

It is well known that women are in the majority in the Australian university student population, but women's presence is not evenly distributed across university courses. Among female-majority fields, from uCube we find extremes in areas such as programmes for initial nurse education and teacher education (86 per cent of enrolments are women in both cases), and for veterinary science registration (77 per cent). At the other extreme, the proportion of women in fields such as Engineering and Related Technologies and Information Technology is around 17 per cent.

In Table 2.3 we saw that the overall long-term Australian university student population is distributed approximately 55:45 in favour of women. Further, from Table 3.3, we know that in 2015, women made up 53 per cent of enrolments in bachelor's degree courses in Agriculture, Environmental and Related Studies, 50 per cent of those in the Natural and Physical Sciences, and as mentioned above, about 17 per cent of enrolments in Engineering and Related Technologies and Information Technology. However, we are also aware that service teaching can mean that students in non-STEM programmes can still receive teaching in STEM disciplines. For example, it is likely that nursing students receive teaching in biology and information technology. Therefore, this aspect of 'service teaching' should be examined, to see how the gender spread pans out within the STEM disciplines, that is, examining the distribution of student load at the level of *narrow* discipline groups. Figures 4.1 to 4.4 explain.

The average female uptake of subjects in the Natural and Physical Sciences overall was just over half in all years examined, with considerable variation within the narrow discipline groups. (See Figure 4.1). Across all courses at all levels, enrolment in subjects in the Biological Sciences was the most favoured by women. The proportion of women has in fact dropped slightly since 2002, but women receive more than 60 per cent of the teaching in this narrow discipline group. A slightly lower proportion of teaching is taken by women in Other Natural and Physical Sciences, but nonetheless, the proportion exceeded 60 per cent across the period. However, it should be noted that this narrow discipline group comprises five defined detailed discipline groups (Medical Science, Forensic Science, Food Science, Pharmacology and Laboratory Technology), plus any other teaching that universities were unable to fit within the discipline group taxonomy. The gender distribution may not be the same across these groups.

Chemical Sciences is the next narrow discipline group favoured by women, with the proportion of women dropping slightly since 2002, but was still about half in 2015. Subjects in the relatively small Earth Sciences narrow discipline group have moved from women comprising just over 40 per cent of the total, to just under 40 per cent by 2015. The proportion of the students taking subjects in the Mathematical Sciences has been slightly under 40 per cent this century.

Finally, Physics and Astronomy is the least attractive Broad Discipline Group for female students, declining from about 29 per cent in 2002, to about 27 per cent in 2015.

Figure 4.1 Student Load 2002 – 2015: Natural & Physical Sciences – Female %

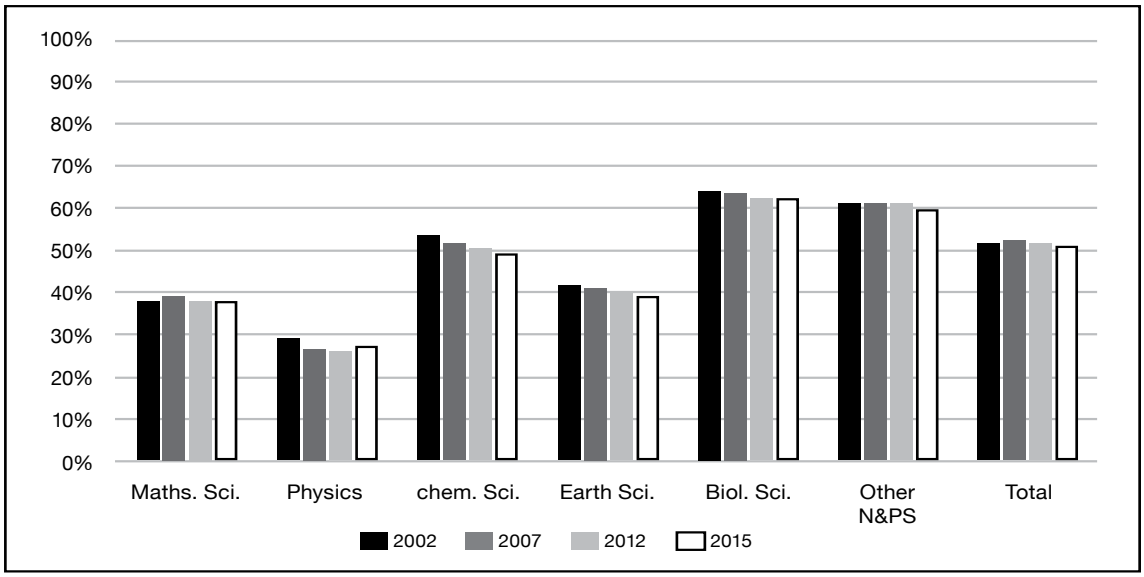


Figure 4.2 examines the proportion of teaching to female students in the Information Technology narrow discipline groups. Overall, the proportion of students taking subjects in informational technology dropped from about 28 per cent 24 per cent over the period, but as shown in the graph, there are variations within the three narrow discipline groups. Only Information Systems subjects have had a female audience exceeding 30 per cent of the total in the 2000s.

Readers will have noticed that even if enrolments by women in Information Technology courses amounted to about 17 per cent of all enrolments in that Broad Field of Education, but that women receive in excess of 20 per cent of all the teaching in the Information Technology discipline group. The reason for this variation can be explained by service teaching in IT subjects that are taken by students in non-Information Technology courses in other fields of education.

Figure 4.2 Student Load 2002 – 2015: Information Technology – Female %

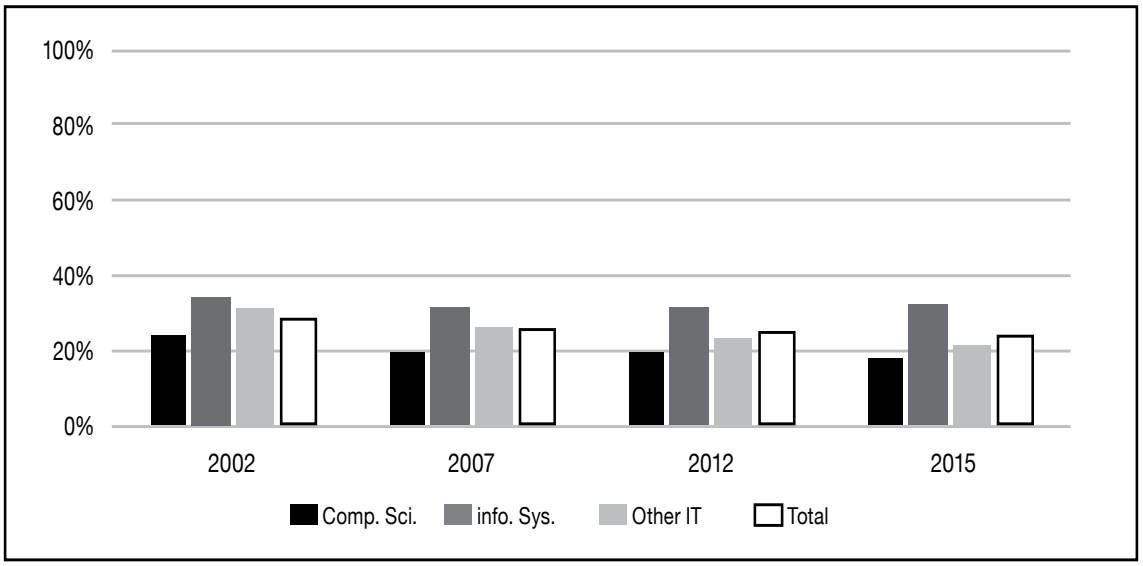
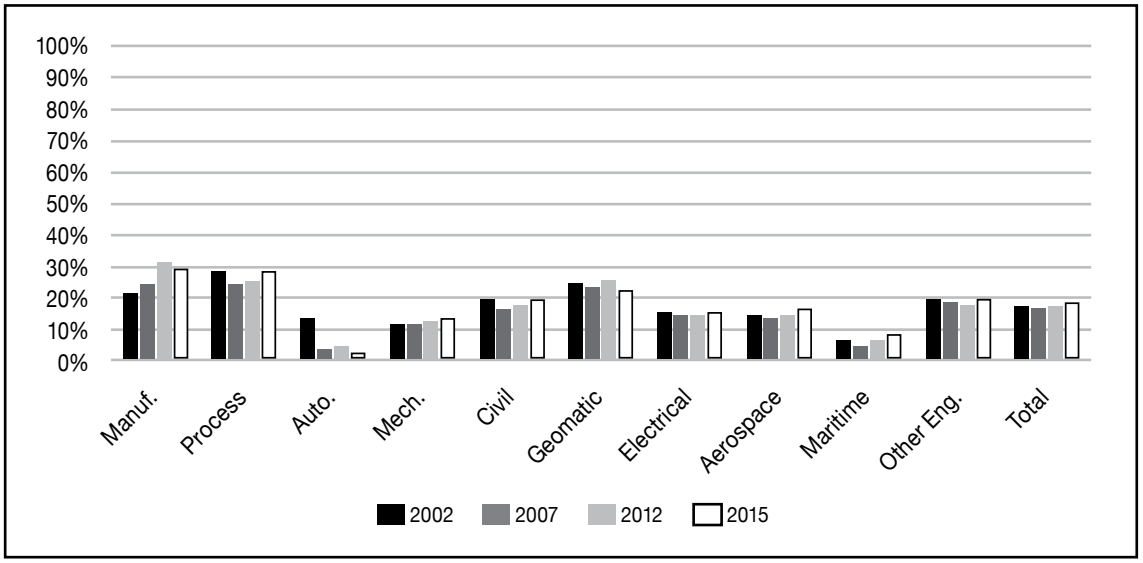


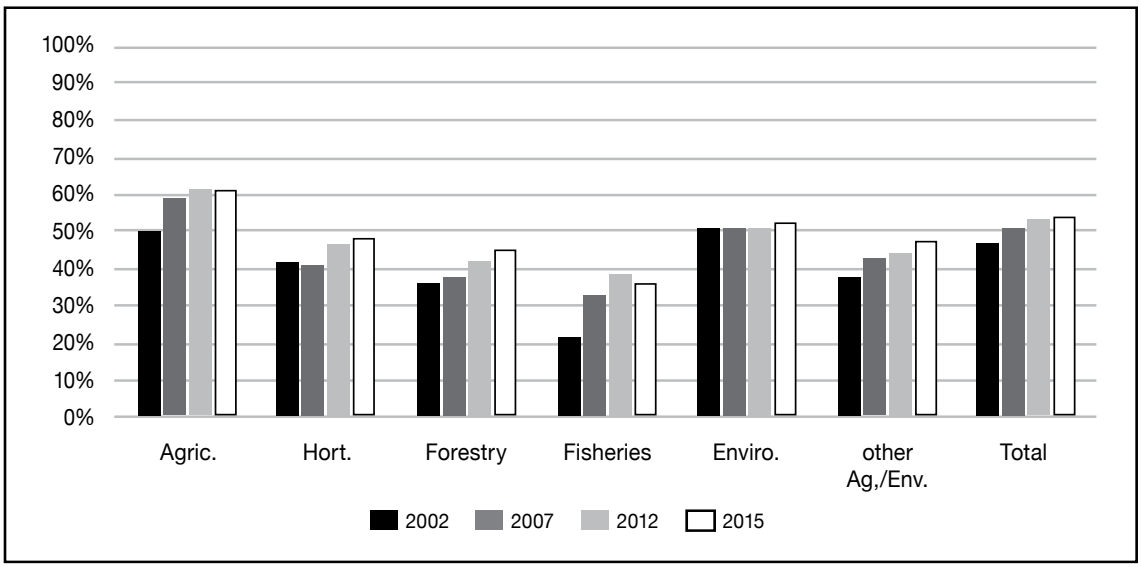
Figure 4.3 presents similar information about the ten narrow discipline groups that make up the Engineering and Related Technologies Broad Discipline Group. Manufacturing Engineering and Process Engineering (within which one can find chemical engineering as the largest single category) have the highest proportion of women in their classes, but this proportion has scarcely reached 30 per cent.

Figure 4.3 Student Load 2002 – 2015: Engineering and Related Technologies – Female %



Finally, in this brief examination of STEM and gender, Figure 6.4 looks at the Broad Discipline Group of Agriculture, Environmental and Related Studies. As can be seen, the narrow discipline groups of Agriculture, and Environmental Studies both had more than half of audiences made up by women, with lower proportions of women in the other narrow discipline groups.

Figure 4.4 Student Load 2002 – 2015: Agriculture, Environmental & Related Studies – Female %



What do students in STEM courses study?

The answer to this question is no doubt that students in STEM courses predominantly study STEM subjects, but of course, most STEM courses (particularly at the undergraduate level) are also likely to include some non-STEM subjects. This section, therefore, examines the what students in STEM courses are studying, by comparing STEM fields of education (courses) with STEM (and other) discipline groups (the subjects in those courses). Among other things, by comparing student enrolments with load, it is possible to measure the amount of service teaching. Most will be aware that educating Australia's student population involves a great deal of cross-disciplinary teaching and service teaching (provided by departments in one faculty / department / discipline to students from another faculty / department / field of education). That is, the subjects a student enrols in are neither necessarily restricted to a single discipline, nor to those taught by a single academic department or faculty.

This section presents analysis that extends beyond the STEM fields of education and discipline groups. In light of the important role of 'science' as service teaching to courses across the university spectrum, this section of the study also considers the teaching to students enrolled in courses in the Health and Society and Culture fields of education. Both of these broad fields of education cover a wide range of sub-fields, and for that reason, Health has been divided into 'medicine', 'pharmacy, optical science and dental studies', 'veterinary studies', and 'other health', the main constituent of which is nursing. In the case of Society and Culture, courses in Behavioural Science have been split out from Law and all other minor fields of education.

Table 4.6 presents a student load table shows the amount of teaching students in STEM and non-STEM courses received, which some non-STEM fields have been expanded. This table can be compared with Table 3.1, showing that the patterns are similar. STEM enrolments increased by 32 per cent between 2002 and 2015 (See Table 3.1), and teaching to students in STEM courses increased by 35 per cent (Table 4.6). The student load shown in Table 4.2 to students in courses in each Field of Education could be in any discipline. For example, the 79,691 EFTSL taught to students in Engineering includes teaching in the Engineering discipline, as well as all other teaching received by those students (such as teaching in mathematics, physics and chemistry, all of which are from the Natural and Physical Sciences discipline). In line with enrolments in broad fields of study, the table shows that there has been strong growth in the Natural and Physical Sciences and Engineering and Related Technologies, minimal expansion in Agriculture, Environmental and Related Studies, and decline in Information Technology.

Overall, teaching to STEM students increased by 35 per cent over the period, compared with growth in teaching to students in non-STEM courses of 68 per cent.

Looking at patterns in Health, it can be seen that there has been strong growth in all sub-categories. It should be noted that the overall expansion in these courses was 132 per cent between 2002 and 2015, with relatively lower growth in medical studies (+103 per cent) compared with the rest of Health. In Behavioural Sciences, the size also doubled, far stronger growth than there had been in the rest of the minor fields within Society and Culture.

Perhaps more interesting is the information provided in Table 4.7, which presents broad analysis for 2015 of what students in STEM courses (all levels) were studying in 2015. This table is split into three sections: EFTSL (numbers); the distribution of this teaching to students by Field of Education; and the distribution of this teaching according to the Discipline Group of that teaching. Taking Engineering as an example, Engineering students received teaching amounting to 79,691 EFTSL, of which 60,011 EFTSL was in Engineering disciplines. Therefore, for Engineering students, about 75 per cent of the teaching they received was in Engineering disciplines, as shown in the second part of the table. These students also received 14 per cent of their teaching in Natural and Physical Sciences subjects, plus one per cent in Agriculture, Environmental and Related Studies, four per cent in Information Technology subjects, and seven per cent in non-STEM disciplines. (Minor rounding errors apply). Table 4.7 also shows that subjects in Engineering and Related Technologies weighted at 71,201 EFTSL were taught, 84 per cent of which was taught to students in Engineering programmes, eight per cent to students in other STEM fields of education, and eight per cent to students in non-STEM programmes. The bottom part of the table demonstrates that Engineering is a relatively low provider of service teaching, compared with say, the Natural and Physical Sciences disciplines. In the latter, only 48 per cent of teaching of is provided to students enrolled in courses in the Natural and Physical Sciences Broad Field of Education, with 12 per cent going to other STEM fields of education, and 39 per cent to students not enrolled in STEM courses.

Table 4.6 Student Load: All Students by Broad Field of Education. Numbers, Percentage & Growth: 2002 – 2015#

Field of Education	2002 EFTSL	2007 EFTSL	2012 EFTSL	2015 EFTSL	Growth EFTSL	2002 %	2007 %	2012 %	2015 %	Growth %
STEM										
N&P Sciences	47,936	52,687	71,911	82,221	34,285	8%	7%	8%	8%	72%
IT	51,285	31,319	32,936	40,335	10,950	8%	4%	4%	4%	-21%
Engineering	46,895	52,624	69,883	79,691	32,796	7%	7%	8%	8%	70%
Agriculture	12,851	10,676	13,137	13,070	219	2%	1%	1%	1%	2%
Sub-total	158,967	147,306	187,867	215,317	56,350	25%	20%	21%	21%	35%
Non-STEM Health										
Medicine	11,229	15,307	22,820	22,848	11,619	2%	2%	3%	2%	103%
Pharmacy, Optical, Dental	5,881	9,441	12,048	12,636	6,755	1%	1%	1%	1%	115%
Veterinary Science	1,901	2,703	3,852	4,570	2,669	0%	0%	0%	0%	140%
Other	52,499	72,272	102,594	126,135	73,636	8%	10%	11%	13%	140%
Subtotal	71,510	99,723	141,314	166,189	94,679	11%	14%	16%	17%	132%
Non-STEM Society & Culture										
Behavioural Sciences	15,129	17,716	25,931	30,805	15,676	2%	2%	3%	3%	104%
Law	20,444	24,883	28,842	33,175	12,731	3%	3%	3%	3%	62%
Other Society & Culture	89,836	93,384	119,061	126,495	36,659	14%	13%	13%	13%	41%
Subtotal	125,409	135,983	173,834	190,475	65,066	20%	19%	19%	19%	52%
Other Non-STEM	270,863	342,880	400,079	430,397	159,534	43%	47%	44%	43%	59%
Subtotal Non-STEM	467,782	578,586	715,227	787,061	319,279	75%	80%	79%	79%	68%
Total	626,749	725,892	903,094	1,002,378	375,629	100%	100%	100%	100%	60%

Source: The Department: Purchased Tables.
Includes additional detail for Health and Society and Culture fields of education

Table 4.7 Student Load: All Students – Teaching and Learning Matrix. All Broad Discipline Groups and all Broad Fields of Education 2015

Field of Education	N&P Sciences	IT	Engineering	Agriculture	Sub-total STEM	Non-STEM	Total
(a) EFTSL	EFTSL	EFTSL	EFTSL	EFTSL	EFTSL	EFTSL	EFTSL
STEM							
N&P Sciences	58,451	1,869	2,968	2,,633	65,921	16,301	82,221
IT	1,746	31,098	2,008	69	34,921	5,412	40,335
Engineering	11,152	2,830	60,011	450	74,443	5,248	79,691
Agriculture	3,010	32	439	6,749	10,230	2,842	13,070
Sub-total	74,359	35,829	65,426	9,901	185,515	29,803	215,317
Non-STEM							
Health							
Medicine	1,656	1	3	1	1,661	21,187	22,848
Pharm, Optical, Dental	3,734	1			3,735	8,901	12,636
Vet Sci	559			429	988	3,582	4,570
Other	20,063	97	136	138	20,434	105,701	126,135
Subtotal	26,012	99	139	568	26,818	139,371	166,189
Society & Culture							
Behavioural Sciences	2,416	48	10	29	2,503	28,302	30,805
Law	341	97	52	55	545	32,630	33,175
Other	4,387	858	239	604	6,088	120,857	126,945
Subtotal	7,144	1,003	301	688	9,136	181,339	190,475
Other Non-STEM	14,882	8,819	5,335	1,623	30,659	159,816	190,475
Subtotal Non-STEM	48,038	9,921	5,775	2,879	66,613	720,448	787,061
Total	122,397	45,750	71,201	12,780	252,128	750,251	1,002,378
(b) FoE %	FoE %	FoE %	FoE %	FoE %	FoE %	FoE %	FoE %
STEM							
N&P Sciences	71%	2%	4%	3%	80%	20%	100%
IT	4%	77%	5%	0%	87%	13%	100%
Engineering	14%	4%	75%	1%	93%	7%	100%
Agriculture	23%	0%	3%	52%	78%	22%	100%
Sub-total	35%	17%	30%	5%	86%	14%	100%
Health							
Medicine	7%	0%	0%	0%	7%	93%	100%
Pharm, Optical Dental	30%	0%	0%	0%	30%	70%	100%
Vet Science	12%	0%	0%	9%	22%	78%	100%
Other	16%	0%	0%	0%	16%	84%	100%
Subtotal	16%	0%	0%	0%	16%	84%	100%
Society & Culture							
Behavioural Sciences	8%	0%	0%	0%	8%	92%	100%
Law	1%	0%	0%	0%	2%	98%	100%
Other	3%	1%	0%	0%	5%	95%	100%
Subtotal	4%	1%	0%	0%	5%	95%	100%
Other Non-STEM	8%	5%	3%	1%	16%	84%	100%
Subtotal Non-STEM	6%	1%	1%	0%	8%	92%	100%
Total	12%	5%	7%	1%	25%	75%	100%
(c) DG %	DG %	DG %	DG %	DG %	DG %	DG %	DG %
STEM							
N&P Sciences	48%	4%	4%	21%	26%	2%	8%
IT	1%	68%	3%	1%	14%	1%	4%
Engineering	9%	6%	84%	4%	30%	1%	8%
Agriculture	2%	0%	1%	53%	4%	0%	1%
Sub-total	61%	78%	92%	77%	74%	4%	21%

Field of Education	N&P Sciences	IT	Engineering	Agriculture	Sub-total STEM	Non-STEM	Total
Health							
Medicine	1%	0%	0%	0%	1%	3%	2%
Pharmacy, Optical, Dental	3%	0%	0%	0%	1%	1%	1%
Vet Sci	0%	0%	0%	3%	0%	0%	0%
Other	16%	0%	0%	1%	8%	14%	13%
Subtotal	21%	0%	0%	4%	11%	19%	17%
Society & Culture							
Behavioural Sciences	2%	0%	0%	0%	1%	4%	3%
Law	0%	0%	0%	0%	0%	4%	3%
Other	4%	2%	0%	5%	2%	16%	13%
Subtotal	6%	2%	0%	5%	4%	24%	19%
Other Non-STEM	12%	19%	7%	13%	12%	21%	19%
Subtotal Non-STEM	39%	22%	8%	23%	26%	96%	79%
Total	100%	100%	100%	100%	100%	100%	100%

Source: The Department: Purchased Tables.
Includes additional detail for Health and Society and Culture fields of education.
FoE: Field of Education; DG: Discipline Group

Looking at teaching to students enrolled in courses in Society and Culture, particularly in the Behavioural Sciences narrow Field of Education, it can be seen that eight per cent of the teaching is in subjects within the Natural and Physical Sciences Broad Discipline Group (see middle of table), and that this teaching to Behavioural Sciences students represented two per cent of all Natural and Physical Sciences in 2015.

Drilling down: Bachelor's Degrees

As revealed in Table 2.2, bachelor's degree enrolments represented 66 per cent of all enrolments in 2015, down from 70 per cent in 2002. This section focuses on bachelor's degrees because this course level has the main impact on what happens in teaching and learning, even if its relative proportion of total enrolments has declined. Table 4.8 shows the distribution of all **teaching** by Broad Discipline Group to students enrolled in all bachelor's degrees. The disciplines are shown as being grouped into STEM and non-STEM disciplines. Among teaching in the STEM disciplines, Information Technology experienced 'negative growth' (-31 per cent), but the other STEM components grew at a faster rate than the growth in bachelor's level teaching across the sector. Engineering and Sciences also grew faster than Non-STEM disciplines overall. Teaching in Agriculture, Environmental and Related Studies represents only about one per cent of all teaching at the bachelor's level. Engineering increased its proportion slightly, from six to seven per cent, as did teaching in the Natural & Physical Sciences (13 per cent in 2002, rising to 14 per cent in 2015). Overall, STEM teaching at the bachelor's level dropped from 29 per cent to 26 per cent, because of the decline in Information Technology teaching. Among the non-STEM disciplines, there was strong growth in Health (increase from none per cent to 15 per cent), with less growth in the Creative Arts and Management & Commerce. Teaching in Society and Culture at the bachelor's degree dropped by three per cent to 25 per cent of the total.

Table 4.8. Student Load: Bachelor's Degree Students by Broad Discipline Group. Numbers, Percentage & Growth: 2002 – 2015

Broad Discipline Group	2002	2007	2012	2015	Growth	2002	2007	2012	2015	Growth
STEM										
N&P Sciences	62,664	70,381	89,185	98,043	35,379	13%	13%	13%	14%	56%
IT	41,493	25,505	26,642	28,674	-12,819	9%	5%	4%	4%	-31%
Engineering	29,634	32,245	44,937	49,765	20,131	6%	6%	7%	7%	68%
Agriculture	5,688	5,985	7,903	8,543	2,855	1%	1%	1%	1%	50%
Subtotal	139,479	134,116	168,667	185,025	45,546	29%	25%	25%	26%	33%
Health										
Medicine	7,291	12,485	18,574	16,490	9,199	1%	2%	3%	2%	126%
Pharm, Optical Dental	3,051	4,600	6,068	5,545	2,494	1%	1%	1%	1%	82%
Vet Sci	1,200	1,858	2,594	2,659	1,459	0%	0%	0%	0%	122%
Other	33,414	46,782	65,639	80,849	47,435	7%	9%	10%	11%	142%
Subtotal	44,956	65,725	92,875	105,543	60,587	9%	12%	14%	15%	135%
Society & Culture										
Behavioural Sciences	18,239	18,599	25,978	27,986	9,747	4%	3%	4%	4%	53%
Law	23,095	29,358	32,688	36,214	13,119	5%	5%	5%	5%	57%
Other	93,282	97,262	111,820	113,698	20,416	19%	18%	17%	16%	22%
Subtotal	134,616	145,219	170,486	177,898	43,282	28%	27%	25%	25%	32%
Other Non-STEM	168,814	197,542	241,450	250,211	81,397	35%	36%	36%	35%	48%
Subtotal Non-STEM	348,386	408,486	504,811	533,652	185,266	71%	75%	75%	74%	53%
TOTAL	487,866	542,602	673,478	718,679	230,813	100%	100%	100%	100%	47%

Source: The Department: Purchased Tables.

This study is principally concerned with STEM, and the next several tables consider changes in bachelor's level courses in the STEM fields of education. The tables compare the situation in 2002 with that in 2015, considering the teaching (STEM and Non-STEM) to students in each of the four STEM groups of courses. The tables show the contribution of STEM teaching at the level of Narrow Discipline Group, and teaching in non-STEM disciplines at the Broad Discipline Group level. The reason for examining STEM at the narrow discipline group level is to see what has changed over time in the composition of STEM university degrees.

Table 4.9 presents a summary of teaching and learning in 2002 and 2015 involving students enrolled in bachelor's degree courses in the individual STEM fields of education and all other fields, and the teaching in all disciplines to those students. In this table, broad fields of education are shown as the columns, and the rows show teaching to students in those broad fields of education according to the Broad Discipline Groups of the subjects being studied by the bachelor's degree students in question. Because of its size, Table 4.9 has been split into two: firstly, showing the actual EFTSL involved in 2002 and 2015, and secondly, the change between 2002 and 2015 (predominantly growth).

Taking bachelor's degree students in the Natural and Physical Sciences as an example, the table should be read as follows. Students enrolled in BSc and other bachelor's degree courses classified by universities within the Natural and Physical Sciences in 2002 were enrolled in Natural and Physical Sciences subjects equivalent to 27,739 EFTSL, out of a total of the 39,748 EFTSL of subjects that such students were enrolled *in toto*. This means that 'science' bachelor's degree students took about 70 per cent of their total teaching in 'science' subjects. Further, they were enrolled in subjects in the three other STEM fields that amounted to about 3,500 EFTSL (about nine per cent of the total), including Information Technology subjects equivalent to 1,694 EFTSL. By 2015, expansion in the number of bachelor's degree students in the Natural and Physical Sciences Broad Field of Education meant that

the total teaching received by these students had increased to 66,418 EFTSL, an increase of 26,670 EFTS, or 67 per cent. Of this teaching, 45,398 EFTSL was in subjects in the Natural and Physical Sciences disciplines, slightly more than 68 per cent of all the teaching received by these students. Another 6,495 EFTSL of teaching in the other STEM disciplines was also received, nearly ten per cent of all teaching to these students.

Bachelor's degree students in Natural and Physical Sciences courses also study subjects outside the STEM disciplines. In 2002, the main sources of service teaching to bachelor's degree students enrolled in Natural and Physical Sciences courses were subjects in the disciplines of Health and Society and Culture. Teaching provided from Society and Culture sources was 5,430 EFTSL, more than three times the amount of teaching received in the other STEM disciplines. A portion of this teaching was in Law, likely to be to students enrolled in combined degrees in science and law. Service teaching in Health disciplines was about 50:50 from medicine and other health disciplines.

The columns for Information Technology, Engineering and Related Technologies, and Agriculture, Environmental and Related Studies present similar information to that given for bachelor's degree students in the Natural and Physical Sciences. In the case of Information Technology, the decline in enrolments has been mentioned in several places above. In 2002, teaching in Information Technology bachelor's degree students was about two-thirds of all the teaching they received. The amount of teaching to these students declined by nearly 14,000 EFTSL (-60 per cent) by 2015, but the proportion of teaching in Information Technology subjects to these students increased to 72 per cent of the total. The main sources of service teaching to Information Technology bachelor's degree students came from subjects in the Natural and Physical Sciences, Engineering and Management and Commerce. These patterns from 2002 persisted to 2015.

In the case of students enrolled in bachelor's degree courses in Engineering and Related Technologies, there was an expansion of total teaching of 17,947 EFTSL (+45 per cent), including growth of 16,779 EFTSL in Engineering subjects. These 'engineering' students received 63 per cent of all their teaching in Engineering and Related Technologies disciplines in 2002, and this proportion increased to 72 per cent by 2015. The major other sources of teaching to bachelor's degree students in Engineering and Related Technologies were the Natural and Physical Sciences, Information Technology, Management and Commerce and Society and Culture. There was no growth in the teaching in Society and Culture subjects over the period. The proportion of teaching provided to engineering students from outside the STEM disciplines was much lower than was the case for students in the Natural and Physical Sciences. In 2002, this teaching comprised 14 per cent of the total, but this proportion declined to ten per cent by 2015.

The final STEM Field of Education to be examined here with respect to what bachelor's degree students are studying is Agriculture, Environmental and Related Studies. This Field of Education / Discipline Group is a relatively small part of Australian higher education. As a Field of Education, it represents 1.3 per cent of all bachelor's degree students, and a similar proportion as a Broad Discipline Group. Table 4.9 shows that in 2002, bachelor's degree students in Agriculture, Environmental and Related Studies Related Studies were provided with 9,102 EFTSL in 2002, and that this declined to 8,896 EFTSL by 2015 (-206 EFTSL; -two per cent). In 2002, these students received about 42 per cent of their teaching in Agriculture, Environmental and Related Studies discipline subjects, and another 36 per cent in Natural and Physical Sciences.

Table 4.9 Student Load: Bachelor's Degree Students in STEM Fields of Education and Non-STEM Fields of Education, 2002 & 2015: EFTSL No.

Discipline Groups – Expanded	Broad Field of Education						
	STEM Fields of Education					Non-STEM FoEs	TOTAL
	N&P Sciences	IT	Engineering	Agriculture/ Environment	Subtotal	Subtotal	
	EFTSL	EFTSL	EFTSL	EFTSL	EFTSL	EFTSL	EFTSL
2002							
N&P Sciences	27,739	3,044	7,375	3,273	41,431	21,232	62,664
IT	1,694	26,253	3,409	67	31,423	10,071	41,493
Engineering	990	2,474	24,741	185	28,390	1,244	29,634
Agriculture	830	18	108	3,867	4,823	867	5,688
Subtotal STEM DGs	31,253	31,789	35,633	7,392	106,067	33,414	139,479
Architecture	45	32	271	66	414	10,091	10,505
Health – Medicine	765	4	3	0	772	7,147	7,921
Health – Other	835	30	52	139	1,056	36,605	37,665
Health – Total	1,600	34	55	139	1,828	43,752	45,586
Education	189	42	4	23	258	37,225	37,483
Management	940	2,986	1,689	495	6,110	73,911	80,020
Society & Culture – Behavioural	2,146	264	95	20	2,525	15,714	18,239
Society & Culture – Law	488	191	104	51	834	22,261	23,095
Society & Culture – Other	2,796	2,005	1,280	846	6,927	86,355	93,282
Society & Culture – Total	5,430	2,460	1,479	917	10,286	124,330	134,616
Creative Arts	287	1,490	352	70	2,199	37,883	40,082
All other	3	0	0	0	3	90	94
Subtotal non-STEM DGs	8,494	7,044	3,850	1,710	21,098	327,282	348,386
TOTAL	39,747	38,833	39,483	9,102	127,165	360,696	487,865
2015							
N&P Sciences	45,398	1,477	9,595	2,426	58,896	39,147	98,043
IT	1,744	17,950	2,029	23	21,746	6,929	28,674
Engineering	2,585	1,544	41,520	344	45,993	3,771	49,765
Agriculture	2,167	57	339	3,766	6,329	2,214	8,543
Subtotal STEM DGs	51,894	21,028	53,483	6,559	132,964	52,061	185,025
Architecture	86	10	331	829	1,256	13,104	14,359
Health-Medicine	1,206	4	11	2	1,223	15,268	16,490
Health-Other	2,119	21	69	106	2,315	86,738	89,053
Health – Total	3,325	25	80	108	3,538	102,006	105,543
Education	652	28	16	53	749	48,770	49,518
Management	1,585	1,651	1,782	382	5,400	114,526	119,927
Society & Culture – Behavioural	2,677	77	107	23	2884	25,102	27,986
Society & Culture – Law	530	127	245	75	977	35,238	36,214
Society & Culture – Other	4,514	789	1,127	747	7,177	106,520	113,699
Society & Culture – Total	7,721	993	1,479	845	11,038	166,860	177,899
Creative Arts	1,129	1,123	254	117	2,623	61,978	64,602
All other	25	39	8	3	57	1,750	1,806
Subtotal non-STEM DGs	14,523	3,869	3,950	2,337	24,661	508,994	533,654
TOTAL	66,417	24,897	57,433	8,896	157,625	561,055	718,679

Discipline Groups – Expanded	Broad Field of Education						
	STEM Fields of Education					Non-STEM FoEs Subtotal	TOTAL
	N&P Sciences	IT	Engineering	Agriculture/ Environment	Subtotal		
	EFTSL	EFTSL	EFTSL	EFTSL	EFTSL	EFTSL	EFTSL
Growth – No.							
N&P Sciences	17,659	-1,567	2,220	-847	17,465	17,915	35,379
IT	50	-8,303	-1,380	-44	-9,677	-3,142	-12,819
Engineering	1,595	-930	16,779	159	17,603	2,527	20,131
Agriculture	1,337	39	231	-101	1,506	1,347	2,855
Subtotal STEM DGs	20,641	-10,761	17,850	-833	26,897	18,647	45,546
Architecture	41	-22	60	763	842	3,013	3,854
Health-Medicine	441	0	8	2	451	8,121	8,569
Health-Other	1,284	-9	17	-33	1,259	50,133	51,388
Health – Total	1,725	-9	25	-31	1,710	58,254	59,957
Education	463	-14	12	30	491	11,545	12,035
Management	645	-1,335	93	-113	-710	40,615	39,907
Society & Culture – Behavioural	531	-187	12	3	359	9,388	9,747
Society & Culture – Law	42	-64	141	24	143	12,977	13,119
Society & Culture – Other	1,718	-1,216	-153	-99	250	20,165	20,417
Society & Culture – Total	2,291	-1,467	0	-72	752	42,530	43,283
Creative Arts	842	-367	-98	47	424	24,095	24,520
All other	22	39	8	3	54	1,660	1,712
Subtotal non-STEM DGs	6,029	-3,175	100	627	3,563	181,712	185,268
TOTAL	26,670	-13,936	17,950	-206	30,460	200,359	230,814
Growth – %							
N&P Sciences	64%	-51%	30%	-26%	42%	84%	56%
IT	3%	-32%	-40%	-66%	-31%	-31%	-31%
Engineering	161%	-38%	68%	86%	62%	203%	68%
Agriculture	161%	217%	214%	-3%	31%	155%	50%
Subtotal STEM DGs	66%	-34%	50%	-11%	25%	56%	33%
Architecture	91%	-69%	22%	1156%	203%	30%	37%
Health-Medicine	58%	0%	267%	#DIV/0!	58%	114%	108%
Health-Other	154%	-30%	33%	-24%	119%	137%	136%
Health – Total	108%	-26%	45%	-22%	94%	133%	132%
Education	245%	-33%	300%	130%	190%	31%	32%
Management	69%	-45%	6%	-23%	-12%	55%	50%
Society & Culture – Behavioural	25%	-71%	13%	15%	14%	60%	53%
Society & Culture – Law	9%	-34%	136%	47%	17%	58%	57%
Society & Culture – Other	61%	-61%	-12%	-12%	4%	23%	22%
Society & Culture – Total	42%	-60%	0%	-8%	7%	34%	32%
Creative Arts	293%	-25%	-28%	67%	19%	64%	61%
All other	733%				1800%	1844%	1821%
Subtotal non-STEM DGs	71%	-45%	3%	37%	17%	56%	53%
TOTAL	67%	-36%	45%	-2%	24%	56%	47%

Source: The Department: Purchased Tables. FoE: Field of Education; DG: Discipline Group

Another 19 per cent of teaching came from non-STEM disciplines. The main change to be noted is huge increase in teaching to Agriculture, Environmental and Related Studies students of subjects in the Broad Discipline Group Architecture and Building. In 2002, 66 equivalent full-time students enrolled in Agriculture, Environmental and Related Studies courses received teaching in subjects in the Architecture and Building Broad Discipline Group. By 2015, this figure had risen to 829 full-time equivalent students, an increase of 1,156 per cent. Nearly all of this increase can be explained by introduction of the Melbourne Model by the University of Melbourne from 2008, and the fact that the Bachelor of Environments programme, intended as the undergraduate precursor to eventual registration as an architect, was classified in the Agriculture, Environmental and Related Studies Broad Field of Education. Please refer to the appropriate section of Chapter 1 for an explanation of this phenomenon.

Natural and Physical Sciences Courses

Tables 4.10 to 4.13 examine student load for the students enrolled only in bachelor's degrees in the *Natural and Physical Sciences*, including BSc and other courses at bachelor's level within this field. Table 4.10 considers what students study as part of their Natural and Physical Sciences bachelor's degree in more detail: to the level of 'narrow' Field of Education. Tables 4.11 and 4.12 provide further information on critical binary populations: female and male students, and domestic and overseas students. This is followed by Table 4.13, which compares commencing students with continuing students. Roughly speaking, commencing students tend to be in the first year of their degree, and continuing students in subsequent years. By comparing the two, it is possible to see if students persist with subjects in some disciplines more than they do in others. If the number of equivalent full-time students in a narrow discipline group is considerably lower for commencing students than it is for continuing students, it is a *prima facie* indication that some subjects are 'starter' subjects. This pattern is replicated below for the other STEM fields of education.

Table 4.10 shows that teaching to Natural & Physical Sciences bachelor's degree students increased by 67 per cent between 2002 and 2015, comprising an increase in STEM teaching of 66 per cent, and in non-STEM disciplines of 71 per cent. The proportion of STEM teaching received by these bachelor's degree students in 2002 was 79 per cent of all the teaching they received, declining slightly to 78 per cent by 2015. There was a reciprocal increase of teaching in non-STEM disciplines. Of the STEM teaching received by Natural and Physical Sciences bachelor's degree students, the rate of growth was 64 per cent, but the proportion of teaching from this source declined from 70 per cent in 2002 to 68 per cent in 2015. These Natural and Physical Sciences bachelor's degree students received a relatively low proportion of teaching in other STEM disciplines in both years shown in Table 4.7. In 2015, teaching in Information Technology constituted three per cent of all teaching received, with equivalent proportions in Engineering and Agriculture, Environmental of four per cent and three per cent, respectively.

Among the non-STEM disciplines in 2015, Natural and Physical Sciences bachelor's degree students received about 12 per cent in Society and Culture disciplines, five per cent in Health disciplines and two per cent in Management and Commerce disciplines. The proportion of non-STEM teaching in Society and Culture disciplines had been slightly higher in 2002 (14 per cent).

Table 4.10. Student Load: All Bachelor's Degree Students in Natural & Physical Sciences Broad Field of Education by Narrow Discipline Group 2002 & 2015

Narrow Discipline Group	2002 EFTSL	2015 EFTSL	Growth 2002 – 2015 EFTSL	2002 % of Total	2015 % of Total	Growth 2002 – 2015 %
STEM Discipline Groups						
Natural & Physical Sciences						
Mathematical Sciences	4,139	6,803	2,664	10%	10%	64%
Physics and Astronomy	1,842	2,650	808	5%	4%	44%
Chemical Sciences	4,259	6,073	1,813	11%	9%	43%
Earth Sciences	1,536	2,307	772	4%	3%	50%
Biological Sciences	13,748	20804	7,057	35%	31%	51%
Other N&P Sciences	2,215	6,761	4,546	6%	10%	205%
Subtotal N&P Sciences DG	**27,739**	**45,398**	**1,7659**	**70%**	**68%**	**64%**
Information Technology						
Computer Science	1,158	1,171	14	3%	2%	1%
Information Systems	344	354	10	1%	1%	3%
Other Information Technology	192	219	27	0%	0%	14%
Subtotal IT DG	**1,694**	**1,744**	**51**	**4%**	**3%**	**3%**
Engineering						
Manufacturing Eng.	8	7	-1	0%	0%	-7%
Process & Resources Eng.	268	556	289	1%	1%	108%
Automotive Eng.	26	0	-26	0%	0%	-100%
Mechanical & Industrial	56	271	215	0%	0%	385%
Civil Engineering.	26	385	359	0%	1%	1376%
Geomatic Eng.	77	225	148	0%	0%	193%
Electrical and Electronic	396	763	368	1%	1%	93%
Aerospace Eng	66	24	-42	0%	0%	-63%
Maritime Eng		2	2	0%	0%	
Other Eng	68	351	284	0%	1%	420%
Subtotal Engineering DG	**990**	**2,585**	**1,595**	**2%**	**4%**	**161%**
Agriculture	79	626	546	0%	1%	688%
Horticulture and Viticulture	67	21	-45	0%	0%	-68%
Forestry Studies	17	8	-9	0%	0%	-55%
Fisheries Studies	71	104	33	0%	0%	47%
Environmental Studies	556	1324	768	1%	2%	138%
Other Agriculture, Env	40	84	45	0%	0%	113%
Subtotal Ag DG	**830**	**2,167**	**1,337**	**2%**	**3%**	**161%**
STEM Subtotal DG	**31,252**	**51,894**	**20,642**	**79%**	**78%**	**66%**
Non-STEM Discipline Groups						
Architecture	45	86	41	0%	0%	89%
Health	1,600	3,325	1,725	4%	5%	108%
Education	189	652	463	0%	1%	244%
Management	941	1,585	645	2%	2%	69%
Society & Culture – Behavioural	2,146	2,677	531	5%	4%	25%
Society & Culture – Law	488	530	42	1%	1%	9%
Society & Culture – Other	2,796	4,514	1,718	7%	7%	61%
Society & Culture – Total	5,430	7,721	2,291	14%	12%	42%
Creative Arts	287	1,129	842	1%	2%	293%
Other	3	25	22	0%	0%	790%
Non-STEM Subtotal DG	8,483	14,524	6,041	21%	22%	71%
Total	**39,735**	**66,418**	**26,670**	**100%**	**100%**	**67%**

Source: The Department: Purchased Tables. FoE: Field of Education; DG: Discipline Group

Table 4.11 considers the teaching to female and male students in bachelor's degrees in courses in the Natural and Physical Sciences. By 2015, the majority of these 'science' students were women, but only just. This fact was shown in Table 3.3, which showed enrolments by women and men (among other things). Table 4.11 distributes the genders according to the subjects they are undertaking as part of their degree. Overall, the proportion of teaching to women in bachelor's programmes in the Natural and Physical Sciences was 51 per cent, down from 56 per cent in 2002. Within this overall result, there are several gender-based variations. Some these are shown, and others can be calculated from the table. In 2002, 54 per cent of the teaching to women in science bachelor's degrees was in STEM subjects, but this declined to 49 per cent by 2015. Teaching to male students is the reciprocals of these percentages: 46 per cent in 2002, and 51 per cent in 2015. On the other hand, 62 per cent of the teaching in non-STEM disciplines to students in bachelor's degrees in the Natural and Physical Sciences was to women, but this figure dropped to 57 per cent in 2015.

Within the STEM disciplines, in 2015, 52 per cent of the teaching in subjects linked to the Natural and Physical Sciences was to women, down from 57 per cent in 2002. In the other STEM disciplines, female students received 19 per cent of the teaching in Information Technology (down from 30 per cent in 2002), and 23 per cent of the teaching in Engineering and Related Technologies. Of the teaching in Agriculture, Environmental and Related Studies to students enrolled in bachelor's degree students, 49 per cent of it was to women in 2015 (down from 54 per cent in 2002).

Looking within the Natural and Physical Sciences Broad Discipline Group, the gender distributions also vary. In 2015, 59 per cent of the teaching in Biological Sciences was to women (down from 63 per cent in 2002), and women were also in the majority in 'Other Natural and Physical Sciences', the narrow discipline to increase the most within the Natural and Physical Sciences. However, here too there was 'leakage' towards male students. Women enrolled in bachelor's degrees in the Natural and Physical Sciences received 64 per cent of the total teaching in this narrow discipline group in 2002, down to 57 per cent in 2015. It should be noted that teaching in the enabling sciences of mathematics, physics and chemistry to women is much lower than that to men, and the proportions are declining. In 2002, 45 per cent of the teaching in Mathematical Sciences was to women, but this dropped to 37 per cent by 2015. In Physics and Astronomy, women's proportion of the teaching declined from 38 per cent to 29 per cent. Women received the majority of the teaching in Chemical Sciences in 2002, but this declined to a shade under 50 per cent by 2015. Women's proportion of teaching in Earth Sciences, the smallest narrow discipline group within the Natural and Physical Sciences, also dropped, from 44 per cent to 38 per cent between 2002 and 2015.

Table 4.11 also shows the distribution by narrow discipline group of teaching to 'science' bachelor's degree students in Information Technology, Engineering and Related Technologies and Agriculture, Environmental and Related Studies. Within Engineering disciplines, the main narrow disciplines providing the most teaching to 'science' students in 2002 were Process Engineering and Electrical and Electronic Engineering. However, there was considerable growth in the amount of teaching to bachelor's degree students in the Natural and Physical Sciences in Civil Engineering, Mechanical and Industrial Engineering and Geomatic Engineering. Again, one can speculate that this growth is also a reflection of there being more 'science' students intending to become engineers.

Table 4.11 provides a distribution (by gender) of the change between 2002 and 2015 as to what constitutes a bachelor's degree in the Natural and Physical Sciences. The distribution of STEM and non-STEM disciplines taken 'science' students did not change: 76 per cent of women and 81 per cent of men took their science degrees from STEM disciplines, with the reciprocal 24 per cent and 19 per cent for male and female students, respectively, being taken from non-STEM subjects. For female bachelor's degree students in the Natural and Physical Sciences, in 2002, eight per cent of their degrees was in mathematics, three per cent in Physics, etc., with subjects from Natural and Physical

Sciences narrow discipline groups totalling 71 per cent. In the other STEM disciplines, Information Technology subjects made up two per cent, one per cent were in Engineering and Related Technologies subjects, and two per cent were in Agriculture, Environmental and Related Studies subjects. Twenty-four per cent of the subjects taken by women as part of their bachelor's degree in the Natural and Physical Sciences were in non-STEM disciplines. By 2015, these proportions changed little. The biggest change occurred in Other Natural and Physical Sciences (from six to 12 per cent of the total degree), but the proportion of subjects in Biological Sciences also declined.

Male students in bachelor's degrees in the Natural and Physical Sciences drew more heavily from the STEM disciplines than did their female counterparts. Men took 81 per cent of their course-wide study load from STEM, but a lower proportion of this came from subjects in Natural and Physical Sciences disciplines than women. However, men studied subjects in Information Technology (four per cent in both 2002 and 2015), Engineering and Related Technologies (six per cent), more than women did.

Among non-STEM disciplines, Subjects in Society and Culture were the biggest source of non-STEM teaching received for both sexes, followed by Health and Management and Commerce. Women had a greater propensity to include subjects from among the Health disciplines. The Society and Culture Broad Discipline Group includes both law and behavioural studies / psychology, both of which have been of interest to 'science' students. In the case of law, some students will be undertaking join degrees such as BSc/LLB.

Table 4.11 Student Load: Male and Female Bachelor's Degree Students in Natural & Physical Sciences Broad Field of Education by Narrow Discipline Group 2002 & 2015

FoE: N&P Sciences	2002					2015				
	Female EFTSL	Male EFTSL	TOTAL EFTSL	Female %	Male %	Female EFTSL	Male EFTSL	TOTAL EFTSL	Female %	Male %
STEM Disciplines										
DG: N&P Sciences										
Mathematical Sciences	1,844	2,295	4,139	8%	13%	2,545	4,257	6,803	8%	13%
Physics &Astronomy	696	1,146	1,842	3%	7%	764	1,885	2,650	2%	6%
Chemical Sciences	2,406	1,853	4,259	11%	11%	3,012	3,061	6,073	9%	9%
Earth Sciences	675	861	1,536	3%	5%	877	1,431	2,307	3%	4%
Biological Sciences	8,691	5,056	13,748	39%	29%	12,307	8,497	20,804	36%	26%
Other N&P Sciences	1,426	789	2,215	6%	4%	3,884	2,877	6,761	12%	9%
Subtotal	15,739	12,000	27,739	71%	68%	23,390	22,008	45,398	69%	67%
DG: IT	509	1,185	1,694	2%	7%	330	1,415	1,744	1%	4%
DG: Engineering	281	708	990	1%	4%	591	1,994	2,585	2%	6%
DG: Agriculture	429	400	830	2%	2%	1,252	915	2,167	4%	3%
Subtotal STEM	16,959	14,293	31,252	76%	81%	25,562	26,332	51,894	76%	81%
Non-STEM Disciplines										
Architecture	20	26	45	0%	0%	34	52	86	0%	0%
Health	1,093	508	1,601	5%	3%	2,044	1,281	3,325	6%	4%
Education	114	76	189	1%	0%	375	277	652	1%	1%
Management	498	442	941	2%	3%	631	954	1,585	2%	3%
Society & Culture	3,349	2,081	5,430	15%	12%	4,504	3,217	7,721	13%	10%
Creative Arts	175	111	287	1%	1%	604	525	1,129	2%	2%
Other	3	0	3			16	9	25		
Subtotal non-STEM	5,252	3,244	8,497	24%	19%	8,209	6,315	14,524	24%	19%
TOTAL	22,211	17,537	39,748	100%	100%	33,771	32,647	66,418	100%	100%

Source: The Department: Purchased Tables. FoE: Field of Education; DG: Discipline Group

Table 4.12 reveals that there are few differences in what constitutes a bachelor's degree in Natural and Physical Sciences between domestic and overseas students in either year shown.

Table 4.12 Student Load: Domestic and Overseas Bachelor's Degree Students in Natural & Physical Sciences Broad Field of Education by Narrow Discipline Group 2002 & 2015

FoE: N&P Sciences	2002					2015				
	Domestic EFTSL	Overseas EFTSL	TOTAL EFTSL	Domestic %	Overseas %	Domestic EFTSL	Overseas EFTSL	TOTAL EFTSL	Domestic %	Overseas %
DG: N&P Sciences										
Mathematical Sciences	3,778	361	4,139	10%	11%	5,908	894	6,803	10%	11%
Physics &Astronomy	1,741	101	1,842	5%	3%	2,389	261	2,650	4%	3%
Chemical Sciences	3,871	388	4,259	11%	11%	5,,308	764	6,073	9%	10%
Earth Sciences	1487	48	1536	4%	1%	2073	235	2,307	4%	3%
Biological Sciences	12,587	1,161	13,748	35%	34%	18,373	2,431	20,804	31%	30%
Other N&P Sciences	1,954	261	2,215	5%	8%	6,003	758	6,761	10%	9%
Subtotal	25,418	2,321	27,739	70%	69%	40,054	5,343	45,398	69%	67%
DG: IT	1,492	202	1,694	4%	6%	1416	329	1,744	2%	4%
DG: Engineering	927	63	990	3%	2%	2,094	491	2,585	4%	6%
DG: Agriculture	766	64	830	2%	2%	1,974	192	2,167	3%	2%
Subtotal STEM	28,603	2,650	31,253	79%	79%	45,538	6,355	51,894	78%	79%
Non-STEM DGs										
Architecture	42	3	45	0%	0%	71	15	86	0%	0%
Health	1,408	193	1,601	4%	6%	2,962	363	3,325	5%	5%
Education	181	8	189	0%	0%	606	47	652	1%	1%
Management	860	80	941	2%	2%	1,311	274	1,585	2%	3%
Soc & Cul	5,007	423	5,430	14%	13%	6,960	761	7,721	12%	10%
Creative Arts	264	23	287	1%	1%	968	161	1,129	2%	2%
Other	3	0	3	0%	0%	21	4	25	0%	0%
Subtotal non-STEM	7,766	731	8,497	21%	22%	12,899	1,625	14,524	22%	20%
TOTAL	36,368	3,381	39,748	100%	100%	58,437	7,981	66,418	100%	100%

Source: The Department: Purchased Tables. FoE: Field of Education; DG: Discipline Group

Table 4.13 examines the distribution of teaching between commencing bachelor's degree students, and students other than those commencing, described here as 'continuing'. The point of this analysis is to see if any particular disciplines come out (in effect) as being studied as first year, perhaps compulsory subjects, that students then drop once they have finished first year. Although the definition of 'commencing student' is more complex than merely new-to-university students starting first year, to a considerable extent, that is what the 'commencing students' represents, particularly where full-time bachelor's degree students are concerned.

Table 4.13 shows that the composition of a bachelor's degree course in the Natural and Physical Sciences in 2002 comprised 75 per cent of subjects in Natural and Physical Sciences disciplines, eight per cent were taken from other STEM disciplines, and 18 per cent were non-STEM subjects. There were only minor changes in this pattern by 2015; in effect, there was a small decline in the proportion made up by subjects in the Natural and Physical Sciences, and a compensating increase in the uptake of non-STEM subjects. However, attention should be paid to the so-called enabling sciences of mathematics, physics and chemistry fall into this category. Commencing students' degrees comprised 14 per cent of mathematics subjects in 2015 (15 per cent in 2002), but continuing students' bachelor's degrees in the Natural and Physical Sciences made up only eight per cent. Physics and Astronomy subjects made up six per cent of a commencing student's course in 2015 (7 per cent in 2002), but only three per cent of continuing students' work load in subsequent years. For chemistry, the uptake by

commencing students dropped from 17 per cent to 14 per cent, but continuing students' uptake of chemistry dropped to six per cent in 2015 (seven per cent in 2002). The fact that the proportion of a commencing student's uptake of say, mathematics is lower than the proportion of mathematics in a continuing student's work load indicates that many students drop mathematics after first year. That is, relatively low proportion of first year mathematics students continue with studies in mathematics.

Looking at the other discipline groups within the Natural and Physical Sciences, uptake of subjects in the Biological Sciences for both commencing and continuing students declined, and there were increases in the teaching of subjects in Other Natural and Physical Sciences. Earth Sciences remained a small discipline group among both commencing and continuing bachelor's degree students, and in both years examined here. Just as many students cease to enrol in the enabling sciences after first year, the opposite is the case in the other narrow disciplines within the Natural and Physical Sciences Broad Discipline Group. In the case of Biological Sciences, for example, the pattern is that more students pick up biological sciences subjects as they progress through their bachelor's degree.

The points to take away from this examination include the use of students' uptake of enabling sciences disciplines as preliminary to the study plans of many of them; the continuing relative strength of the Biological Sciences, but to a lesser extent than in the past; and perhaps the relatively low uptake by bachelor's degree students in Natural and Physical Sciences courses of subjects in the other STEM disciplines.

While examining change in what students in bachelor's degrees in the Natural and Physical Sciences are studying, Figure 4.5 shows changes in the narrow disciplines being studied. The columns show the actual EFTSL for each narrow discipline group within Natural and Physical Sciences. In conjunction with Table 4.7, we can see that the Biological Sciences are by far the most 'popular' with bachelor's degree students enrolled in courses in the Natural and Physical Sciences, although the overall proportion of teaching to science students declined (from 50 to 46 per cent between 2002 and 2015). Mathematical Sciences teaching represented 15 per cent of total Natural and Physical Sciences teaching in both years shown, having increased from 4,139 EFTSL to 6,803 EFTSL. The proportion of this 'science' teaching provided to 'science' students declined slightly in Physics and Astronomy, Chemical Sciences and Earth Sciences, and only 'Other Natural and Physical Sciences' showed proportionate increase. The 'Other' category includes Medical Sciences, Forensic Sciences, Food Science and Biotechnology, Pharmacology, Laboratory Technology, and 'Other – not elsewhere classified'. This latter category can often be an indication of universities being vague or even lazy, by not coding the subjects they teach carefully.

Table 4.13 Student Load: Commencing and Continuing Bachelor's Degree Students in Natural & Physical Sciences Broad Field of Education by Narrow Discipline Group 2002 & 2015

FoE: N&P Sciences	2002					2015				
	Comm. EFTSL	Cont. EFTSL	TOTAL EFTSL	Comm. %	Cont. %	Comm. EFTSL	Cont. EFTSL	TOTAL EFTSL	Comm. %	Cont. %
DG: N&P Sciences										
Mathematical Sciences	2,129	2,010	4,139	15%	8%	3,501	3,302	6,803	14%	8%
Physics &Astronomy	994	848	1,842	7%	3%	1,373	1,277	2,650	6%	3%
Chemical Sciences	2,412	1,848	4,259	17%	7%	3,515	2,558	6,073	14%	6%
Earth Sciences	432	1,104	1,536	3%	4%	593	1,714	2,307	2%	4%
Biological Sciences	4,276	9,472	13,748	30%	37%	6,441	14,363	20,804	26%	34%
Other N&P Sciences	562	1,654	2,215	4%	7%	2,283	4,477	6,761	9%	11%
Subtotal	10,804	16,934	27,739	75%	67%	17,707	27,691	45,398	72%	66%

FoE: N&P Sciences	2002					2015				
	Comm. EFTSL	Cont. EFTSL	TOTAL EFTSL	Comm. %	Cont. %	Comm. EFTSL	Cont. EFTSL	TOTAL EFTSL	Comm. %	Cont. %
DG: IT	595	1,099	1694	4%	4%	696	1,048	1,744	3%	3%
DG: Engineering	244	746	990	2%	3%	616	1,969	2,585	3%	5%
DG: Agriculture	224	606	830	2%	2%	616	1,550	2,167	3%	4%
Subtotal STEM	11,867	19,385	31,253	83%	76%	19,635	32,258	51,894	81%	78%
Non-STEM Disciplines										
Architecture	7	39	45	0%	0%	22	64	86	0%	0%
Health	319	1,282	1,601	2%	5%	918	2,407	3,325	4%	6%
Education	44	146	189	0%	1%	161	491	652	1%	1%
Management	260	681	941	2%	3%	542	1,043	1,585	2%	2%
Soc & Cul	1,811	3,619	5,430	13%	14%	2,889	4,833	7,721	12%	12%
Creative Arts	143	144	287	1%	1%	424	706	1129	2%	2%
Other	0	3	3	0%	0%	10	15	25	0%	0%
Subtotal non-STEM	2,584	5,912	8,497	18%	23%	4,965	9,558	14,524	20%	23%
TOTAL	14,451	25,297	39,748	100%	100%	24,600	41,817	66,418	100%	100%

Source: The Department: Purchased Tables. FoE: Field of Education; DG: Discipline Group

Figure 4.5 Student Load: Comparison of Teaching of Natural and Physical Sciences Subjects to Students in Natural & Physical Sciences Bachelor's Courses – 2002 & 2015 – EFTSL – No.

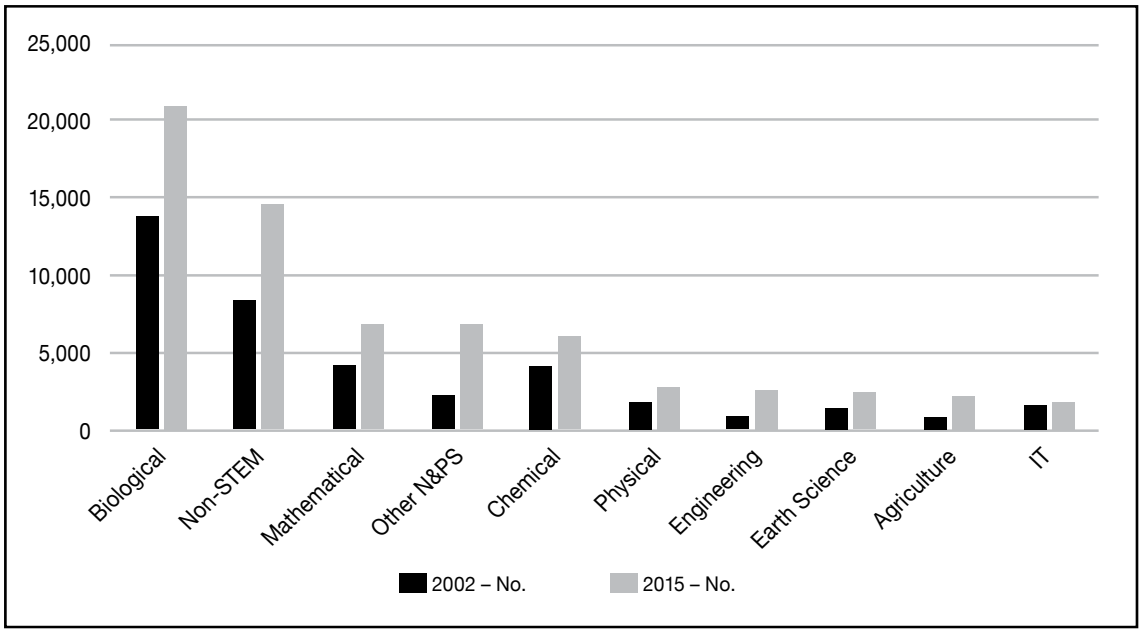
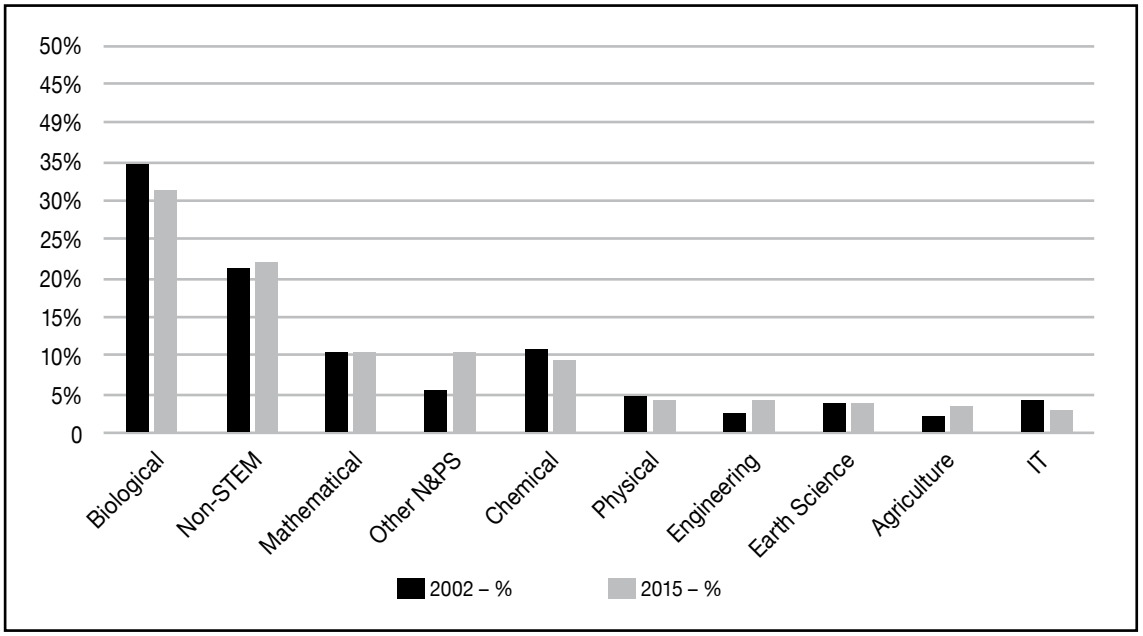


Figure 4.6 Student Load: Comparison of Teaching of Natural and Physical Sciences Subjects to Students in Natural & Physical Sciences Bachelor's Courses – 2002 & 2015 – EFTSL – %



Figures 4.5 and 4.6 clearly expose what has happened this century to the 'BSc' degree. Apart from growth of interest in 'Other Natural and Physical Sciences', there has been little change in the relative popularity of the 'science' disciplines, or the proportions of the other STEM disciplines (Information Technology, Engineering and Related Technologies, and Agriculture, Environmental and Related Studies), or even the non-STEM disciplines. However, if one goes back to 1989, the shape of a 'science degree' has changed considerably. In 1989, teaching in the mathematical sciences comprised over 17 per cent of what science students studied23, but by 2002, this was down to ten per cent. Similarly, there were declines in the extent of teaching in the chemical sciences and physical sciences, and a compensating increase in the biological sciences, from about one-quarter to over one-third. The issue here is that there was a considerable change from the pattern of 'science' study in the 1980s compared with the situation this century. Exact precision is not possible due to the changes in the groupings of courses and subjects and the counting methodology that occurred in 2001 and 2002 (See Chapter 1).

Information Technology Courses

The apparent decline of interest in programmes in Information Technology is well known and has been mentioned in various parts of this study. The impact of this decline within the STEM disciplines shown in Table 4.14 was by 51 per cent in Natural and Physical Sciences disciplines (particularly in the Mathematical Sciences -1444 EFTSL, or -52 per cent), 38 per cent in Information Technology disciplines, and 38 per cent in Engineering and Related Technologies disciplines, particularly in Electrical and Electronic Engineering (-50 per cent). Information Technology bachelor's degree students receive little teaching in Agriculture, Environmental and Related Studies disciplines. The decline in teaching from the non-STEM disciplines was 45 per cent, leading to an overall decline of teaching received of 36 per cent.

Table 4.15 presents similar analysis relating to male and female students enrolled in bachelor's degree courses in Information Technology. The impact of the Melbourne Model on bachelor's-level

23 See Dobson, I. (2003). Science at the crossroads? A study of trends in university science from Dawkins to now 1989 – 2002, Table 52. ACDS. ISBN 0-7326-2250-6.

enrolments in IT courses must also be borne in mind. In addition to the decline in Information Technology enrolments every year from 2003 to 2011, the University of Melbourne's intake into IT courses became an expanded intake into bachelor's degrees in Natural and Physical Sciences.

Table 4.14. Student Load: All Bachelor's Degree Students in Information Technology Broad Field of Education by Narrow Discipline Group 2002 – 2015

Narrow Discipline Group	2002 EFTSL	2015 EFTSL	Growth EFTSL	2002 %	2015 %	Growth %
STEM Disciplines						
Natural & Physical Sciences						
Mathematical Sciences	2,766	1,321	-1,444	7%	5%	-52%
Physics &Astronomy	128	77	-51	0%	0%	-40%
Chemical Sciences	40	17	-22	0%	0%	-56%
Earth Sciences	15	11	-4	0%	0%	-26%
Biological Sciences	79	30	-50	0%	0%	-63%
Other N&P Sciences	17	21	3	0%	0%	20%
Subtotal N&P Sciences DG	3,045	1,477	-1,568	8%	6%	-51%
Information Technology	2		-2	0%	0%	-100%
Computer Science	14,691	8,173	-6,517	38%	33%	-44%
Information Systems	8,034	5,147	-2,888	21%	21%	-36%
Other Information Technology	3,526	4,630	1,104	9%	19%	31%
Subtotal IT DG	26,251	17,950	-8301	68%	72%	-32%
Engineering & Related Technologies						
Manufacturing Eng	1	33	32	0%	0%	3664%
Process and Resources Eng	2	4	2	0%	0%	125%
Automotive Eng	2	0	-2	0%	0%	-100%
Mechanical and Industrial Eng	10	21	12	0%	0%	123%
Civil Engineering	15	15	0	0%	0%	1%
Geomatic Eng.	37	14	-23	0%	0%	-62%
Electrical and Electronic	2,317	1,163	-1,154	6%	5%	-50%
Aerospace Eng	23	18	-4	0%	0%	-19%
Other Eng	68	275	207	0%	1%	304%
Subtotal ENG DG	2,474	1,544	-931	0	6%	-38%
Agriculture	0	1	1	0%	0%	
Horticulture and Viticulture	0	0	0	0%	0%	-73%
Forestry Studies	0	0	0	0%	0%	-100%
Fisheries Studies	0	0	0	0%	0%	
Environmental Studies	17	33	16	0%	0%	97%
Other Agriculture, Env	0	23	23	0%	0%	
Subtotal Ag DG	18	57	40	0	0%	227%
Subtotal STEM DG	31,787	21,027	-10,760	82%	85%	-34%
Non-STEM Discipline Groups						
Architecture	32	10	-22	0%	0%	-69%
Health	34	24	-10	0%	0%	-28%
Education	42	28	-14	0%	0%	-33%
Management	2,986	1,651	-1,335	8%	7%	-45%
Soc & Cul	2,460	996	-1,463	6%	4%	-59%
Creative Arts	1490	1114	-376	4%	4%	-25%
Other		21	21	0%	0%	
Non-STEM Subtotal DG	7,044	3,844	-3,200	18%	15%	-45%
Total	38,834	24,877	-13,957	100%	100%	-36%

Source: The Department: Purchased Tables. FoE: Field of Education; DG: Discipline Group

Table 4.15 summarises the differences in the context of what makes up a bachelor's degree course in Information Technology between female and male students. The answer to this implied question seems to be that there is little difference based on gender. It is also the case that there was relatively little difference in what constituted a bachelor course in Information Technology in 2015 compared with 2002, particularly for women. For male students, their uptake of subjects in the Information Technology discipline group increased slightly. Service teaching from the Natural and Physical Sciences is all but restricted to Mathematical Sciences and nearly all the subjects taken in Engineering and Related Technologies are in Electrical and Electronic Engineering. Among non-STEM disciplines, the majority of subjects taken are provided in Management and Commerce, and Society and Culture. The general propensity is that a larger proportion of female students take subjects from non-STEM disciplines.

Table 4.15 Student Load: Female and Male Bachelor's Degree Students in Information Technology Bachelor's Courses by Narrow Discipline Group 2002 & 2015

FoE: IT	2002					2015				
	Female EFTSL	Male EFTSL	TOTAL EFTSL	Females %	Males %	Female EFTSL	Male EFTSL	TOTAL EFTSL	Females %	Males %
DG: N&P Sciences										
Mathematical Sciences	586	2,180	2,766	6%	7%	189	1,132	1,321	5%	5%
Physics &Astronomy	15	113	128	0%	0%	12	65	77	0%	0%
Chemical Sciences	12	27	40	0%	0%	4	14	17	0%	0%
Earth Sciences	3	12	15	0%	0%	5	6	11	0%	0%
Biological Sciences	30	49	79	0%	0%	6	24	30	0%	0%
Other N&P Sciences	4	13	17	0%	0%	2	19	21	0%	0%
Subtotal	650	2,394	3,044	7%	8%	219	1,258	1,477	6%	6%
DG: IT										
Computer Science	3,121	11,570	14,691	34%	39%	1,058	7,115	8,173	34%	34%
Information Systems	2,068	5,966	8,034	23%	20%	959	4,187	5,147	23%	20%
Other IT	806	2,722	3,528	9%	9%	644	3,986	4,630	9%	19%
Subtotal	5,995	20,258	26,253	66%	68%	2,661	15,289	17,950	66%	73%
DG: Engineering	442	2,032	2,474	5%	7%	186	1,358	1,544	5%	6%
DG: Agriculture	6	12	18	0%	0%	30	27	57	1%	0%
Subtotal STEM	7,093	24,696	31,789	78%	83%	3,096	17,932	21,028	81%	85%
Non-STEM Disciplines										
Architecture	6	26	32	0%	0%	2	9	10	0%	0%
Health	23	11	34	0%	0%	6	18	24	0%	0%
Education	14	28	42	0%	0%	7	22	28	0%	0%
Management	899	2,087	2,986	10%	7%	347	1,305	1,651	9%	6%
Soc & Cul	782	1,678	2,460	9%	6%	214	779	993	6%	4%
Creative Arts	324	1,166	1,490	4%	4%	155	967	1,123	4%	5%
Other	0	0	0	0%	0%	11	28	39	0%	0%
Subtotal	2,048	4,996	7,044	22%	17%	742	3,128	3,868	19%	15%
TOTAL	9,141	29,693	38,834	100%	100%	3,832	21,045	24,877	100%	100%

Source: The Department: Purchased Tables. FoE: Field of Education; DG: Discipline Group

Looking at the make-up of bachelor's degrees in Information Technology, from Table 4.16 it can be seen that Overseas students tend to draw a higher proportion of their studies from Information Technology subjects than do domestic students, and domestic IT students study more subjects in the Natural and Physical Sciences, especially in Mathematical Sciences. As already noted, Information Technology bachelor's degree students taking Engineering and Related Technologies students do so predominantly from Electrical and Electronic Engineering.

Table 4.16 Student Load: Domestic and Overseas Bachelor's Degree Students in Information Technology by Narrow Discipline Group 2002 & 2015

FoE: IT	2002					2015				
	Domestic EFTSL	Overseas EFTSL	TOTAL EFTSL	Domestic %	Overseas %	Domestic EFTSL	Overseas EFTSL	TOTAL EFTSL	Domestic %	Overseas %
DG: N&P Sciences										
Mathematical Sciences	1,865	900	2,766	8%	4%	940	382	1,321	6%	4%
Physics &Astronomy	101	27	128	0%	0%	66	11	77	0%	0%
Chemical Sciences	36	4	40	0%	0%	15	2	17	0%	0%
Earth Sciences	13	2	15	0%	0%	10	1	11	0%	0%
Biological Sciences	73	6	79	0%	0%	27	3	30	0%	0%
Other N&P Sciences	15	2	17	0%	0%	19	2	21	0%	0%
Subtotal	2,104	941	3,044	9%	5%	1,077	400	1,477	7%	5%
DG: IT										
Computer Sci	8,968	5,723	14,691	37%	33%	5,303	2,870	8,173	33%	33%
Info. Sys	4,580	3,455	8,034	19%	24%	3,060	2,087	5,147	19%	24%
Other IT	2,081	1,447	3,528	9%	21%	2,778	1,853	4,630	17%	21%
Subtotal	15,629	10,624	26,253	65%	77%	11,140	6,809	17,950	69%	77%
DG: Eng	1,590	884	2,474	7%	5%	1,133	411	1,544	7%	5%
DG: Ag, Env	13	5	18	0%	1%	8	50	57	0%	1%
Subtotal STEM	19,336	12,454	31,789	81%	84%	13,358	7,670	21,028	83%	87%
Non-STEM DGs										
Architecture	12	20	32	0%	0%	6	4	10	0%	0%
Health	31	3	34	0%	0%	20	4	24	0%	0%
Education	36	6	42	0%	0%	22	6	28	0%	0%
Management	2,009	978	2,986	8%	7%	1,022	630	1,651	6%	7%
Soc & Cul	1,733	727	2,460	7%	3%	691	302	993	4%	3%
Creative Arts	854	636	1,490	4%	2%	928	195	1,123	6%	2%
Other	0	0	0	0%	0%	5	16	21	0%	0%
Subtotal	4,675	2,370	7,044	19%	16%	2,694	1,157	3,850	17%	13%
TOTAL	24,010	14,824	38,834	100%	100%	16,051	8,826	24,877	100%	100%

Source: The Department: Purchased Tables. FoE: Field of Education; DG: Discipline Group

Table 4.17 presents similar information for bachelor's degree students in Information Technology according to their commencing status. As can be seen, in 2015, teaching to these students in 2015 was less than half of what it had been in 2002. The proportion of Information Technology bachelor's degrees drawn from IT subjects has increased over the period, for both commencing and continuing students, and the proportion provided from the Natural and Physical Sciences discipline group declined, particularly in Mathematical Sciences. Of course, for a student enrolled in a degree in Information Technology, 'science' teaching represents service teaching, and one would expect such teaching to predominate in earlier years, particularly in first year. Of the teaching received in Engineering and Related Technologies, most is in the narrow discipline of Electrical and Electronic Engineering.

Table 4.17 Student Load: Commencing and Continuing Bachelor's Degree Students in Information Technology by Narrow Discipline Group 2002 & 2015

FoE: IT	2002					2015				
	Com. EFTSL	Cont. EFTSL	TOTAL EFTSL	Com. %	Cont. %	Com. EFTSL	Cont. EFTSL	TOTAL EFTSL	Com. %	Cont. %
DG: N&P Sciences										
Mathematical Sciences	1483	1283	2766	11%	5%	729	592	1321	8%	4%
Physics &Astronomy	76	53	128	1%	0%	30	47	77	0%	0%

FoE: IT	2002					2015				
	Com. EFTSL	Cont. EFTSL	TOTAL EFTSL	Com. %	Cont. %	Com. EFTSL	Cont. EFTSL	TOTAL EFTSL	Com. %	Cont. %
Chemical Sciences	16	23	40	0%	0%	8	9	17	0%	0%
Earth Sciences	4	11	15	0%	0%	3	8	11	0%	0%
Biological Sciences	25	54	79	0%	0%	9	21	30	0%	0%
Other N&P Sciences	6	11	17	0%	0%	7	14	21	0%	0%
Subtotal	1,610	1,435	3,044	11%	6%	786	691	1,477	9%	4%
DG: IT										
Computer Sci	5,057	9,634	14,691	36%	39%	3,100	5,073	8,173	34%	32%
Info. Systems	2,669	5,365	8,034	19%	22%	1,955	3,192	5,147	21%	20%
Other IT	1,119	2,409	3,528	8%	10%	1,460	3,170	4,630	16%	20%
Subtotal	8,845	17,408	26,253	63%	70%	6,515	11,434	17,950	71%	73%
DG: Engineering	948	1,526	2,474	7%	6%	513	1,031	1,544	6%	7%
DG: Agriculture	4	14	18	0%	0%	2	55	57	0%	0%
Subtotal STEM	11,407	20,383	31,789	81%	82%	7,816	13,211	21,028	85%	84%
Non-STEM Disciplines										
Architecture	23	10	32	0%	0%	4	6	10	0%	0%
Health	9	25	34	0%	0%	8	17	24	0%	0%
Education	10	32	42	0%	0%	12	16	28	0%	0%
Management	1,070	1,916	2,986	8%	8%	583	1,068	1,651	6%	7%
Soc & Cul	923	1,537	2,460	7%	6%	348	645	993	4%	4%
Creative Arts	578	912	1,490	4%	4%	440	682	1,123	5%	4%
Other	0	0	0	0%	0%	15	6	21	0%	0%
Subtotal	2,612	4,432	7,044	19%	18%	1,410	2,441	3,850	15%	16%
TOTAL	14,019	24,815	38,834	100%	100%	9,226	15,651	24,877	100%	100%

Source: The Department: Purchased Tables. FoE: Field of Education; DG: Discipline Group

Engineering and Related Technologies Courses

Tables 4.18 to 4.21 show the distribution of teaching to students in bachelor's degree courses in Engineering and Related Technologies: overall, by gender, by citizenship status, and by commencing status. Table 4.18 shows that these students receive most of their teaching in STEM disciplines (93 per cent in 2015, up from 90 per cent in 2002). It increased by 45 per cent over the period, comprising an increase of 50 per cent in the STEM disciplines taught to bachelor's degree students in Engineering and Related Technologies programmes, and three per cent in non-STEM disciplines.

Table 4.18. Student Load: All Bachelor's Degree Students in Engineering & Related Technologies Broad Field of Education by Narrow Discipline Group 2002 & 2015

Narrow Discipline Group	2002 EFTSL	2015 EFTSL	Growth EFTSL	2002 %	2015 %	Growth %
STEM Disciplines						
Mathematical Sciences	4,607	6,065	1,458	12%	11%	32%
Physics &Astronomy	1,536	1,676	140	4%	3%	9%
Chemical Sciences	595	793	197	2%	1%	33%
Earth Sciences	311	479	168	1%	1%	54%
Biological Sciences	243	360	117	1%	1%	48%
Other N&P Sciences	82	221	139	0%	0%	169%
Subtotal N&P Sciences DG	7,375	9,595	2,219	19%	17%	30%
Computer Science	2,643	1,481	-1,162	7%	3%	-44%
Information Systems	558	315	-244	1%	1%	-44%
Other Information Technology	207	233	26	1%	0%	12%
Subtotal IT DG	3,409	2,029	-1,380	9%	4%	-40%

Narrow Discipline Group	2002 EFTSL	2015 EFTSL	Growth EFTSL	2002 %	2015 %	Growth %
Manufacturing Eng.	633	586	-47	2%	1%	-7%
Process and Resources Eng.	2,383	4,831	2,448	6%	8%	103%
Automotive Eng.	16	33	17	0%	0%	103%
Mechanical and Industrial	4,214	8,506	4,293	11%	15%	102%
Civil Eng.	3,578	9,403	5,825	9%	16%	163%
Geomatic Eng.	741	803	62	2%	1%	8%
Electrical and Electronic Eng.	9,077	8,287	-790	23%	14%	-9%
Aerospace Eng.	933	1,237	304	2%	2%	33%
Maritime Eng.	99	522	423	0%	1%	426%
Other Eng.	3,067	7,313	4,246	8%	13%	138%
Subtotal Eng DG	**24,741**	**41,520**	**16,780**	**63%**	**72%**	**68%**
Agriculture	6	6	1	0%	0%	9%
Horticulture and Viticulture	1	0	-1	0%	0%	-72%
Forestry Studies	0	0	0	0%	0%	
Fisheries Studies	0	0	0	0%	0%	
Environmental Studies	99	326	226	0%	1%	227%
Other Agriculture, Env	1	6	5	0%	0%	432%
Subtotal Ag DG	**108**	**339**	**231**	**0%**	**1%**	**214%**
Subtotal STEM DG	**35,633**	**53,483**	**17,849**	**90%**	**93%**	**50%**
Non-STEM Discipline Groups						
Architecture	271	331	61	1%	1%	22%
Health	56	80	24	0%	0%	43%
Education	4	16	11	0%	0%	252%
Management	1,689	1,782	93	4%	3%	6%
Soc & Cul	1,479	1,479	-1	4%	3%	0%
Creative Arts	352	254	-98	1%	0%	-28%
Other		8	8	0%	0%	
Subtotal non-STEM DG	**3852**	**3949**	**97**	**10%**	**7%**	**3%**
Total	**39,485**	**57,432**	**17,947**	**100%**	**100%**	**45%**

Source: The Department: Purchased Tables. FoE: Field of Education; DG: Discipline Group

Engineering bachelor's degree students received 72 per cent of their teaching in Engineering and Related Technologies disciplines in 2015, up from 63 per cent in 2002. Teaching from the Natural and Physical Sciences disciplines increased by 30 per cent over the period, but the proportion of 'science' teaching dropped from 19 per cent to 17 per cent between the two years. Non-STEM teaching represented only seven per cent of all teaching in 2015 (down from ten per cent in 2010).

Table 4.19 allows for a comparison of what constitutes an engineering bachelor's degree for women and men. Along with Information Technology, Engineering and Related Technologies is the other field in which women are in an extreme minority. In 2015, women represented less than 16 per cent of all bachelor's degree enrolments. According to the subjects these students study, there are only minor variations between what women and men study to qualify in engineering, unlike the situation with male and female students enrolled in bachelor's degree courses in the Natural and Physical Sciences. Perhaps the largest variation is to be found with Process and Resources Engineering, which is the Narrow Discipline Group within which chemical engineering falls. Female engineering students were also likely to be taking Chemical Sciences subjects, within the Natural and Physical Sciences narrow discipline group. The changes that have occurred over time have done so in tandem, with the proportion of an 'engineering' degree constituted by engineering subjects has gone up, while the proportion of teaching in Information Technology and non-STEM disciplines declined.

Table 4.19 Student Load: Male and Female Bachelor's Degree Students in Engineering & Related Technologies Broad Field of Education by Narrow Discipline Group 2002 & 2015

FoE: Engineering	2002					2015				
	Female EFTSL	Male EFTSL	TOTAL EFTSL	Females %	Males %	Female EFTSL	Male EFTSL	TOTAL EFTSL	Females %	Males %
DG: N&P Sciences										
Mathematical Sciences	706	3,901	4,607	11%	12%	971	5,094	6,065	10%	11%
Physics &Astronomy	220	1,316	1536	3%	4%	257	1,420	1,676	3%	3%
Chemical Sciences	166	430	595	3%	1%	251	542	793	3%	1%
Earth Sciences	71	240	311	1%	1%	93	386	479	1%	1%
Biological Sciences	100	144	243	2%	0%	139	221	360	1%	0%
Other N&P Sciences	25	58	82	0%	0%	71	151	221	1%	0%
Subtotal	1,287	6,088	7,375	20%	18%	1,781	7,813	9,595	19%	16%
DG: IT	462	2,948	3,409	7%	9%	240	1,789	2,029	3%	4%
DG: Engineering										
Manufacturing	93	540	633	1%	2%	66	520	586	1%	1%
Process	668	1,716	2,383	10%	5%	1,274	3,557	4,831	14%	7%
Automotive	2	14	16	0%	0%	1	32	33	0%	0%
Mechanical	437	3,776	4,214	7%	11%	991	7,516	8,506	11%	16%
Civil	633	2,944	3,578	10%	9%	1,593	7,810	9,403	17%	16%
Geomatic	141	601	741	2%	2%	80	724	803	1%	2%
Electrical and Elect	1,226	7,851	9,077	19%	24%	1,021	7,266	8,287	11%	15%
Aerospace	131	802	933	2%	2%	202	1,036	1,237	2%	2%
Maritime	7	93	99	0%	0%	41	481	522	0%	1%
Other Engineering	494	2,573	3,067	8%	8%	1,174	6,139	7,313	13%	13%
Subtotal	3,831	20,910	24,741	60%	63%	6,440	35,080	41,520	70%	73%
DG: Agriculture	30	78	108	0%	0%	70	269	339	1%	1%
Subtotal STEM	5,610	30,024	35,633	87%	90%	8,531	44,951	53,483	93%	94%
Non-STEM Disciplines										
Architecture	49	222	271	1%	1%	65	266	331	1%	1%
Health	22	34	56	0%	0%	26	54	80	0%	0%
Education	1	4	4	0%	0%	2	14	16	0%	0%
Management	321	1,368	1,689	5%	4%	302	1,480	1,782	3%	3%
Soc & Cul	352	1,127	1,479	5%	3%	294	1,184	1,479	3%	2%
Creative Arts	76	277	352	1%	1%	44	210	254	0%	0%
Other	0	0	0	0%	0%	1	6	7	0%	0%
Subtotal	820	3,032	3,852	13%	9%	735	3,214	3,949	8%	7%
TOTAL	6,430	33,056	39,485	100%	100%	9,267	48,165	57,432	100%	100%

Source: The Department: Purchased Tables. FoE: Field of Education; DG: Discipline Group

Table 4.20 looks at the uptake of bachelor's degrees in Engineering and Related Technologies according to whether they are domestic or overseas students, who made up 28 per cent of the total in 2015. There are several variations in what domestic and overseas students study in their Engineering and Related Technology bachelor's degrees. For example, it can be seen in Table 4.20 that domestic students tend to draw more heavily from subjects in the Natural and Physical Sciences, but Mathematical Sciences is the biggest single 'science' discipline for both domestic and overseas students. Domestic students also take more Information Technology subjects, but the overall proportion declined between 2002 and 2015. Overseas students take rather more subjects in Engineering and Related Technologies.

Table 4.20 Student Load: Domestic and Overseas Bachelor's Degree Students in Engineering & Related Technologies Broad Field of Education by Narrow Discipline Group 2002 & 2015

FoE: Engineering	2002					2015				
	Domestic EFTSL	Overseas EFTSL	TOTAL EFTSL	Domestic %	Overseas %	Domestic EFTSL	Overseas EFTSL	TOTAL EFTSL	Domestic %	Overseas %
DG: N&P Sciences										
Mathematical Sciences	3,780	827	4,607	12%	9%	4,537	1,528	6,065	11%	9%
Physics &Astronomy	1,288	249	1,536	4%	2%	1,303	374	1,676	3%	2%
Chemical Sciences	504	92	595	2%	2%	533	260	793	1%	2%
Earth Sciences	286	25	311	1%	1%	352	127	479	1%	1%
Biological Sciences	221	22	243	1%	0%	321	39	360	1%	0%
Other N&P Sciences	72	10	82	0%	0%	182	40	221	0%	0%
Subtotal	6,151	1,225	7,375	19%	14%	7,228	2,367	9,595	18%	14%
DG: IT	2,834	576	3,409	9%	2%	1,630	399	2,029	4%	2%
DG: Engineering										
Manufacturing	447	186	633	1%	1%	377	209	586	1%	1%
Process	1,944	439	2,383	6%	11%	2,936	1,895	4,831	7%	11%
Automo	15	1	16	0%	0%	25	8	33	0%	0%
Mech	3,105	1,108	4,214	10%	17%	5,644	2,862	8,506	14%	17%
Civil	3,047	531	3,578	10%	16%	6,651	2,751	9,403	16%	16%
Geomatic	699	42	741	2%	0%	728	75	803	2%	0%
Electrical and Elect	6,715	2,362	9,077	21%	17%	5,376	2,911	8,287	13%	17%
0315 Aerospace	753	180	933	2%	2%	899	338	1,237	2%	2%
0317 Maritime	92	8	99	0%	1%	336	186	522	1%	1%
Other Engineering	2,657	410	3,067	8%	12%	5,391	1,922	7,313	13%	12%
Subtotal	19,474	5,267	24,741	61%	79%	28,363	13,157	41,520	70%	79%
DG: Agriculture	96	12	108	0%	0%	286	53	339	1%	0%
Subtotal STEM	28,555	7,080	35,633	89%	95%	37,507	15,976	53,483	93%	95%
Non-STEM Disciplines										
Architecture	248	23	271	1%	0%	277	54	331	1%	0%
Health	41	15	56	0%	0%	61	19	80	0%	0%
Education	4	1	4	0%	0%	15	1	16	0%	0%
Management	1,302	387	1,689	4%	5%	1,447	336	1,782	4%	2%
Soc & Cul	1,228	252	1,479	4%	3%	1,208	271	1,479	3%	2%
Creative Arts	311	42	352	1%	1%	217	37	254	1%	0%
Other	0	0	0	0%	0%	1	7	7	0%	0%
Subtotal non-STEM	3,134	718	3,852	10%	9%	3,225	724	3,949	8%	4%
TOTAL	31,688	7,797	39,485	100%	100%	40,732	16,700	57,432	100%	100%

Source: The Department: Purchased Tables. FoE: Field of Education; DG: Discipline Group

Table 4.21 looks at commencing and continuing students in bachelor's degrees in Engineering and Related Technologies. The fact that subjects in the Natural and Physical Sciences disciplines feature predominantly among commencing students confirms that first year engineering degrees often comprise 'science' teaching, before students move into the bulk of their training in engineering. Among commencing students, teaching in science disciplines (especially in Mathematical Sciences and Physics and Astronomy) are important. The proportion of these disciplines taken by continuing engineering bachelor's degree students is much lower than for commencing students. The proportion of engineering degrees made from Information Technology subjects declined between 2002 and 2015, and engineering students appear to have little linkage to subjects in Agriculture, Environmental and Related Studies. Also, the proportion of teaching in non-STEM disciplines declined, but commencing students are less likely to take these subjects than continuing students.

Table 4.21 Student Load: Commencing and Continuing Bachelor's Degree Students in Engineering & Related Technologies Broad Field of Education by Narrow Discipline Group 2002 & 2015

FoE: Engineering	2002					2015				
	Com. EFTSL	Cont. EFTSL	TOTAL EFTSL	Com. %	Cont. %	Com. EFTSL	Cont. EFTSL	TOTAL EFTSL	Com. %	Cont. %
DG: N&P Sciences										
Mathematical Sciences	2,428	2,179	4,607	21%	8%	3,288	2,777	6,065	20%	7%
Physics &Astronomy	992	544	1,536	8%	2%	1,004	673	1,676	6%	2%
Chemical Sciences	350	245	595	3%	1%	383	410	793	2%	1%
Earth Sciences	58	253	311	0%	1%	146	333	479	1%	1%
Biological Sciences	61	182	243	1%	1%	122	238	360	1%	1%
Other N&P Sciences	32	51	82	0%	0%	91	130	221	1%	0%
Subtotal	3,921	3,454	7,375	33%	12%	5,034	4,560	9,595	30%	11%
DG: IT	942	2,468	3,409	8%	9%	733	1,296	2,029	4%	3%
DG: Engineering										
Manufacturing	196	437	633	2%	2%	174	412	586	1%	1%
Process	555	1,828	2,383	5%	7%	792	4,039	4,831	5%	10%
Automotive	4	12	16	0%	0%	7	26	33	0%	0%
Mechanical	943	3,271	4,214	8%	12%	1,819	6,687	8,506	11%	16%
Civil	587	2,990	3,578	5%	11%	1,552	7,850	9,403	9%	19%
Geomatic	187	554	741	2%	2%	254	549	803	2%	1%
Electrical and Elect	2,281	6,796	9,077	19%	24%	2,042	6,244	8,287	12%	15%
Aerospace	220	713	933	2%	3%	300	938	1,237	2%	2%
Maritime	31	69	99	0%	0%	221	301	522	1%	1%
Other Engineering	986	2,081	3,067	8%	7%	2,801	4,511	7,313	17%	11%
Subtotal	5,990	18,751	24,741	51%	68%	9,963	31,557	41,520	60%	77%
DG: Agriculture	18	90	108	0%	0%	166	172	339	1%	0%
Subtotal STEM	10,871	24,763	35,633	92%	89%	15,896	37,585	53,483	95%	91%
Non-STEM Disciplines										
Architecture	52	219	271	0%	1%	83	248	331	1%	1%
Health	13	43	56	0%	0%	19	61	80	0%	0%
Education	2	3	4	0%	0%	9	7	16	0%	0%
Management	371	1,318	1,689	3%	5%	274	1,508	1,782	2%	4%
Soc & Cul	330	1,149	1,479	3%	4%	287	1,192	1,479	2%	3%
Creative Arts	83	269	352	1%	1%	83	171	254	0%	0%
Other				0%	0%	3	5	8	0%	0%
Subtotal non-STEM	852	3,000	3,852	7%	11%	759	3,191	3,949	5%	8%
TOTAL	11,722	27,763	39,485	100%	100%	16,656	40,776	57,432	100%	100%

Source: The Department: Purchased Tables. FoE: Field of Education; DG: Discipline Group

Agriculture, Environmental and Related Studies Courses

Agriculture, Environmental and Related Studies is a relatively small part of Australian higher education. As a Field of Education, it represents 1.3 per cent of all bachelor's degree students, and a similar proportion as a Broad Discipline Group. As noted earlier, the Melbourne Model has disrupted the historical time series in several ways, including the way things look for the Agriculture, Environmental and Related Studies Broad Field of Education. Referring to Table 4.22, shows growth in the extent of teaching to Agriculture, Environmental and Related Studies bachelor's degree students. In 2002, 66 equivalent full-time students received teaching in subjects in the Architecture and Building Broad Discipline Group. By 2015, this figure had risen to 829 equivalent full-time students. In the overall scheme of things, neither of these figures is significantly large, but for anyone

seeking to analyse apparent trends in the Agriculture, Environmental and Related Studies broad Field of Education, it represents a serious perturbation. Refer to Chapter 1 for an explanation of changes in the time series in Agriculture, Environmental and Related Technologies.

From Table 4.23 it is possible to compare enrolment patterns by gender. The main changes appear to be the proportion of service teaching to Agriculture, Environmental and Related Studies bachelor's degree students from Natural and Physical Sciences (down from 36 per cent to 26 per cent for women; 36 per cent to 29 per cent for men), with increases in the proportion of teaching from the Architecture and Building Broad D2iscipline Group.

Table 4.22 Student Load: All Bachelor's Degree Students in Agriculture, Environmental & Related Studies Broad Field of Education by Narrow Discipline Group 2002 & 2015

Narrow Discipline Group	2002 EFTSL	2015 EFTSL	Growth EFTSL	2002 %	2015 %	Growth %
STEM Disciplines						
Mathematical Sciences	388	384	-5	4%	4%	-1%
Physics &Astronomy	83	35	-48	1%	0%	-57%
Chemical Sciences	529	353	-176	6%	4%	-33%
Earth Sciences	603	425	-178	7%	5%	-30%
Biological Sciences	1,581	1,037	-544	17%	12%	-34%
Other N&P Sciences	89	192	103	1%	2%	116%
Subtotal N&P Sciences DG	**3,273**	**2,426**	**-848**	**36%**	**27%**	**-26%**
Computer Science	29	7	-22	0%	0%	-77%
Information Systems	26	12	-14	0%	0%	-54%
Other IT	12	5	-8	0%	0%	-63%
Subtotal IT DG	**67**	**23**	**-44**	**1%**	**0%**	**-66%**
Manufacturing Eng	0	0	0	0%	0%	-48%
Process and Resources	20	1	-18	0%	0%	-94%
Mechanical and Industrial Eng	4	28	23	0%	0%	531%
Civil Engineering	21	143	122	0%	2%	575%
Geomatic Engineering	102	137	35	1%	2%	34%
Electrical and Electronic Eng	1	0	-1	0%	0%	-62%
Aerospace Eng	0	0	0	0%	0%	
Maritime Eng		0	0	0%	0%	
Other Eng	37	34	-3	0%	0%	-7%
Subtotal Engineering DG	**186**	**344**	**159**	**2%**	**4%**	**85%**
Agriculture	1,792	1,403	-389	20%	16%	-22%
Horticulture and Viticulture	193	107	-86	2%	1%	-45%
Forestry Studies	78	28	-50	1%	0%	-64%
Fisheries Studies	149	22	-128	2%	0%	-85%
Environmental Studies	1264	1,936	673	14%	22%	53%
Other Agriculture, Env	391	271	-121	4%	3%	-31%
Subtotal Agriculture DG	**3,867**	**3,766**	**-100**	**42%**	**42%**	**-3%**
Subtotal STEM DG	**7,393**	**6,559**	**-833**	**81%**	**74%**	**-11%**
Non-STEM Discipline Groups						
Architecture	66	829	763	1%	9%	1160%
Health	139	108	-31	2%	1%	-22%
Education	23	53	30	0%	1%	129%
Management	495	382	-113	5%	4%	-23%
Soc & Cul	917	845	-72	10%	9%	-8%
Creative Arts	70	117	47	1%	1%	68%
Other		3	3	0%	0%	
Subtotal Non-STEM DG	**1,710**	**2,337**	**628**	**19%**	**26%**	**37%**
Total	**9,102**	**8,897**	**-206**	**100%**	**100%**	**-2%**

Source: The Department: Purchased Tables. FoE: Field of Education; DG: Discipline Group

Patterns of learning by students enrolled in bachelor's degree courses in Agriculture, Environmental and Related Studies have probably changed more than any of the other STEM fields of education. Looking at the study patterns of domestic and overseas students enrolled in 2002, overseas students enrolled in these courses drew 47 per cent of their teaching from subjects in the Natural and Physical Sciences, (cf. 36 per cent for domestic students), but this declined considerably, to 18 per cent in the case of overseas students, and more modestly, to 29 per cent for domestic students. The proportion of teaching in Engineering subjects stayed the same for domestic students (about four per cent), but for overseas students, the proportion increased from three to seven per cent between 2002 and 2015. Proportions of teaching in Agriculture, Environmental and Related Studies subjects changed in opposite directions between 2002 and 2015 for overseas and domestic students. The proportion for domestic students increased from to 43 to 45 per cent, but for overseas students, there was a decline from 32 to 29 per cent.

Table 4.23 Student Load: Male and Female Bachelor's Degree Students in Agriculture, Environmental & Related Studies Broad Field of Education by Narrow Discipline Group 2002 & 2015

	2002					2015				
	Female EFTSL	Male EFTSL	TOTAL EFTSL	Females %	Males %	Female EFTSL	Male EFTSL	TOTAL EFTSL	Females %	Males %
DG: N&P Sciences										
Mathematical Sciences	179	209	388	4%	4%	187	197	384	4%	5%
Physics &Astronomy	40	43	83	1%	1%	18	18	35	0%	0%
Chemical Sciences	251	278	529	6%	6%	178	175	353	4%	4%
Earth Sciences	293	310	603	7%	7%	190	234	425	4%	6%
Biological Sciences	782	800	1,581	18%	17%	540	497	1,037	12%	12%
Other N&P Sciences	29	60	89	1%	1%	92	100	192	2%	2%
Subtotal	1,573	1,700	3,273	36%	36%	1,205	1,221	2,426	26%	29%
DG: IT	24	43	67	1%	1%	8	15	23	0%	0%
DG: Engineering	73	113	185	2%	2%	151	193	344	3%	5%
DG: Agriculture										
Agriculture	917	875	1,792	21%	19%	833	570	1,403	18%	14%
Hort / Vit	78	115	193	2%	2%	46	61	107	1%	1%
Forestry	31	47	78	1%	1%	14	14	28	0%	0%
Fisheries	28	121	149	1%	3%	7	14	22	0%	0%
Env. Studies	646	617	1,264	15%	13%	1,041	895	1,936	22%	21%
Other Ag / Env	164	227	391	4%	5%	119	152	271	3%	4%
Subtotal	1,864	2,002	3,867	44%	43%	2,060	1,706	3,767	44%	40%
Subtotal STEM	3,534	3,858	7,392	83%	82%	3,424	3,135	6,560	73%	74%
Non-STEM Disciplines										
Architecture	32	34	66	1%	1%	460	369	829	10%	9%
Health	69	70	139	2%	1%	64	44	108	1%	1%
Education	13	10	23	0%	0%	29	24	53	1%	1%
Management	252	243	495	6%	5%	182	200	382	4%	5%
Soc & Cul	480	437	917	11%	9%	460	385	845	10%	9%
Creative Arts	29	41	70	1%	1%	62	55	117	1%	1%
Other	0	0	0	0%	0%	1	2	3	0%	0%
Subtotal	874	835	1,710	20%	18%	1,259	1,079	2,337	27%	26%
TOTAL	4,408	4,694	9,102	100%	100%	4,682	4,214	8,896	100%	100%

Source: The Department: Purchased Tables. FoE: Field of Education; DG: Discipline Group

The biggest change, and on the surface and unlikely change for agriculture and environmental studies students, has been the huge increase, particularly for overseas students, of teaching in subjects in the Architecture and Building Broad Discipline Group. The proportion of teaching from

these disciplines to both domestic and overseas students in 2002 was one per cent. In 2015, for domestic students, the proportion had risen to seven per cent, but for overseas students, 24 per cent of teaching to these students was in Architecture and Building subjects. In fact, overseas students from all around the country received one EFTSL of teaching in Architecture and Building in 2002, increasing to 331 EFTSL in 2015. Coincidentally, this change of pattern matches the introduction of the Melbourne Model.

Table 4.24 Student Load: Domestic and Overseas Bachelor's Degree Students in Agriculture, Environmental & Related Studies Broad Field of Education by Narrow Discipline Group 2002 & 2015

FoE: Agriculture	2002					2015				
	Domestic EFTSL	Overseas EFTSL	TOTAL EFTSL	Domestic %	Overseas %	Domestic EFTSL	Overseas EFTSL	TOTAL EFTSL	Domestic %	Overseas %
DG: N&P Sciences										
Mathematical Sciences	372	16	388	4%	7%	324	59	384	4%	4%
Physics &Astronomy	80	3	83	1%	1%	31	4	35	0%	0%
Chemical Sciences	502	27	529	6%	11%	322	31	353	4%	2%
Earth Sciences	583	20	603	7%	9%	389	35	425	5%	3%
Biological Sciences	1, 540	41	1,581	17%	18%	943	95	1,037	13%	7%
Other N&P Sciences	85	4	89	1%	2%	165	27	192	2%	2%
Subtotal	3,163	110	3,273	36%	47%	2,174	251	2,426	29%	18%
DG: IT	65	2	67	1%	1%	20	3	23	0%	0%
DG: Eng	313	7	319	4%	3%	288	102	390	4%	7%
DG: Agiculture										
Agriculture	1,764	28	1,792	20%	12%	1,293	110	1,403	17%	8%
Hort / Vit	190	3	193	2%	1%	81	26	107	1%	2%
Forestry	74	3	78	1%	1%	23	5	28	0%	0%
Fisheries	146	4	149	2%	2%	17	5	22	0%	0%
Env. Studies	1,235	28	1,264	14%	12%	1,702	234	1,936	23%	17%
Other Ag	383	8	391	4%	4%	255	16	271	3%	1%
Subtotal	3,793	74	3,867	43%	32%	3,371	395	3,766	45%	29%
Subtotal STEM	7,334	193	7,526	84%	83%	5,853	751	6,605	78%	54%
Non-STEM Disciplines										
Architecture	65	1	66	1%	1%	498	331	829	7%	24%
Health	137	2	139	2%	1%	102	6	108	1%	0%
Education	23	0	23	0%	0%	45	8	53	1%	1%
Management	485	9	495	5%	4%	300	82	382	4%	6%
Soc & Cul	886	31	917	10%	13%	680	165	845	9%	12%
Creative Arts	68	2	70	1%	1%	71	46	117	1%	3%
Other	0	0	0	0%	0%	2	1	3	0%	0%
Subtotal	1,664	45	1,710	19%	19%	1,699	638	2,337	23%	46%
TOTAL	8,868	234	9,102	100%	100%	7,513	1,384	8,896	100%	100%

Source: The Department: Purchased Tables. FoE: Field of Education; DG: Discipline Group

Turning now to commencing and continuing students enrolled in Agriculture, Environmental and Related Studies bachelor's degrees, teaching in the natural and physical sciences is also been important, but has declined over the period shown, particularly in the Biological Sciences. In 2002, subjects in the Natural and Physical Sciences made up nearly half of what a student starting their studies in agriculture, forestry or environmental science took, but this declined to 37 per cent by 2015. The science work load taken on by continuing students also declined. Another pattern change can be seen in the Engineering and Related Technologies discipline group: there has been a considerable increase in the teaching in Mechanical Engineering, and the overall proportion of teaching in engineering subjects increased from two per cent to four per cent. Only the Department can work out

what is behind these changes. Access to the data files that we all had until the 2009 academic year could provide the level of detail required.

Table 4.25 Student Load: Commencing and Continuing Bachelor's Degree Students in Agriculture, Environmental & Related Studies Broad Field of Education by Narrow Discipline Group 2002 & 2015

STEM Disciplines	2002					2015				
	Com. EFTSL	Cont. EFTSL	TOTAL EFTSL	Com. %	Cont. %	Com. EFTSL	Cont. EFTSL	TOTAL EFTSL	Com. %	Cont. %
DG: N&P Sciences										
Mathematical Sciences	180	208	388	6%	4%	202	181	384	7%	3%
Physics &Astronomy	56	27	83	2%	0%	23	12	35	1%	0%
Chemical Sciences	331	198	529	11%	3%	225	128	353	7%	2%
Earth Sciences	235	368	603	7%	6%	149	276	425	5%	5%
Biological Sciences	659	922	1581	21%	16%	465	573	1037	15%	10%
Other N&P Sciences	38	51	89	1%	1%	62	130	192	2%	2%
Subtotal	1499	1774	3273	48%	30%	1126	1299	2426	37%	22%
DG: IT	41	26	67	1%	0%	5	18	23	0%	0%
DG: Engineering	60	126	186	2%	2%	107	237	344	4%	4%
DG: Agriculture										
Agriculture	545	1247	1792	17%	21%	389	1014	1403	13%	17%
Hort / Vit	46	147	193	1%	2%	15	92	107	0%	2%
Forestry	7	70	78	0%	1%	18	10	28	1%	0%
Fisheries	46	103	149	1%	2%	4	18	22	0%	0%
Env. Studies	291	973	1264	9%	16%	652	1284	1936	21%	22%
Other Ag / Env	94	297	391	3%	5%	72	199	271	2%	3%
Subtotal	1029	2838	3867	33%	48%	1151	2616	3766	38%	45%
Subtotal STEM	2629	4764	7393	84%	80%	2389	4170	6559	79%	71%
Non-STEM Disciplines										
Architecture	13	52	66	0%	1%	186	643	829	6%	11%
Health	16	123	139	1%	2%	39	69	108	1%	1%
Education	2	21	23	0%	0%	9	44	53	0%	1%
Management	150	345	495	5%	6%	114	268	382	4%	5%
Soc & Cul	299	618	917	9%	10%	267	578	845	9%	10%
Creative Arts	45	25	70	1%	0%	32	86	117	1%	1%
Other	0	0	0	0%	0%	2	2	3	0%	0%
Subtotal non-STEM	526	1183	1710	17%	20%	649	1688	2337	21%	29%
TOTAL	3154	5948	9102	100%	100%	3038	5858	8896	100%	100%

Source: The Department: Purchased Tables. FoE: Field of Education; DG: Discipline Group

The next section repeats the analysis above for PhD students, albeit at a much-reduced level of detail.

Drilling down: PhDs

The PhD is an important degree in the STEM disciplines, particularly in the Natural and Physical Sciences. The PhD represents a barrier to entry in many academic and research markets.

Table 4.26 summarises the teaching at the PhD level by broad discipline group. Overall, PhD teaching increased by 62 per cent between 2002 and 2015, with STEM disciplines providing 47 per cent of all teaching at this level in 2015, up from 40 per cent in 2002. Growth was particularly strong in Engineering and Related Technologies (+3,678 EFTSL, +145 per cent). The overall proportion of PhD-level teaching increased from ten per cent to 15 per cent in this Broad Discipline Group. PhD teaching in the Natural and Physical Sciences is now the largest, at 24 per cent of all PhD teaching in 2015.

The next-highest taught disciplines are in Society and Culture (21 per cent in 2015, down from 26 per cent in 2002), and Health 15 per cent. The largest increases occurred in the Natural and Physical Sciences (+3,942 EFTSL), Engineering and Related Technologies (+3,678) and Health (+3,069). In contrast with most matters relating to Information Technology, there was expansion of 855 EFTSL (+88 per cent) over the period.

Table 4.26 Student Load: PhD Students by Broad Discipline Group, 2002 – 2015

Broad Discipline Group	2002	2007	2012	2015	Growth No.	2002	2007	2012	2015	Growth %.
N&P Sciences	5,806	7,127	9,010	9,748	3,942	23%	24%	23%	24%	68%
IT	967	1,318	1,626	1,822	855	4%	4%	4%	4%	88%
Engineering	2,529	3,214	5,214	6,207	3,678	10%	11%	13%	15%	145%
Agriculture,	1,003	1,203	1,485	1,654	651	4%	4%	4%	4%	65%
Subtotal–STEM	10,305	12,862	17,335	19,431	9,126	40%	42%	45%	47%	89%
Architecture	303	356	570	606	303	1%	1%	1%	1%	100%
Health	2,979	3,883	5,202	6,048	3,069	12%	13%	13%	15%	103%
Education	2,005	1,820	2,205	2,143	138	8%	6%	6%	5%	7%
Management	2,424	2,472	2,872	2,524	100	9%	8%	7%	6%	4%
Soc & Cul	6,730	7,635	8,747	8,686	1,956	26%	25%	23%	21%	29%
Creative Arts	822	1,240	1,717	1,865	1,043	3%	4%	4%	5%	127%
Other	0	0	18	38	38	0%	0%	0%	0%	
Subtotal -Non-STEM	15,263	17,406	21,331	21,910	6,647	60%	58%	55%	53%	44%
Total	25,568	30,267	38,666	41,339	15,771	100%	100%	100%	100%	62%

Source: The Department: Purchased Tables.

Tables 4.27 and 4.28 repeat the information in Table 4.26 in more detail. Both tables show the distribution of PhD students in 2002 and 2009 by narrow discipline group in teaching in the STEM disciplines, according to gender (Table 4.28), and citizenship status (Table 4.29). These tables allow an examination of these two important binary groups, to seek differences in the pattern of what each student group studies. The percentage columns show the distribution of all teaching to students enrolled in PhDs in the two years examined.

Table 4.27 shows gender differences among PhD students in their propensity to study at this level. In 2002, 32 per cent of female PhD students were studying in the STEM disciplines, compared with 48 per cent of male PhD students. Within the STEM disciplines, women were more likely than men to be studying Information Technology, Engineering and Related Technologies and Agriculture, Environmental and Related Studies. Within the Natural and Physical Sciences, women were more likely than men to be studying in the Biological Sciences, and there were more female than male students undertaking PhD studies in Other Natural and Physical Sciences. In fact, around 70 per cent of female PhD students in the Natural and Physical Sciences were enrolled in a programme in either

Biological Sciences, or Other Natural and Physical Sciences (cf. about 52 per cent of equivalent male PhD students). Overall, however, 54 per cent of the student load in the Natural and Physical Sciences was to male students. Elsewhere it has been shown that women are under-represented in Engineering and Related Technologies and Information Technology, in which 21 per cent and 24 per cent respectively of teaching was to women.

Perhaps the main gender-related variation between 2002 and 2015 was the increased proportion of all PhD teaching to male students in the Engineering and Related Technologies discipline. PhD studies in Engineering increased from 15 per cent of all PhD teaching, to 22 per cent. At the same time, the proportion of male students undertaking PhD studies in STEM disciplines increased from 48 per cent to 57 per cent of the PhDs taken by men. However, the proportion of STEM PhDs taken by women also increased: from 32 per cent to 37 per cent. In the case of women, in 2002, 32 per cent of all PhDs were in Society and Culture disciplines, which declined to 25 per cent in 2015.

Table 4.27 Student Load: Female and Male PhD Students by Broad and Narrow Discipline Group, 2002 -2015

Broad/ Narrow Discipline Group	2002					2015				
	Female	Male	TOTAL	Female %	Male %	Female	Male	TOTAL	Female %	Male %
N&P Sciences										
Mathematical	114	256	370	1%	2%	215	443	658	1%	2%
Physics	144	379	523	1%	3%	284	715	998	1%	3%
Chemical	291	404	695	2%	3%	528	845	1,373	3%	4%
Earth Sci	248	448	696	2%	3%	411	506	917	2%	2%
Biological	1,464	1,260	2,724	12%	9%	2,025	1,743	3,768	10%	8%
Other N&P Sciences	412	387	798	3%	3%	1,133	900	2,033	6%	4%
TOTAL	2,673	3,134	5,806	22%	23%	4,596	5,152	9,748	22%	25%
IT	0	4	4	0%	0%	0	0	0	0%	0%
CompSci	117	425	541	1%	3%	296	797	1,093	1%	4%
Info Sys	51	134	185	0%	1%	98	248	346	0%	1%
Other IT	64	172	236	1%	1%	107	275	382	1%	1%
TOTAL	233	734	967	2%	5%	502	1,320	1,822	2%	6%
Engineering										
Engineering	0	1	1	0%	0%	0	0	0	0%	0%
Manufacturing	40	100	140	0%	1%	63	80	143	0%	0%
Process	147	383	530	1%	3%	427	852	1,279	2%	4%
Automotive	0	6	6	0%	0%	0	0	0	0%	0%
Mechanical	44	283	327	0%	2%	146	776	922	1%	4%
Civil	92	305	397	1%	2%	306	892	1,198	1%	4%
Geomatic	29	66	94	0%	0%	46	78	125	0%	0%
Electrical	94	583	678	1%	4%	339	1,095	1,433	2%	5%
Aerospace	12	41	54	0%	0%	15	64	80	0%	0%
Maritime	2	8	10	0%	0%	3	42	45	0%	0%
Other Eng	77	215	291	1%	2%	280	702	982	1%	3%
TOTAL	537	1,991	2,529	4%	15%	1,626	4,581	6,207	8%	22%
Agriculture & Env.										
Agriculture	209	273	482	2%	2%	394	401	795	2%	2%
Horticulture	26	24	51	0%	0%	10	6	16	0%	0%
Forestry	6	21	27	0%	0%	26	32	58	0%	0%
Fisheries	12	49	61	0%	0%	22	43	66	0%	0%
Environmental	133	149	282	1%	1%	330	279	609	2%	1%
Other Ag	39	60	99	0%	0%	46	65	110	0%	0%
TOTAL	426	577	1,003	3%	4%	828	826	1,654	4%	4%
Subtotal STEM	3,869	6,436	10,305	32%	48%	7,552	11,879	19,431	37%	57%

Broad/ Narrow Discipline Group	2002					2015				
	Female	Male	TOTAL	Female %	Male %	Female	Male	TOTAL	Female %	Male %
04 Architecture	132	171	303	1%	1%	303	302	606	1%	1%
06 Health	1,820	1,159	2,979	15%	9%	3,779	2,269	6,048	18%	11%
07 Education	1,227	779	2,005	10%	6%	1,427	716	2,143	7%	3%
08 Management	782	1,642	2,424	6%	12%	1,204	1,320	2,524	6%	6%
09 Soc & Culture	3,917	2,814	6,730	32%	21%	5,148	3,538	8,686	25%	17%
10 Creative	437	385	822	4%	3%	1,044	821	1,865	5%	4%
Other	0	0	0	0%	0%	15	22	38	0%	0%
Subtotal Non-STEM	8,315	6,950	15,263	68%	52%	12,920	8,988	21,910	63%	43%
TOTAL	12,182	13,386	25,568	100%	100%	20,471	20,869	41,339	100%	100%

Source: The Department: Purchased Tables.

Table 4.28 shows patterns and differences in PhD uptake by domestic and overseas students. There was strong growth at the PhD level, particularly by overseas students. Their proportion of the total increased from 20 per cent to 38 per cent between 2002 and 2015. There was also a considerable switch in favour of the STEM disciplines. In 2002, 61 per cent of all teaching to overseas students at the PhD level was non-STEM disciplines, but by 2015, the proportion declined to 38 per cent.

Table 4.28 Student Load: Domestic and Overseas PhD Students by Broad and Narrow Discipline Group, 2002 – 2015

Broad/Narrow Discipline Group	2002					2015				
	Domestic	Overseas	TOTAL	Dom %	OS %	Domestic	Overseas	TOTAL	Dom %	OS %
N&P Sciences										
Mathematical	292	79	370	1%	2%	381	278	658	1%	2%
Physics	443	80	523	2%	2%	567	431	998	2%	3%
Chemical	591	104	695	3%	2%	720	653	1,373	3%	4%
Earth Sci	561	135	696	3%	3%	484	433	917	2%	3%
Biological	2,367	357	2,724	12%	7%	2,202	1,566	3,768	9%	10%
Other N&P Sciences	663	135	798	3%	3%	1,165	869	2,033	5%	6%
TOTAL	4,917	889	5,806	24%	18%	5,518	4,230	9,748	22%	27%
IT	2	2	4	0%	0%	0	0	0	0%	0%
CompSci	419	123	541	2%	2%	462	631	1,093	2%	4%
Info Sys	141	44	185	1%	1%	135	211	346	1%	1%
Other IT	186	51	236	1%	1%	181	201	382	1%	1%
TOTAL	747	220	967	4%	4%	779	1,043	1,822	3%	7%
Engineering										
Engineering	1	0	1	0%	0%	0	0	0	0%	0%
Manufacturing	99	41	140	0%	1%	56	87	143	0%	1%
Process	397	133	530	2%	3%	442	837	1,279	2%	5%
Automotive	6	0	6	0%	0%	0	0	0	0%	0%
Mechanical	264	63	327	1%	1%	418	504	922	2%	3%
Civil	296	101	397	1%	2%	488	710	1,198	2%	5%
Geomatic	64	30	94	0%	1%	58	66	125	0%	0%
Electrical	499	178	678	2%	4%	623	810	1,433	2%	5%
Aerospace	43	10	54	0%	0%	62	17	80	0%	0%
Maritime	7	3	10	0%	0%	20	25	45	0%	0%
Other Eng	221	70	291	1%	1%	421	561	982	2%	4%
TOTAL	1,899	630	2,529	9%	12%	2,589	3,618	6,207	10%	23%

Broad/Narrow Discipline Group	2002					2015				
	Domestic	Overseas	TOTAL	Dom %	OS %	Domestic	Overseas	TOTAL	Dom %	OS %
Agriculture & Env.										
Agriculture	368	114	482	2%	2%	314	481	795	1%	3%
Horticulture	38	13	51	0%	0%	5	10	16	0%	0%
Forestry	19	8	27	0%	0%	26	32	58	0%	0%
Fisheries	43	18	61	0%	0%	21	44	66	0%	0%
Environmental	239	44	282	1%	1%	363	246	609	1%	2%
Other Ag	87	13	99	0%	0%	40	70	110	0%	0%
TOTAL	794	209	1,003	4%	4%	769	884	1,654	3%	6%
Subtotal STEM	8,357	1,948	10,305	41%	38%	9,655	9,775	19,431	38%	62%
Architecture	225	77	303	1%	2%	410	196	606	2%	1%
Health	2,618	361	2,979	13%	7%	4,510	1,538	6,048	18%	10%
Education	1,575	430	2,005	8%	8%	1,513	630	2,143	6%	4%
Management	1,167	1,256	2,424	6%	25%	1,360	1,164	2,524	5%	7%
Soc & Cul	5,862	869	6,730	29%	17%	6,525	2,162	8,686	25%	14%
Creative Arts	702	120	822	3%	2%	1,595	270	1,865	6%	2%
Other	0	0	0	0%	0%	27	11	38	0%	0%
Subtotal Non-STEM	12,149	3,113	15,263	59%	61%	15,940	5,971	21,910	62%	38%
TOTAL	20,506	5,062	25,568	100%	100%	25,594	15,746	41,339	100%	100%

Source: The Department: Purchased Tables.

The growth was particularly strong with overseas PhD students taking the Engineering and Related Technologies discipline, in which there was a six-fold increase from 630 EFTSL in 2002 to 3,618 EFTSL in 2015. There was also strong expansion in the Natural and Physical Sciences discipline, with an almost five-fold increase from 889 EFTSL to 4,230 EFTSL.

The final table so far as PhD students are concerned is Table 4.29, which has been split into two parts in order to examine teaching to PhD students in the specific STEM fields of education, and all PhD students in non-STEM PhDs. Considering students enrolled in 'science' PhDs, Table 4.27 shows, unsurprisingly, that Science PhD students predominantly study from the Natural and Physical Sciences discipline group. In 2002, 92 per cent of the teaching to these students was in Natural and Physical Sciences disciplines, with some teaching in Agriculture, Environmental and Related Studies disciplines (one suspects, in Environmental Science), with teaching also from Health, and Society and Culture. It is likely that the latter teaching is in Behavioural Sciences. There was considerable expansion in PhDs in the Natural and Physical Sciences (+73 per cent).

Looking at PhDs in Information Technology, the number (expressed in EFTSL) more than doubled between 2002 and 2015. Most of the teaching to these students is from the Information Technology disciplines (about 95 per cent in both points of measurement).

The situation for Engineering and Related Technologies PhD students is similar. There was strong overall growth (+118 per cent), and most of the teaching to these students is in Engineering and Related Technologies disciplines (91 per cent in 2002, and 96 per cent in 2015).

Table 4.29a Student Load: PhD Students in STEM Fields of Education and All Non-STEM Fields of Education, 2002 & 2015: EFTSL No.

Discipline Groups – Expanded	Broad Field of Education						
	STEM Fields of Education					Non-STEM FoEs	TOTAL
2002	**N&P Sciences**	**IT**	**Engineering**	**Agriculture**	**Subtotal**		
N&P Sciences	5,097	10	36	212	5,355	452	5,806
IT	12	714	165	15	906	63	967
Engineering	41	13	2,452	6	2,512	17	2,529
Agriculture	96	4	1	869	970	32	1,003
Subtotal STEM DGs	5,246	741	2,654	1,102	9,743	564	10,305
Architecture	18	0	3	1	22	280	303
Health-Medicine	126	1	0	0	127	1,386	1,513
Health-Other	39	1	14	3	57	1,416	1,142
Education	0	1	2	6	9	1,998	2,005
Management	2	2	3	2	9	2,415	2,424
Soc. & Culture	94	1	3	45	143	5,837	5,979
Creative Arts	7	7	0	0	14	807	822
All other							
TOTAL	5,527	752	2,680	1,157	10,116	15,452	25,568
2015	**N&P Sciences**	**IT**	**Engineering**	**Agriculture**	**Subtotal**		
N&P Sciences	8,559	41	54	339	8,993	755	9,748
IT	19	1,558	110	1	1,688	134	1,822
Engineering	120	32	6,027	7	6,186	21	6,207
Agriculture	151	1	1	1,462	1,615	39	1,654
Subtotal STEM DGs	8,849	1,632	6,192	1,809	18,482	949	19,431
Architecture	2	0	5	22	29	578	606
Health-Medicine	307	0	2	2	311	2,422	2,733
Health-Other	173	2	1	36	212	2,308	2,487
Education	1	0	1	1	3	2,140	2,143
Management	10	3	5	2	20	2,505	2,524
Soc. & Culture	198	3	37	30	268	7,128	7,383
Creative Arts	2	1	1	0	4	1,861	1,865
Other	0	2	2	4	8	30	38
TOTAL	9,542	1,642	6,246	1,905	19,335	22,004	41,339

Source: The Department: Purchased Tables. FoE: Field of Education; DG: Discipline Group

Teaching to PhD students in Agriculture, Environmental and Related Studies is much less restricted to Agriculture, Environmental and Related Studies disciplines. About 25 per cent of teaching to these PhD students was from other Broad Discipline Groups in 2002, and 23 per cent in 2015.

Table 4.29b Student Load: PhD Students in STEM Fields of Education and All Non-STEM Fields of Education, 2002 & 2015: EFTSL No. and %

Discipline Groups – Expanded	Broad Field of Education						
	STEM Fields of Education					Non-STEM FoEs	TOTAL
Growth – No.	N&P Sciences	IT	Engineering	Agriculture	Subtotal		
N&P Sciences	3,462	31	18	127	3,638	303	3,942
IT	7	844	-55	-14	782	71	855
Engineering	79	19	3,575	1	3,674	4	3,678
Agriculture	55	-3	0	593	645	7	651
Subtotal STEM DGs	3,603	891	3,538	707	8,739	385	9,126
Architecture	-16	0	2	21	7	298	303
Health-Medicine	181	-1	2	2	184	1,036	1,220
Health-Other	134	1	-13	33	155	892	1,345
Education	1	-1	-1	-5	-6	142	138
Management	8	1	2	0	11	90	100
Soc. & Culture	104	2	34	-15	125	1,291	1,404
Creative Arts	-5	-6	1	0	-10	1,054	1,043
Other	0	2	2	4	8	30	38
TOTAL	4,015	890	3,566	748	9,219	6,552	15,771
Growth – %	N&P Sciences	IT	Engineering	Agriculture	Subtotal		
N&P Sciences	68%	310%	50%	60%	68%	67%	68%
IT	58%	118%	-33%	-93%	86%	113%	88%
Engineering	193%	146%	146%	17%	146%	24%	145%
Agriculture	57%	-75%	0%	68%	66%	22%	65%
Subtotal STEM DGs	69%	120%	133%	64%	90%	68%	89%
Architecture	-89%		67%	2,100%	32%	106%	100%
Health-Medicine	144%	-100%			145%	75%	81%
Health-Other	344%	100%	-93%	1,100%	272%	63%	118%
Education		-100%	-50%	-83%	-67%	7%	7%
Management	400%	50%	67%	0%	122%	4%	4%
Soc. & Culture	111%	200%	1,133%	-33%	87%	22%	23%
Creative Arts	-71%	-86%			-71%	131%	127%
Other							
TOTAL	73%	118%	133%	65%	91%	42%	62%

Source: The Department: Purchased Tables. FoE: Field of Education; DG: Discipline Group

Drilling down: Students enrolled in a course leading to provisional registration as a medical practitioner

Chapter 3 presented enrolments of 'students enrolled in a course leading to provisional registration as a medical practitioner' (see Tables 3.16 – 3.18) according to several variables. The next two tables present more information about that cohort of students. The tables show data from 2005 (the first year for which these data were made available) to 2015. Table 4.30 shows that the amount of teaching to this cohort increased from 9,435 EFTSL to 18,063 EFTSL, an increase of 91 per cent. In 2005, about ten per cent of this teaching was provided in the Natural and Physical Sciences Broad Discipline Group, with very little teaching being provided in disciplines other than Health. Within the Health Broad Discipline Group, the great majority of the teaching was within the minor Discipline Group 'Medicine'. No surprises there, perhaps.

Looking at the teaching to 'medical practitioner' students in subjects from the Natural and Physical Sciences discipline group, one can only wonder about the apparent volatility of the numbers. Why did

the amount of teaching in the Natural and Physical Sciences drop by over 41 per cent between 2010 and 2011? Does this have something to do with the introduction of graduate school models, and the shift of medical practitioner students at some universities to become postgraduates? To answer such questions would require access to the data files that used to be available to the public.

Table 4.30 Student Load: Medical Practitioner Students by Discipline Group, 2002 & 2015: EFTSL No. and %

Year	N&PS Total EFTSL	Health Medicine EFTSL	Health other EFTSL	Health Total EFTSL	All Other DGs EFTSL	Total EFTSL	%NPS %	%Health %	% all Other %
2005	897	8,101	294	8,395	143	9,435	10%	89%	2%
2006	1,017	9,331	244	9,575	154	10,746	9%	89%	1%
2007	1,062	10,519	260	10,779	164	12,005	9%	90%	1%
2008	1,194	12,059	268	12,327	209	13,729	9%	90%	2%
2009	1,274	13,637	184	13,821	187	15,281	8%	90%	1%
2010	1,462	14,573	177	14,750	203	16,414	9%	90%	1%
2011	856	15,960	200	16,160	115	17,131	5%	94%	1%
2012	1,094	16,402	23	16,425	88	17,608	6%	93%	0%
2013	1,117	16,544	13	16,557	77	17,752	6%	93%	0%
2014	953	16,152	16	16,168	35	17,155	6%	94%	0%
2015	1,183	16,766	42	16,808	73	18,063	7%	93%	0%

Source: The Department: Purchased Tables. FoE: Field of Education; DG: Discipline Group

Table 4.31 takes a closer look at teaching within the Natural and Physical Sciences Discipline Group. The overall teaching of 'science' to these students has not kept pace with the expansion in the number of 'medical practitioner' students, but at least some of the reason for that is that some students now start their studies in a degree classified as other than 'Health – Medicine'. However, of the teaching to these students within the Natural and Physical Sciences, there has been an apparent switch away from the Narrow Discipline Group of 'Biological Sciences', into 'Other Natural and Physical Sciences'. Teaching from the other Narrow Discipline Groups has always been quite low. As stated earlier, the only way to examine this more closely would be to be able to access the information submitted to the Department by universities in finer detail. Under current arrangements, only the Department itself would be able to do so.

Table 4.31 Student Load: Medical Practitioner Students in the Natural and Physical Sciences Discipline Group, 2002 & 2015: EFTSL No. and %

Year	N&PS Biology EFTSL	N&PS Chemical/ Physics/ Earth Sc./ Maths EFTSL	N&PS Other EFTSL	N&PS Total EFTSL	N&PS Biology %	N&PS Chemical/ Physics/ Earth Sc./ Maths %	N&PS Other %	N&PS Total %
2005	380	7	510	897	42%	1%	57%	100%
2006	400	16	601	1,017	39%	2%	59%	100%
2007	451	17	594	1,062	42%	2%	56%	100%
2008	495	33	666	1,194	41%	3%	56%	100%
2009	530	51	693	1,274	42%	4%	54%	100%
2010	392	56	1,014	1,462	27%	4%	69%	100%
2011	134	18	704	856	16%	2%	82%	100%
2012	71	6	1,017	1,094	6%	1%	93%	100%
2013	56	8	1,053	1,117	5%	1%	94%	100%
2014	50	7	896	953	5%	1%	94%	100%
2015	46	12	1,125	1,183	4%	1%	95%	100%

Source: The Department: Purchased Tables.

The next chapter presents an examination of course completions in the STEM fields of education between 2002 and 2015.

CHAPTER 5
STEM Course Completions 2002 – 2015

This chapter provides a closer look at award course completions in the STEM Fields of Education between 2002 and 2015. The tables and graphs in this chapter have been prepared from larger tables purchased from the Department. Because of concerns about privacy and the potential for individual students to be identified from university statistics, the Department uses a technique called input perturbation that means that they don't necessarily report the actual figure[24]. I mention this because it is possible for figures obtained from legitimate sources to vary by small amounts. In the tables, Total Completions usually exceeds Total Students because some students complete more than one course in the same year (such as combine course students graduating with both a BSc and an LLB).

Table 5.1 looks more closely at the composition of STEM course completions cf. non-STEM course completions in 2002 and 2015, by level of course. The number of STEM course completions (all course levels) was 47,194 in 2002, which rose to 61,783 in 2015, a 31 per cent increase, as noted in Chapter 2. The proportion of STEM course completions declined from 23 per cent of all completions in 2002, to 18 per cent in 2015. Non-STEM course completers numbered 159,183 in 2002, rising to 272,646 in 2015. The largest number of completers of STEM qualifications receive a bachelor's degree (38,317 in 2015), followed by 12,405 completions in master's by course work degrees. However, the overall proportion that bachelor's degrees made up of all STEM degree completions declined, from 67 to 62 per cent, whereas the proportion of master's by coursework completions increased from 15 to 20 per cent of all STEM completions. Note that I have used the term 'PhD' throughout this chapter, but the Department's official nomenclature is 'doctorate by research'.

The distribution of graduates within the STEM fields of education altered considerably over the period, due specifically to the relative decline of Information Technology. In 2002, course completions in Information Technology were 39 per cent of the total, but by 2015, this proportion had declined to 22 per cent. Meanwhile, completions in the Natural and Physical Sciences increased from 30 to 39 per cent, and in Engineering, from 23 to 33 per cent. Agriculture, Environmental and Related Studies completions declined slightly as a proportion (from eight to seven per cent).

24 See http://highereducationstatistics.education.gov.au/DataNotes.aspx

Table 5.1 Course Completions: All Students by Course Level, 2002 & 2015

Broad Field of Education	Postgraduate				Undergraduate		Total	% Bachelor's
	PhD	Masters by Research	Masters by Coursework	Other PG	Bachelor's	Other UG		
2002								
STEM								
N&P Sciences	1,062	206	441	533	11,586	145	13,973	83%
IT	99	40	4,249	3,730	10,210	159	18,487	55%
Engineering	478	188	1,695	487	7,469	519	10,836	69%
Agriculture	222	76	475	301	2,358	488	3,898	60%
Sub-total	1,861	510	6,860	5,051	31,623	1,311	47,194	67%
STEM %	43%	33%	20%	17%	24%	26%	23%	
Non-STEM	2,430	1,041	27,338	23,836	100,809	3,729	159,183	63%
Total Completions	4,291	1,551	34,198	28,887	132,432	5,040	206,377	64%
Total Students	4,291	1,551	34,153	28,885	126,833	5,031	200,744	63%
2015								
N&P Sciences	1,907	311	1,734	876	18,589	598	24,015	77%
IT	326	32	4,967	657	6,248	1,135	13,365	47%
Engineering	1,258	229	4,748	1,009	11,117	1,728	20,089	55%
Agriculture	427	41	956	353	2,363	174	4,314	55%
Sub-total STEM	3,918	613	12,405	2,895	38,317	3,635	61,783	62%
STEM %	47%	37%	16%	7%	20%	18%	18%	
Non-STEM	4,448	1,063	62,928	36,329	150,763	17,115	272,646	55%
Total Completions	8,366	1,676	75,333	39,224	189,080	20,750	334,429	57%
Total Students	8,366	1,676	74,864	39,112	180,068	20,750	324,836	55%
Growth – No.								
N&P Sciences	845	105	1,293	343	7,003	453	10,042	70%
IT	227	-8	718	-3,073	-3,962	976	-5,122	77%
Engineering	780	41	3,053	522	3,648	1,209	9,253	39%
Agriculture	205	-35	481	52	5	-314	416	1%
Sub-total STEM	2,057	103	5,545	-2,156	6,694	2,324	14,589	46%
STEM %	50%	82%	13%	-21%	12%	15%	11%	
Non-STEM	2,018	22	35,590	12,493	49,954	13,386	113,463	44%
Total Completions	4,075	125	41,135	10,337	56,648	15,710	128,052	44%
Total Students	4,075	125	40,711	10,227	53,235	15,719	124,092	43%
Growth – %								
N&P Sciences	80%	51%	293%	64%	60%	312%	72%	
IT	229%	-20%	17%	-82%	-39%	614%	-28%	
Engineering	163%	22%	180%	107%	49%	233%	85%	
Agriculture	92%	-46%	101%	17%	0%	-64%	11%	
Sub-total STEM	111%	20%	81%	-43%	21%	177%	31%	
STEM %	116%	251%	67%	-119%	49%	57%	50%	
Non-STEM	83%	2%	130%	52%	50%	359%	71%	
Total Completions	95%	8%	120%	36%	43%	312%	62%	
Total Students	95%	8%	119%	35%	42%	312%	62%	

Source: The Department: Purchased Tables

The importance of the PhD in the STEM fields is clear from this table: in 2002, graduations in the STEM fields of education at the doctorate by research course level constituted 43 per cent of all graduations at this level in 2002, and the proportion had risen to 47 per cent by 2015.

Table 5.2 considers course completions by women. In 2002, the 16,236 female STEM course completers made up 14 per cent of all female course completers (i.e., 86 per cent of women completing courses were in non-STEM programmes), but this proportion declined to 11 per cent by 2015, during which year 20,731 STEM qualifications were awarded to women. Completions of STEM programmes overall show that 72 per cent of completions were at the bachelor's level, and this proportion declined to 66 per cent by 2015. However, there were variations within STEM fields. For example, in Natural and Physical Sciences, 78 per cent of completions by women were at the bachelor's level (down from 87 per cent in 2002). Proportions of completions at the bachelor's level were lower in the other fields of education. The proportion of completions at the bachelor's level in non-STEM fields in 2002 was 67 per cent, but this proportion declined to 57 per cent by 2015.

Table 5.2 also shows growth in completions between 2002 and 2015. Overall, 4,495 more women completed STEM programmes (+ 28 per cent), but there was a decline in Information Technology completions of 2,343 (- 47 per cent). These figures should be compared with the 72 per cent growth in qualifications in non-STEM fields.

Women increased their presence in PhD-level qualifications in STEM fields by 136 per cent overall, with a particularly enhanced showing in PhD completions in Engineering, Technology and Related Technologies (+ 235 completions; + 294 per cent.). There was also strong increase in Information Technology (+ 267 per cent), but numbers are lower than in the other STEM fields.

Table 5.2 Course Completions: Female Students by Course Level, 2002 & 2015

	PhD	Masters by Research	Masters by Coursework	Other PG	Bachelors	Other UG	Total	% Bachelor's
2002								
N&P Sciences	445	88	207	263	6,621	25	7,649	87%
IT	24	12	1,172	1,021	2,699	28	4,956	54%
Engineering	80	38	314	77	1,292	24	1,825	71%
Agriculture	99	34	217	136	1,153	167	1,806	64%
Sub-total STEM	648	172	1,910	1,497	11,765	244	16,236	72%
STEM %	34%	22%	12%	9%	15%	12%	14%	
Sub-total Non-STEM	1,261	610	13,920	14,570	66,142	1,822	98,325	67%
Total Completions	1,909	782	15,830	16,067	77,907	2,066	114,561	68%
Total Students	1,909	782	15,824	16,044	74,808	2,066	111,433	67%
2015								
N&P Sciences	930	140	881	414	9,720	330	12,415	78%
IT	88	15	1,127	182	1,040	161	2,613	40%
Engineering	315	84	924	190	1,762	199	3,474	51%
Agriculture	199	19	520	186	1,243	62	2,229	56%
Sub-total STEM	1,532	258	3,452	972	13,765	752	20,731	66%
STEM %	37%	29%	9%	4%	13%	7%	11%	
Sub-total Non-STEM	2,610	634	37,138	23,340	96,058	9,621	169,401	57%
Total Completions	4,142	892	40,590	24,312	109,823	10,373	190,132	58%
Total Students	4,142	892	40,338	24,242	104,875	10,373	184,862	57%
Growth – No.								
N&P Sciences	485	52	674	151	3,099	305	4,766	65%
IT	64	3	-45	-839	-1,659	133	-2,343	71%
Engineering	235	46	610	113	470	175	1,649	29%
Agriculture	100	-15	303	50	90	-105	423	21%
Sub-total STEM	884	86	1,542	-525	2,000	508	4,495	44%
STEM %	40%	78%	6%	-6%	6%	6%	6%	
Sub-total Non-STEM	1,349	24	23,218	8,770	29,916	7,799	71,076	42%
Total Completions	2,233	110	24,760	8,245	31,916	8,307	75,571	42%
Total Students	2,233	110	24,514	8,198	30,067	8,307	73,429	41%
Growth – %								
N&P Sciences	109%	59%	326%	57%	47%	1220%	62%	
IT	267%	25%	-4%	-82%	-61%	475%	-47%	
Engineering	294%	121%	194%	147%	36%	729%	90%	
Agriculture	101%	-44%	140%	37%	8%	-63%	23%	
Sub-total STEM	136%	50%	81%	-35%	17%	208%	28%	
Sub-total Non-STEM	107%	4%	167%	60%	45%	428%	72%	
Total Completions	117%	14%	156%	51%	41%	402%	66%	
Total Students	117%	14%	155%	51%	40%	402%	66%	

Source: The Department: Purchased Tables

Looking at course completions by male students, male STEM graduations made up 14 per cent of all male students completing courses in 2002, the same proportion as for women. (See Table 5.3, and cf. Table 5.2). The STEM proportion of all course completions doubled to 28 per cent by 2015. This situation should be compared with the relative decline of completions in STEM programmes by women. Growth overall between 2002 and 2015 represented 33 per cent, including growth in Natural and Physical Sciences completions and Engineering and Related Technologies completions of 83 and 84 per cent, respectively. The decline in Information Technology completions over the period kept the overall STEM increase lower than it would have been. There had been nearly 31,000 course completions in STEM fields in 2002, rising to just over 41,000 in 2015.

Completions in bachelor's degrees represented the majority course level, with the 19,858 STEM bachelor's degree completions representing 64 per cent of the 30,958 completions at all levels in 2002. The equivalent proportion in 2015 had declined to 60 per cent of all. The proportion of course completers at bachelor's level was greater in the Natural and Physical Sciences (79 per cent and 76 per cent of the total in 2002 and 2015, respectively), with lower proportions in the other STEM fields of education.

Table 5.3 Course Completions: Male Students by Course Level, 2002 & 2015

	PhD	Masters by Research	Masters by Coursework	Other PG	Bachelors	Other UG	Total	% Bachelor's
2002								
N&P Sciences	617	118	234	270	4,965	120	6,324	79%
IT	75	28	3,077	2,709	7,511	131	13,531	56%
Engineering	398	150	1,381	410	6,177	495	9,011	69%
Agriculture	123	42	258	165	1,205	321	2,092	58%
Sub-total STEM	**1,213**	**338**	**4,950**	**3,554**	**19,858**	**1,067**	**30,958**	**64%**
STEM %	34%	22%	12%	9%	15%	12%	14%	
Sub-total Non-STEM	**1,169**	**431**	**13,418**	**9,266**	**34,667**	**1,907**	**60,858**	**57%**
Total Completions	2,382	769	18,368	12,820	54,525	2,974	91,816	59%
Total Students	**2,382**	**769**	**18,329**	**12,841**	**52,025**	**2,965**	**89,311**	**58%**
2015								
N&P Sciences	977	171	853	462	8,869	268	11,600	76%
IT	238	17	3,840	475	5,208	974	10,752	48%
Engineering	943	145	3,824	819	9,355	1,529	16,615	56%
Agriculture	228	22	436	167	1,120	112	2,085	54%
Sub-total STEM	**2,386**	**355**	**8,953**	**1,923**	**24,552**	**2,883**	**41,052**	**60%**
STEM %	56%	45%	26%	13%	31%	28%	28%	
Sub-total Non-STEM	**1,838**	**429**	**25,790**	**12,989**	**54,705**	**7,494**	**103,245**	**53%**
Total Completions	4,224	784	34,743	14,912	79,257	10,377	144,297	55%
Total Students	**4,224**	**784**	**34,526**	**14,870**	**75,193**	**10,377**	**139,974**	**54%**
Growth – No.								
N&P Sciences	360	53	619	192	3,904	148	5,276	74%
IT	163	-11	763	-2,234	-2,303	843	-2,779	83%
Engineering	545	-5	2,443	409	3,178	1,034	7,604	42%
Agriculture	105	-20	178	2	-85	-209	-7	1214%
Sub-total STEM	**1,173**	**17**	**4,003**	**-1,631**	**4,694**	**1,816**	**10,094**	**47%**
STEM %	64%	113%	24%	-78%	19%	25%	19%	
Sub-total Non-STEM	**669**	**-2**	**12,372**	**3,723**	**20,038**	**5,587**	**42,387**	**47%**
Total Completions	1,842	15	16,375	2,092	24,732	7,403	52,481	47%
Total Students	**1,842**	**15**	**16,197**	**2,029**	**23,168**	**7,412**	**50,663**	**46%**
Growth – %								
N&P Sciences	58%	45%	265%	71%	79%	123%	83%	94%
IT	217%	-39%	25%	-82%	-31%	644%	-21%	149%
Engineering	137%	-3%	177%	100%	51%	209%	84%	61%
Agriculture	85%	-48%	69%	1%	-7%	-65%	0%	2108%
Sub-total STEM	**97%**	**5%**	**81%**	**-46%**	**24%**	**170%**	**33%**	**72%**
STEM %								
Sub-total Non-STEM	**57%**	**0%**	**92%**	**40%**	**58%**	**293%**	**70%**	**83%**
Total Completions	77%	2%	89%	16%	45%	249%	57%	79%
Total Students	**77%**	**2%**	**88%**	**16%**	**45%**	**250%**	**57%**	**79%**

Source: The Department: Purchased Tables

Table 5.4 provides scope for comparing the patterns of change in numbers of course completions

between women and men. This table shows numbers of completions for all students, and the proportion of these by women. System-wide, course completions by women in 2015 represented 57 per cent of all completions, but women represented 62 per cent of non-STEM course completions, and 34 per cent of STEM completions. This 62:34 split was also the case in 2002. Within STEM, women were responsible for 52 per cent of completions in the Natural and Physical Sciences and in Agriculture, Environmental and Related Studies, but only 20 per cent and 17 per cent of the completions in Information Technology and Engineering and Related Technologies, respectively.

Table 5.4 Course Completions: All Students and Female % by Course Level, 2002 & 2015

	PhD	Masters by Research	Masters by Coursework	Other PG	Bachelors	Other UG	Total
2002							
All Completions							
N&P Sciences	1,062	206	441	533	11,586	145	13,973
IT	99	40	4,249	3,730	10,210	159	18,487
Engineering	478	188	1,695	487	7,469	519	10,836
Agriculture	222	76	475	301	2,358	488	3,898
Sub-total STEM	1,861	510	6,860	5,051	31,623	1,311	47,194
Non-STEM	2,430	1,041	27,338	23,836	100,809	3,729	159,183
Total Completions	4,291	1,551	34,198	28,887	132,432	5,040	206,377
Female % of All							
N&P Sciences	42%	43%	47%	49%	57%	17%	55%
IT	24%	30%	28%	27%	26%	18%	27%
Engineering	17%	20%	19%	16%	17%	5%	17%
Agriculture	45%	45%	46%	45%	49%	34%	46%
Sub-total STEM	35%	34%	28%	30%	37%	19%	34%
Non-STEM	52%	59%	51%	61%	66%	49%	62%
Total Completions	44%	50%	46%	56%	59%	41%	56%
2015							
All Completions							
N&P Sciences	1,907	311	1,734	876	18,589	598	24,015
IT	326	32	4,967	657	6,248	1,135	13,365
Engineering	1,258	229	4,748	1,009	11,117	1,728	20,089
Agriculture	427	41	956	353	2,363	174	4,314
Sub-total STEM	3,918	613	12,405	2,895	38,317	3,635	61,783
Non-STEM	4,448	1,063	62,928	36,329	150,763	17,115	272,646
Total Completions	8,366	1,676	75,333	39,224	189,080	20,750	334,429
Female % of All							
N&P Sciences	49%	45%	51%	47%	52%	55%	52%
IT	27%	47%	23%	28%	17%	14%	20%
Engineering	25%	37%	19%	19%	16%	12%	17%
Agriculture	47%	46%	54%	53%	53%	36%	52%
Sub-total STEM	39%	42%	28%	34%	36%	21%	34%
Non-STEM	59%	60%	59%	64%	64%	56%	62%
Total Completions	50%	53%	54%	62%	58%	50%	57%

Source: The Department: Purchased Tables

Table 5.5 considers domestic students, a group which represented 79 per cent of all enrolments in 2002 and 74 per cent in 2015. Among domestic students in STEM programmes, 74 per cent completed bachelor's programmes in 2015, compared with 60 per cent of domestic students in non-STEM programmes. The comparative figures for overseas students were 41 and 44 per cent, respectively, in 2015 (see Table 5.5). Domestic students, therefore, are more likely to be pursuing bachelor's degree-level studies. Within the STEM fields, domestic students were more likely to have pursued bachelor's-level studies in the Natural

and Physical Sciences (82 per cent in 2015) than in the other STEM fields. Equivalent proportions for the other three STEM fields were 67 per cent in Information Technology, 66 per cent in Engineering and Related Technologies and 63 per cent in Agriculture, Environmental and Related Studies.

Growth in the number of STEM completions amounted to a 70 per cent increase (+ 6,462 completions, all levels), with variations within the STEM fields: Natural and Physical Sciences increased by 7,030, or 78 per cent; Engineering and Related Technologies increased by 3,859 completions, or 50 per cent. However, the number of completions in Information Technology and Agriculture, Environmental and Related Studies programmes declined over the period.

Table 5.5 Course Completions: Domestic Students by Course Level, 2002 & 2015

	PhD	Masters by Research	Masters by Coursework	Other PG	Bachelors	Other UG	Total	% Bachelor's
2002								
N&P Sciences	896	160	219	454	10,691	141	12,561	85%
IT	74	31	1,658	1,538	6,135	58	9,494	65%
Engineering	379	147	624	337	5,721	478	7,686	74%
Agriculture	175	49	229	245	2,298	477	3,473	66%
Sub-total STEM	1,524	387	2,730	2,574	24,845	1,154	33,214	75%
STEM %								
Non-STEM	2,105	903	14,401	20,799	82,235	3,341	123,784	66%
Total Completions	3,629	1,290	17,131	23,373	107,080	4,495	156,998	68%
Total Students	3,629	1,290	17,125	23,346	101,667	4,495	151,552	67%
2015								
N&P Sciences	1,186	228	802	784	16,147	444	19,591	82%
IT	146	20	840	428	3,539	344	5,317	67%
Engineering	602	108	1,543	849	7,634	809	11,545	66%
Agriculture	217	23	479	300	2,034	170	3,223	63%
Sub-total STEM	2,151	379	3,664	2,361	29,354	1,767	39,676	74%
STEM %								
Non-STEM	3,183	915	32,371	31,482	112,945	6,307	187,203	60%
Total Completions	5,334	1,294	36,035	33,843	142,299	8,074	226,879	63%
Total Students	5,334	1,294	35,870	33,735	133,622	8,073	217,928	61%
Growth – No.								
N&P Sciences	290	68	583	330	5,456	303	7,030	78%
IT	72	-11	-818	-1,110	-2,596	286	-4,177	62%
Engineering	223	-39	919	512	1,913	331	3,859	50%
Agriculture	42	-26	250	55	-264	-307	-250	106%
Sub-total STEM	627	-8	934	-213	4,509	613	6,462	70%
STEM %	37%	-200%	5%	-2%	13%	17%	9%	
Non-STEM	1,078	12	17,970	10,683	30,710	2,966	63,419	48%
Total Completions	1,705	4	18,904	10,470	35,219	3,579	69,881	50%
Total Students	1,705	4	18,745	10,389	31,955	3,578	66,376	48%
Growth – %								
N&P Sciences	32%	43%	266%	73%	51%	215%	56%	
IT	97%	-35%	-49%	-72%	-42%	493%	-44%	
Engineering	59%	-27%	147%	152%	33%	69%	50%	
Agriculture	24%	-53%	109%	22%	-11%	-64%	-7%	
Sub-total STEM	41%	-2%	34%	-8%	18%	53%	19%	
Non-STEM	51%	1%	125%	51%	37%	89%	51%	
Total Completions	47%	0%	110%	45%	33%	80%	45%	
Total Students	47%	0%	109%	45%	31%	80%	44%	

Source: The Department: Purchased Tables

Table 5.6 records course completions by overseas students. From Table 4.3, we know that overseas students now comprise over one-quarter of the students enrolled in Australian university courses, up from 20 per cent in 2002, and the number of overseas students almost doubled between 2002 and 2015. Therefore, there has also been considerable expansion in course completions by overseas students, with the total number increasing from 49,379 in 2002 to 107,550 in 2015. This is a growth rate of 118 per cent. Within the STEM fields, the growth was less spectacular, at 58 per cent.

Table 5.6 Course Completions: Overseas Students by Course Level, 2002 & 2015

	PhD	Masters by Research	Masters by Coursework	Other PG	Bachelors	Other UG	Total	% Bachelor's
2002								
N&P Sciences	166	46	222	79	895	4	1,412	63%
IT	25	9	2,591	2,192	4,075	101	8,993	45%
Engineering	99	41	1,071	150	1,748	41	3,150	55%
Agriculture	47	27	246	56	60	11	425	14%
Sub-total STEM	337	123	4,130	2,477	6,778	157	13,980	48%
STEM %								
Non-STEM	325	138	12,937	3,037	18,574	388	35,399	52%
Total Completions	662	261	17,067	5,514	25,352	545	49,379	51%
Total Students	662	261	17,028	5,539	25,166	536	49,192	51%
2015								
N&P Sciences	721	83	932	92	2,442	154	4,424	55%
IT	180	12	4,127	229	2,709	791	8,048	34%
Engineering	656	121	3,205	160	3,483	919	8,544	41%
Agriculture	210	18	477	53	329	4	1,091	30%
Sub-total STEM	1,767	234	8,741	534	8,963	1,868	22,107	41%
STEM %								
Non-STEM	1,265	148	30,557	4,847	37,818	10,808	85,443	44%
Total Completions	3,032	382	39,298	5,381	46,781	12,677	107,550	43%
Total Students	3,032	382	38,994	5,377	46,446	12,677	106,908	43%
Growth – No.								
N&P Sciences	555	37	710	13	1,547	150	3,012	51%
IT	155	3	1,536	-1,963	-1,366	690	-945	145%
Engineering	557	80	2,134	10	1,735	878	5,394	32%
Agriculture	163	-9	231	-3	269	-7	666	40%
Sub-total STEM	1,430	111	4,611	-1,943	2,185	1,711	8,127	27%
STEM %	60%	92%	21%	1461%	10%	14%	14%	
Non-STEM	940	10	17,620	1,810	19,244	10,420	50,044	38%
Total Completions	2,370	121	22,231	-133	21,429	12,131	58,171	37%
Total Students	2,370	121	21,966	-162	21,280	12,141	57,716	37%
Growth – %								
N&P Sciences	334%	80%	320%	16%	173%	3750%	213%	
IT	620%	33%	59%	-90%	-34%	683%	-11%	
Engineering	563%	195%	199%	7%	99%	2141%	171%	
Agriculture	347%	-33%	94%	-5%	448%	-64%	157%	
Sub-total STEM	424%	90%	112%	-78%	32%	1090%	58%	
STEM %								
Non-STEM	289%	7%	136%	60%	104%	2686%	141%	
Total Completions	358%	46%	130%	-2%	85%	2226%	118%	
Total Students	358%	46%	129%	-3%	85%	2265%	117%	

Source: The Department: Purchased Tables

Table 5.7 allows for comparison between changes among overseas and domestic students. It shows numbers of all completions in 2002 and 2015, and the proportion of these made up by overseas students. Overseas students produce a larger proportion of course completions than their overall presence among university enrolments would suggest. In recent years, overseas students have been about 26 per cent of enrolments, yet in 2015, they produced 32 per cent of all course completions. Within the STEM fields, they generated 36 per cent of all completions in 2015. The main reason for this is because they are more highly represented in shorter programmes, typically at the masters by coursework and other postgraduate levels. Within STEM fields, overseas students are also more highly represented at the PhD level.

Table 5.7 Course Completions: All Students and Overseas % by Course Level, 2002 & 2015

	PhD	Masters by Research	Masters by Coursework	Other PG	Bachelors	Other UG	Total
2002							
All Completions							
N&P Sciences	1,062	206	441	533	11,586	145	13,973
IT	99	40	4,249	3,730	10,210	159	18,487
Engineering	478	188	1,695	487	7,469	519	10,836
Agriculture	222	76	475	301	2,358	488	3,898
Sub-total STEM	1,861	510	6,860	5,051	31,623	1,311	47,194
Non-STEM	2,430	1,041	27,338	23,836	100,809	3,729	159,183
Total Completions	4,291	1,551	34,198	28,887	132,432	5,040	206,377
Overseas % of All							
N&P Sciences	16%	22%	50%	15%	8%	3%	10%
IT	25%	23%	61%	59%	40%	64%	49%
Engineering	21%	22%	63%	31%	23%	8%	29%
Agriculture	21%	36%	52%	19%	3%	2%	11%
Sub-total STEM	18%	24%	60%	49%	21%	12%	30%
Non-STEM	13%	13%	47%	13%	18%	10%	22%
Total Completions	15%	17%	50%	19%	19%	11%	24%
2015							
All Completions							
N&P Sciences	1,907	311	1,734	876	18,589	598	24,015
IT	326	32	4,967	657	6,248	1,135	13,365
Engineering	1,258	229	4,748	1,009	11,117	1,728	20,089
Agriculture	427	41	956	353	2,363	174	4,314
Sub-total STEM	3,918	613	12,405	2,895	38,317	3,635	61,783
Non-STEM	4,448	1,063	62,928	36,329	150,763	17,115	272,646
Total Completions	8,366	1,676	75,333	39,224	189,080	20,750	334,429
Overseas % of All							
N&P Sciences	38%	27%	54%	11%	13%	26%	18%
IT	55%	38%	83%	35%	43%	70%	60%
Engineering	52%	53%	68%	16%	31%	53%	43%
Agriculture	49%	44%	50%	15%	14%	2%	25%
Sub-total STEM	45%	38%	70%	18%	23%	51%	36%
Non-STEM	28%	14%	49%	13%	25%	63%	31%
Total Completions	36%	23%	52%	14%	25%	61%	32%

Source: The Department: Purchased Tables

Tables 5.8 to 5.11 show numbers of course completions by course level, by university, for each of the STEM fields of education. Table 5.8, for instance, presents these results for course completions for students enrolled in courses in the Natural and Physical Sciences, followed by equivalents for the other three STEM fields of education. Purchased tables were used, because neither the published tables available on-line, nor those that can be confected oneself via the uCube system, allow for PhDs, master's by research and master's by coursework completions to be shown separately.

The impact of the alleged threat to individual privacy is evident in these tables, with non-declaration of the actual figures for cells with fewer than five observations, and 'not published' ('np'). To explain (if such is necessary), taking the first row in Table 5.8, data for Charles Sturt University for 2015, the total number of completions (all levels) was 218, comprising 125 bachelor's degrees, 75 'other postgraduate' completions, and 13 master's by coursework completion. Two course levels produced fewer than five completions. Given that the missing observations total five, perhaps there were three completions at master's by research level, and two at other undergraduate level.

In other places, the Department's stealth programme has decided not to report (for example) the number of PhD graduations at the University of New England in 2015. On the basis of the numbers that we have been permitted to see, it can be discerned that there must have been between six and nine PhDs awarded that year. Given the nature of PhD awards, I fancy that if anyone could be bothered to do so, they could access freely-available information on the UNE website, to see exactly how many PhDs were awarded at ceremonies in 2015, and perhaps even their names and UNE affiliations. However, I digress. There is little point in providing much commentary on these tables. Surfeit it to say, it is possible to see which universities awarded qualifications in the STEM fields in 2002 and 2015, with detailed information provided for 2015.

Table 5.8 Course Completions: 2002 (Total) & 2015 by University & Course Level– All Students: Natural and Physical Sciences

	2002	2015								
	TOTAL	PhD	Masters by Research	Masters by Crswork	Other PG	Bachelor	Other UG	Total	Growth – No	Growth – %
NSW										
Charles Sturt	236	0	< 5	13	75	125	< 5	218	-18	-8%
Macquarie	233	78	100	101	27	347	0	653	420	180%
Southern Cross	10	< 5	0	11	< 5	70	< 5	88	78	780%
UNE	126	np	< 5	9	29	177	29	254	128	102%
Newcastle	325	44	< 5	np	< 5	264	0	318	-7	-2%
Sydney	1,017	112	11	63	23	1,025	0	1,234	217	21%
UNSW	693	120	31	68	21	1,153	0	1,393	700	101%
UTS	331	35	< 5	66	np	575	0	689	358	108%
Wollongong	309	80	np	30	< 5	297	0	423	114	37%
Western Sydney	325	44	< 5	< 5	< 5	536	48	636	311	96%
Private Providers	8	0	0	0	0	6	85	91	83	10,38%
Victoria										
Deakin	331	32	< 5	21	np	403	0	466	135	41%
Federation	64	6	0	0	67	99	0	172	108	169%
La Trobe	376	42	< 5	66	np	482	< 5	601	225	60%
Monash	1,068	271	11	44	6	1,652	0	1,984	916	86%
RMIT	359	39	< 5	175	np	399	23	644	285	79%
Swinburne	146	36	0	75	60	170	0	341	195	134%
Melbourne	1,442	104	13	247	168	2,401	37	2,970	1528	106%
Victoria	164	np	< 5	0	0	64	0	72	-92	-56%
Private Providers	0	0	0	0	0	< 5	np	236	236	

	2002 TOTAL	2015 PhD	Masters by Research	Masters by Crswork	Other PG	Bachelor	Other UG	Total	Growth – No	Growth – %
Queensland										
Bond	0	< 5	0	np	0	31	0	44	44	
CQU	116	10	< 5	0	0	41	np	61	-55	-47%
Griffith	273	20	0	18	11	525	0	574	301	110%
James Cook	355	45	6	104	32	279	8	474	119	34%
QUT	325	60	12	31	9	326	0	438	113	35%
Queensland	1,159	242	33	171	53	1,338	11	1,848	689	59%
USQ	243	5	< 5	7	58	144	< 5	218	-25	-10%
Sunshine Coast	64	6	0	0	0	113	14	133	69	108%
Private Providers	0	0	0	0	0	0	27	27	27	
WA										
Curtin	382	46	5	114	31	575	0	771	389	102%
Edith Cowan	115	< 5	< 5	< 5	20	114	0	141	26	23%
Murdoch	369	17	5	0	19	424	0	465	96	26%
Notre Dame	0	0	0	np	< 5	35	0	43	43	
UWA	560	71	17	94	43	2,311	21	2,557	1997	357%
Private Providers	0	0	0	0	0	0	0	0		
South Australia										
Flinders	346	32	< 5	30	np	316	0	399	53	15%
Adelaide	661	82	13	49	14	589	0	747	86	13%
UniSA	136	np	0	< 5	0	149	24	197	61	45%
Tasmania										
Tasmania	439	49	< 5	30	np	330	0	427	-12	-3%
Northern Territory										
Charles Darwin	65	9	0	0	0	51	6	66	1	2%
ACT										
ANU	667	118	np	63	12	502	< 5	707	40	6%
Canberra	118	9	< 5	np	23	137	8	184	66	56%
Private Providers	0	0	0	0	0	11	0	11	11	
Multi-State										
ACU	17	0	0	0	0	0	0	0	-17	-100%

Source: The Department: Purchased Tables

Table 5.9 Course Completions: 2002 (Total) & 2015 by University & Course Level– All Students: Information Technology

	2002 TOTAL	2015 PhD	Masters by Research	Masters by Crswork	Other PG	Bachelor	Other UG	Total	Growth – No	Growth – %
NSW										
Charles Sturt	493	0	0	475	118	152	0	745	252	51%
Macquarie	293	np	0	29	< 5	170	0	210	-83	-28%
Southern Cross	159	0	0	0	0	np	< 5	71	-88	-55%
UNE	60	< 5	0	11	< 5	26	0	42	-18	-30%
Newcastle	205	< 5	0	41	< 5	163	0	209	4	2%
Sydney	224	5	0	112	11	96	0	224	0	0%
UNSW	743	np	< 5	98	12	215	0	338	-405	-55%
UTS	920	30	0	231	44	321	12	638	-282	-31%
Wollongong	973	np	< 5	164	0	382	0	570	-403	-41%
Western Sydney	821	< 5	< 5	45	6	191	19	266	-555	-68%
Private Providers	< 5	0	0	0	0	160	239	399		

	2002 TOTAL	2015 PhD	Masters by Research	Masters by Crswork	Other PG	Bachelor	Other UG	Total	Growth – No	Growth – %
Victoria										
Deakin	407	np	< 5	199	21	245	0	480	73	18%
Federation	490	np	< 5	425	15	226	< 5	676	186	38%
La Trobe	232	np	0	205	< 5	102	0	318	86	37%
Monash	2,413	25	5	364	20	376	0	790	-1623	-67%
RMIT	944	16	0	212	8	477	73	786	-158	-17%
Swinburne	773	9	0	253	19	359	79	719	-54	-7%
Melbourne	433	21	< 5	368	9	< 5	np	406	-27	-6%
Victoria	705	< 5	0	168	np	64	166	426	-279	-40%
Private Providers	0	0	0	44	9	66	201	320	320	
Queensland										
Bond	< 5	< 5	0	0	0	np	< 5	8		
CQU	1,834	0	0	415	66	96	18	595	-1,239	-68%
Griffith	546	np	0	76	< 5	186	0	277	-269	-49%
James Cook	49	< 5	0	82	24	175	np	297	248	506%
QUT	1,276	42	8	275	22	441	38	826	-450	-35%
Queensland	279	12	< 5	78	19	172	< 5	286	7	3%
USQ	371	0	0	147	5	85	0	237	-134	-36%
Sunshine Coast	33	0	0	0	0	17	0	17	-16	-48%
Private Providers	0	0	0	0	0	0	79	79	79	
WA										
Curtin	378	np	< 5	73	54	32	0	169	-209	-55%
Edith Cowan	570	np	< 5	72	21	128	0	230	-340	-60%
Murdoch	210	6	0	26	7	310	0	349	139	66%
Notre Dame	< 5	0	0	0	0	0	0	0		
UWA	181	6	0	0	0	16	0	22	-159	-88%
Private Providers	0	0	0	0	0	0	66	66	66	
South Australia										
Flinders	92	< 5	0	np	0	59	0	76	-16	-17%
Adelaide	86	7	< 5	36	< 5	92	0	141	55	64%
UniSA	400	np	0	62	38	134	< 5	246	-154	-39%
	0	0	0	13	0	0	61	74	74	
Tasmania									0	
Tasmania	258	< 5	0	28	np	186	0	226	-32	-12%
Northern Territory									0	
Charles Darwin	72	< 5	0	9	0	27	< 5	40	-32	-44%
ACT									0	
ANU	105	0	0	39	6	60	0	105	0	0%
Canberra	316	np	< 5	69	51	143	38	315	-1	0%
Private Providers	0	0	0	0	0	< 5	0	< 5		
Multi-State										
ACU	137	0	0	np	< 5	21	17	49	-88	-64%

Source: The Department: Purchased Tables

Table 5.10 Course Completions: 2002 (Total) & 2015 by University & Course Level All Students: Engineering & Related Technologies

	2002	2015								
	TOTAL	PhD	Masters by Research	Masters by Crswork	Other PG	Bachelor	Other UG	Total	Growth – No	Growth – %
NSW										
Charles Sturt	20	0	0	< 5	0	0	0	< 5		
Macquarie	15	11	0	12	0	18	0	41	26	173%
Southern Cross	< 5	0	0	0	0	0	0	0		
UNE	11	0	0	< 5	0	np	0	6	-5	-45%
Newcastle	251	32	7	47	14	311	0	411	160	64%
Sydney	422	83	27	336	13	571	0	1,030	608	144%
UNSW	1,656	185	26	811	94	1,224	0	2,340	684	41%
UTS	402	50	16	248	68	472	0	854	452	112%
Wollongong	269	54	13	166	np	335	< 5	576	307	114%
Western Sydney	383	np	< 5	26	30	153	22	242	-141	-37%
Private Providers	8	0	0	0	0	0	284	284	276	3,450%
Victoria									0	
Deakin	179	np	< 5	165	0	153	0	356	177	99%
Federation	60	0	0	64	93	34	0	191	131	218%
La Trobe	54	6	0	104	0	60	0	170	116	215%
Monash	643	117	30	98	8	825	0	1,078	435	68%
RMIT	815	66	np	271	< 5	1,170	277	1,802	987	121%
Swinburne	485	24	16	274	90	613	142	1,159	674	139%
Melbourne	785	65	np	763	< 5	46	0	884	99	13%
Victoria	148	14	< 5	< 5	< 5	84	0	105	-43	-29%
Private Providers	0	0	0	9	0	6	204	219	219	
Queensland										
CQU	118	< 5	< 5	6	101	63	39	213	95	81%
Griffith	230	24	0	141	19	344	0	528	298	130%
James Cook	93	np	< 5	0	0	90	12	108	15	16%
QUT	573	54	15	50	14	581	0	714	141	25%
Queensland	569	135	8	165	31	740	0	1,079	510	90%
USQ	313	np	< 5	88	26	280	189	602	289	92%
Sunshine Coast	0	< 5	0	np	0	32	0	40	40	
Private Providers	0	0	0	0	0	0	192	192	192	
WA										
Curtin	449	49	9	228	109	877	0	1,272	823	183%
Edith Cowan	45	np	< 5	86	14	129	0	245	200	444%
Murdoch	40	< 5	< 5	12	25	42	0	84	44	110%
Notre Dame	0	0	0	0	0	0	0	0	0	
UWA	367	51	< 5	167	np	389	0	626	259	71%
Private Providers	0	0	0	0	0	0	208	208	208	
South Australia										
Flinders	54	< 5	< 5	15	14	49	0	83	29	54%
Adelaide	385	53	10	165	19	610	0	857	472	123%
UniSA	316	37	< 5	159	120	372	np	706	390	123%
Private Providers	0	0	0	13	8	0	113	134	134	
Tasmania										
Tasmania	537	11	0	5	70	253	6	345	-192	-36%
Northern Territory									0	
Charles Darwin	11	0	0	8	0	30	15	53	42	382%

	2002 TOTAL	2015 PhD	Masters by Research	Masters by Crswork	Other PG	Bachelor	Other UG	Total	Growth – No	Growth – %
ACT										
ANU	104	49	< 5	35	0	156	np	251	147	141%
Canberra	22	0	0	0	0	0	0	0	-22	-100%

Source: The Department: Purchased Tables

Table 5.11 Course Completions: 2002 (Total) & 2015 by University & Course Level All Students: Agriculture, Environmental and Related Studies

	2002 TOTAL	2015 PhD	Masters by Research	Masters by Crswork	Other PG	Bachelor	Other UG	Total	Growth – No	Growth –- %
NSW										
Charles Sturt	238	30	< 5	40	22	178	np	279	41	17%
Macquarie	111	0	0	59	8	25	0	92	-19	-17%
Southern Cross	130	np	< 5	6	< 5	84	15	113	-17	-13%
UNE	175	24	< 5	57	33	88	np	211	36	21%
Newcastle	70	6	< 5	23	6	80	0	116	46	66%
Sydney	205	22	< 5	48	np	24	0	105	-100	-49%
UNSW	70	< 5	0	32	11	< 5	0	47	-23	-33%
UTS	32	0	0	12	0	27	0	39	7	22%
Western Sydney	127	0	< 5	0	0	np	0	35	-92	-72%
Victoria										
Deakin	128	0	0	0	6	149	0	155	27	21%
Federation	0	0	0	0	0	0	0	0	0	
La Trobe	110	10	0	0	0	87	0	97	-13	-12%
Monash	53	< 5	< 5	31	< 5	32	0	69	16	30%
RMIT	39	0	0	29	0	60	0	89	50	128%
Melbourne	341	31	5	235	80	624	28	1,003	662	194%
Victoria	14	0	0	0	0	0	0	0	-14	-100%
Private Providers	21	0	0	0	6	39	103	148	127	605%
Queensland										
Bond	0	< 5	0	11	< 5	13	< 5	28	28	
CQU	60	< 5	0	< 5	np	22	0	35	-25	-42%
Griffith	144	38	0	41	5	55	0	139	-5	-3%
James Cook	36	22	np	0	< 5	20	0	50	14	39%
QUT	22	0	0	0	0	0	0	0	-22	-100%
Queensland	586	43	< 5	93	42	204	np	392	-194	-33%
Sunshine Coast	45	< 5	< 5	< 5	8	52	0	67	22	49%
WA										
Curtin	106	8	< 5	0	< 5	15	< 5	30		-72%
Edith Cowan	49	6	< 5	< 5	11	14	0	36	-13	-27%
Murdoch	137	< 5	< 5	9	24	73	0	111	-26	-19%
Notre Dame	8	0	0	< 5	0	0	0	< 5		
UWA	95	61	np	46	< 5	18	0	131	36	38%
South Australia										
Flinders	86	0	0	np	< 5	28	0	52	-34	-40%
Adelaide	246	42	< 5	23	14	135	< 5	219	-27	-11%
UniSA	52	np	< 5	16	0	32	0	60	8	15%

	2002 TOTAL	2015 PhD	Masters by Research	Masters by Crswork	Other PG	Bachelor	Other UG	Total	Growth – No	Growth –- %
Tasmania										
Tasmania	206	21	< 5	31	18	56	< 5	132	-74	-36%
Northern Territory										
Charles Darwin	6	np	0	< 5	< 5	14	0	24	18	300%
ACT										
ANU	130	22	0	80	24	43	0	169	39	30%
Canberra	0	0	0	0	0	17	0	17	17	
Multi-State										
ACU	18	< 5	0	0	0	np	< 5	21	3	17%

Source: The Department: Purchased Tables

Earlier in this text, and in earlier examinations of science enrolments, student load and course completions, I noted that Australian higher education institutions have an extensive list of narrow and detailed fields of education. However, the existence of this list does not necessarily assist in providing additional detailed information about what qualifications students are ending up with. There are two main reasons for this. First, some courses, particularly at the bachelor's level, are generic in nature, and it is not easy to classify them to a narrow or detailed level. For example, students in BSc degrees tend to start with a broad spread of subjects, before narrowing their focus somewhat by final year. For such courses, it is not possible to classify the situation below the Broad Field of Education 'Natural and Physical Sciences'. However, by the time students are completing PhD-level qualifications, one might have expected that the ensuing degree would be highly specialised.

Table 5.12 shows course completions at the PhD level in 2015 in the Natural and Physical Sciences field of education. There are five options at the 'narrow' field of education classification, with the category '0199 Other Natural and Physical Sciences'. This category comprises individual detailed fields of education in Medical Science; Forensic Science; Food Science and Biotechnology; Pharmacology; plus Natural and Physical Sciences 'not elsewhere classified'. It would seem that some universities are not very specific in how they could their course completions, with Go8 members Monash and the University of Western Australia standing out, and among other universities, perhaps Western Sydney University. In 2015, Monash, it would seem, graduated 167 PhD biologists and fewer than five mathematicians, but reported no PhDs in physics, chemistry or earth sciences. However, they did graduate 100 'Other Natural and Physical Sciences' PhDs. UWA produced 70 in this catch-all category, and <5 earth scientists.

Perhaps the main 'problem' with this lack of specificity by universities is that if any agency, national or international, asks, for example, 'how many PhDs were awarded in Chemical Sciences in 2015', the answer from the Department will likely be '226'. However, this answer will underestimate the real number to the extent that there has been non-specific reporting by universities.

The 'Total' column shows the numerical total of that column, but the narrow field of education columns are 'estimates' based on the likely value of the '< 5' cells. Sometimes it is obvious what the cell values are.

Table 5.12 Course Completions: PhD Students by Narrow Field of Education, by University, Natural and Physical Sciences, 2015. Ranked by No. of PhDs Awarded

	0101 Mathematical Sciences	0103 Physics & Astronomy	0105 Chemical Sciences	0107 Earth Sciences	0109 Biological Sciences	0199 Other Natural & Physical Sciences	Sub-Total
Monash	< 5				167	100	271
Queensland	9	11	11	12	131	69	243
UNSW	10	14	24	12	37	23	122
ANU	5	28	19	17	33	16	118
Sydney	9	28	19	7	36	13	112
Melbourne	11	9	20	7	48	5	104
Adelaide	< 5	7	8	10	54		82
Wollongong	10	18	23	8	21		80
Macquarie	8	14	15	20	21		78
UWA				< 5		70	71
QUT	15					45	60
Tasmania	< 5	9	6	< 5	26	5	50
Curtin	5		12	6	11	12	46
James Cook	< 5	< 5	< 5	< 5	36	-	45
Newcastle	9	< 5	9		16	7	44
W. Sydney					< 5	43	44
La Trobe	< 5	< 5	< 5		36	-	42
RMIT	< 5	< 5	5		26	< 5	39
Swinburne	< 5	8	5		-	19	36
UTS	< 5		32		< 5	-	35
Deakin			-		20	12	32
Flinders		< 5	9	< 5	18	-	32
UniSA	< 5	-	5		-	17	23
Griffith					6	14	20
Murdoch	< 5	< 5			13	< 5	17
CQU					5	5	10
C. Darwin				< 5	5	< 5	9
Canberra						9	9
UNE						7	7
Federation	< 5				5	-	6
Victoria		< 5				< 5	6
Sun. Coast					< 5	< 5	6
USQ	< 5	< 5			< 5	-	5
Total							
Estimated Total	113	162	226	109	787	498	1904

Source: The Department: Purchased Tables
Note: A total of 84 course completions are included in the cells marked as < 5.

Numbers of PhD graduation in Information Technology are many fewer than in the Natural and Physical Sciences, with 301 PhDs having been awarded in 2015. Many of us are perhaps uncertain about the differences between 'computer science' and 'information systems', not to mention 'other Information Technology'. Monash, Griffith and Federation Universities awarded information technology PhDs in this third category.

Table 5.13 Course Completions: PhD Students by Narrow Field of Education, by University, Information Technology, 2015. Ranked by No. of PhDs Awarded

	0201 Computer Science	0203 Information Systems	0299 Other IT	Total
QUT	-	42	-	42
UTS	30	-	-	30
Monash	-	-	25	25
Melbourne	21	-	-	21
Wollongong	11	10	-	21
RMIT	16	-	-	16
Deakin	14	-	-	14
Canberra	-	12	< 5	13
UQ	9	< 5	< 5	12
UNSW	8	< 5	-	11
UniSA	10	< 5	-	11
Griffith	-	-	11	11
Curtin	< 5	5	-	9
La Trobe	9	-	-	9
Swinburne	7	< 5	-	9
Macquarie	8	-	-	8
Federation	-	-	8	8
Edith	5	-	< 5	7
Adelaide	7	-	-	7
UWA	6	-	-	6
Murdoch	-	-	-	6
Sydney	< 5	-	< 5	5
Estimated Total	168	80	53	301

Source: The Department: Purchased Tables
Note: A total of 27 course completions are included in the cells marked as < 5.

In the case of Engineering, the University of New South Wales is the most prolific producer of PhD graduates in Engineering and Related Technologies, followed by the University of Queensland and Monash University. Monash, it would seem, graduated 108 chemical engineers, and another nine in fields of education other than the ones specified. See Table 5.14.

Table 5.14 Course Completions: PhD Students by Narrow Field of Education, by University, Engineering and Related Technologies, 2015. Ranked by No. of PhDs Awarded

	0303 Process	0307 Mechanical	0309 Civil	0311 Geomatic	0313 Electrical	0315 Aerospace	0399 Other Engineering	Total
2015								
UNSW	34	29	33	< 5	74	< 5	8	185
U Q	55	15	12	10	7	< 5	33	135
Monash	108	-	-	-	-	-	9	117
Sydney	18	18	14	-	25	-	6	83
RMIT	< 5	26	< 5	< 5	17	13	< 5	66
Melbourne	15	13	14	8	14	-	-	65
Adelaide	19	8	14	< 5	11	-	< 5	54
Wollongong	-	24	11	-	19	-	-	54
QUT	-	-	-	-	54	-	-	54
UWA	-	16	20	-	9	-	6	51
UTS	-	-	48	-	< 5	-	-	50
ANU	49	-	-	-	-	-	-	49

	0303 Process	0307 Mechanical	0309 Civil	0311 Geomatic	0313 Electrical	0315 Aerospace	0399 Other Engineering	Total
Curtin	19	< 5	14	< 5	10	-	-	49
UniSA	17	6	6	-	8	-	-	37
Deakin	-	-	35	-	-	-	-	35
Newcastle	12	6	6	-	6	-	< 5	32
Swinburne	< 5	6	6	-	< 5	-	7	24
Griffith	-	-	24	-	-	-	-	24
USQ	-	-	18	-	-	-	-	18
Victoria U	< 5	-	< 5	-	11	-	-	14
Edith Cowan	-	-	-	-	12	-	-	12
Macquarie	-	-	-	-	11	-	-	11
Tasmania#	-	< 5	-	< 5	-	-	-	11
WSU	7	-	-	-	-	-	-	7
La Trobe	-	-	-	-	6	-	-	6
James Cook	< 5	-	< 5	-	< 5	-	-	5
Estimated Total	362	173	285	32	300	19	77	1,248

Source: The Department: Purchased Tables
Note: A total of 54 course completions are included in the cells marked as < 5.
UTas total includes five completions in 0317 Maritime Engineering, which has been left out of the tables for reasons of space.

Finally, in 2015, the system produced 410 PhD graduates, in the Agriculture, Environmental and Related Studies, with the most coming from the University of Western Australia. All of these were in Agriculture. Griffith University, the Australian National University and James Cook University produced the most PhD graduates in Environmental Studies.

Table 5.15 Course Completions: PhD Students by Narrow Field of Education, by University, Agriculture, Environmental and Related Studies, 2015. Ranked by No. of PhDs Awarded

	0501 Agriculture	0505 Forestry	0507 Fisheries	0509 Environ	0599 Other Agric / Env	Total
2015						
UWA	61					61
UQ	42			< 5		43
Adelaide	41			< 5		42
Griffith	-			38		38
Melbourne	20	11				31
Charles Sturt	< 5				26	30
UNE					24	24
ANU				22	-	22
Sydney	19			< 5	< 5	22
James Cook			6	16		22
UTasmania	11		6		< 5	21
UniSA				11		11
La Trobe	9				< 5	10
Curtin	< 5				6	8
Charles Darwin				7		7
Southern Cross				6		6
Edith Cowan				6		6
Newcastle				6		6
Estimated Total	209	11	12	116	62	410

Source: The Department: Purchased Tables
Note: A total of 16 course completions are included in the cells marked as < 5.

Students enrolled in a Course leading to provisional registration as a medical practitioner

The final aspect of course completions covered in this chapter relates to students enrolled in a course leading to provisional registration as a medical practitioner. This cohort was also examined in the third and fourth chapters in the context of enrolment and student load patterns, respectively.

Table 5.16 is a composite table that shows the number of completions by course level, gender and citizenship status. Between 2002 and 2015, the number of medical practitioner course completions increased by 163 per cent, from 1,420 to 3,733. The first medical practitioners to graduate with a postgraduate qualification occurred in 2013 (Flinders University), followed by the University of Melbourne, Griffith University and ANU from 2014. In 2015, 682 (18 per cent) of total completions in this cohort graduated with a postgraduate qualification. The other 15 universities seem to have stayed with the 'traditional' undergraduate system providing training for registration as medical practitioners[25].

The gender distribution over the period has seen just more half of medical practitioner graduates being women. In line with the overall proportionate growth in Overseas students, their proportion increased from 11 per cent in 2002, to 19 per cent in 2015.

Table 5.16 Course Completions: Students enrolled in a Course leading to provisional registration as a medical practitioner, by Course Level, Gender and Citizenship Status 2002 – 2015

	2002 No.	2007 No.	2012 No.	2015 No.	Growth No.	Growth %
Postgraduate				682	682	
Undergraduate	1,420	1,867	3,142	3,051	1,631	115%
Postgraduate %				18%	29%	
Male	705	839	1,453	1,824	1,119	159%
Female	715	1,028	1,689	1,909	1,194	167%
Female %	50%	55%	54%	51%	52%	
Domestic	1,259	1,552	2,582	3,042	1,783	142%
Overseas	161	315	560	691	530	329%
Overseas %	11%	17%	18%	19%	23%	
Total	1,420	1,867	3,142	3,733	2,313	163%

Source: The Department. uCube

Table 5.17 presents a summary of medical practitioner graduations by university, ranked according to the number of completions in 2015. That year, Monash graduated 502 medical practitioners, a number that was 216 per cent larger than the number of completions in 2002. The next-largest university in this context was the University of Queensland, which had produced many more graduates than Monash in 2002. The Universities of Melbourne, Sydney and New South Wales were the next in line.

25 These figures can be accessed via uCube at http://highereducationstatistics.education.gov.au/ Users need to filter for <Special Course = 3> and <Level of Course = Postgraduate>

Table 5.17 Course Completions: Students enrolled in a Course leading to provisional registration as a medical practitioner, by Institution (ranked), 2002 – 2015

	2002 No.	2007 No.	2012 No.	2015 No.	Growth No.	Growth %
Monash	159	179	446	502	343	216%
Queensland	219	314	395	489	270	123%
Melbourne	212	267	308	328	116	55%
Sydney	200	246	292	285	85	43%
UNSW	180	207	221	280	100	56%
UWA	116	134	184	222	106	91%
Notre Dame			206	193	193	
James Cook		67	96	174	174	
Adelaide	106	125	131	169	63	59%
Griffith				147	147	
Flinders	79	104	128	145	66	84%
Newcastle	81	81	119	133	52	64%
Deakin			128	128	128	
Western Sydney			96	116	116	
Tasmania	68	70	113	102	34	50%
Wollongong			73	85	85	
ANU		73	93	83	83	
Bond			69	78	78	
UNE			44	74	74	
Total	1,420	1,867	3,142	3,733	2,313	163%

Source: The Department. uCube

Finally, Table 5.18 looks at an aspect of the 'medical practitioner labour force' issue, by comparing the number of domestic graduations by state / territory. New South Wales universities produced 26 per cent of medical practitioner graduates in 2015, but that state contains 30 per cent of the Australian Population. There is a smaller mismatch in Victoria. However, Queensland, Western Australia, South Australia and the ACT all produce a slightly higher proportion of the medical practitioner course completers than reflected in their state-based populations. The Northern Territory does not have a medical school.

Table 5.18 Course Completions: Domestic Students enrolled in a Course leading to provisional registration as a medical practitioner, by State / Territory, 2002 – 2015

	2002 No.	2007 No.	2012 No.	2015 No.	2015 %	Population No.	Population %
New South Wales	408	451	722	800	26%	7,861.1	32%
Victoria	329	322	644	751	25%	6,323.6	26%
Queensland	219	360	439	673	22%	4,928.5	20%
Western Australia	110	130	371	386	13%	2,580.4	10%
South Australia	136	162	222	272	9%	1,723.5	7%
Tasmania	57	57	99	82	3%	520.9	2%
ACT	0	70	85	78	3%	410.3	2%
N Territory						246.1	1%
Total	1,259	1,552	2,582	3,042	100%	24,598.9	100%

Source: Completions – The Department. uCube
Population – Australian Bureau of Statistics. http://www.abs.gov.au/AUSSTATS/abs@.nsf/mf/3101.0

6. Conclusion

This century has seen radical changes in Australian higher education, and these have been described in the text. However, a brief recap is in order. The principal aim of this study was to undertake a detailed examination of patterns of participation in the so-called STEM fields of education of science, technology, engineering and mathematics, and the arrangement of Australian higher education makes this a feasible objective. Additional material on teaching to students in Health and Society and Culture courses has also been included, but it is less easy to map changes for programmes that cannot be defined according to a 'broad' Field of Education. Whereas we can be fairly certain about what is being measured in in the broad Field of Education Engineering and Related Technologies, this is not the case within broad Field of Education Health, which in addition to 'medicine', also includes nursing, dental science, veterinary science, various health therapies, and even 'complementary medicine'. However, by using the 'special course' variable in the statistical collection, some information has been provided about 'students enrolled in a course leading to provisional registration as a medical practitioner', one of the 'special courses' identified in the collection.

This study has provided information about university enrolments, student load and course completions from 2002 to 2015, and some of the broad trends have been reiterated below. However, analysts and policy also need to be aware that changes that could easily be missed have changed the scope of what the statistics mean. These issues were laid out in the introduction and have been mentioned again at various places in the text.

Looking at overall patterns in the 21st century, STEM enrolments (at all levels) declined as a proportion from 24 per cent (2002) to 20 per cent (2015). Within this overall relative decline in STEM enrolments, there has been growth of about 46,000 students in courses in the Natural and Physical Sciences, and 45,000 in Engineering and Related Technologies. The numerical growth in these two fields of education was counteracted in part by the apparent steady-state situation in Agriculture, Environmental and Related Studies programmes, and a decline of over 18,000 enrolments in courses in Information Technology. Overall, there were nearly 73,000 more enrolments in STEM programmes in 2015 cf. 2002, but this figure must be compared with increases in Management and Commerce (+129,000), Health (+124,000), and Society and Culture (+112,000). Growth in STEM enrolments was 32 per cent, compared with 66 per cent in non-STEM fields.

Women became the majority of the university population during the 1980s. Women have tended to be more common in the non-STEM fields of education, but by 2015, they made up about half of enrolments in Natural and Physical Sciences and Agriculture, Environmental and Related Studies, but their presence in Engineering and Related Technologies (17 per cent) and Information Technology (19 per cent) was the lowest of any fields of education.

Overseas student numbers have been on a quite steep growth trajectory for many years, but particularly this century. In the 21st century, growth in overseas student enrolments increased from over 185,000 to over 363,000 enrolments (+178,045, or 96 per cent) between 2002 and 2015. In doing so, overseas students' proportion of all enrolments increased from 21 per cent to 26 per cent. The proportion had reached as high as 27 per cent in 2007.

Within the STEM fields of education, both overseas and domestic students increased their number by more than 36,000 between 2002 and 2015. However, the proportion of overseas students increased from 24 per cent in 2002 per cent to 30 per cent in 2015. Overseas students in non-STEM fields of education increased their proportion from 18 per cent to 23 per cent over the period. Growth in overseas students

was strongest in Engineering and Related Technologies, in which the rate of growth was about 180 per cent, and these students increased their presence from 22 to 36 per cent over the period.

The largest purveyor of STEM training among Australian universities was the University of New South Wales in both 2002 and 2015. The other major STEM players are the Universities of Melbourne, Queensland and Sydney, as well as Monash University and RMIT. Adding to these universities UTS and Curtin University of Technology, Australia had nine universities with more than 10,000 STEM students in 2015.

Another enrolment trend has seen the proportion of enrolments in undergraduate degrees decline, and an increase in the proportion of students in 'other postgraduate' courses. This decline was less in the Natural and Physical Sciences than in other fields of education, and part of the reason for this could be the impact of the new 'graduate school' arrangements at the Universities of Melbourne and Western Australia, which added about 3,000 new enrolments in the Natural and Physical Sciences, matched by compensating declines in bachelor's degree enrolments in the other STEM fields of education, as well as other areas from outside the STEM fields, such as medicine, and in Melbourne's case, Architecture and Building.

The broad patterns with university enrolments described above have been replicated by the number of students eventually completing the university qualification they were enrolled in. Of course, the patterns with course completions is that they lag behind enrolment patterns.

Despite the relatively comprehensive coverage provided by the Department's on-line table-building uCube system, one area that uCube does not shed light is how the composition of study programmes changes over time. For example, uCube will not allow the analyst to see how the composition of (say) bachelor's degrees in the Natural and Physical Sciences has changed. Nor can this information be gleaned by referring to tables published by the Department, because such information is simply not provided in those tables. Therefore, purchasing custom-made tables is the only way to see, for example, the changes in the composition of bachelor's degrees. In a nutshell, uCube permits one to see changes in the amount of teaching over time at the Broad Discipline Group level, but not which students are studying those disciplines. Similarly, uCube provides no insights at the *Narrow* Discipline Group level, although the Department does publish a few tables that show the amount of teaching at the narrow discipline group level.[26]

Although useful, such tables do not show how the composition of courses in 'science' (or any other field of education) has changed over time. Earlier studies showed that the content of the average 'science' degree had changed[27], and in particular, the relative decline in the 'enabling sciences' of chemistry, mathematics and physics was noted. Looking at bachelor's degrees in the Natural and Physical Sciences in the 21st century, such relative declines are still evident. As Table 4.10 of this study revealed, although Mathematical Sciences teaching represented ten per cent of the teaching to 'bachelor of science' students in both 2002 and 2015, teaching in the Chemical Sciences declined from 11 per cent to nine per cent, and in Physics and Astronomy from five per cent to four per cent.

Although comparisons back to 1989, when the first study for the ACDS was undertaken, would be interesting, they can be at best imperfect. Since 1989, major changes have occurred in the way courses

26 See, for example, Table 4.4: Actual Student Load (EFTSL) for All Students by Narrow Discipline Group and Broad Level of Course, Full Year 2015, downloadable from the Department's website.

27 See Dobson, I. & Calderon, A. (1999). Trends in Science Education: Learning teaching and outcomes 1989 – 1997. ACDS. ISBN 0-7326-2104-6; Dobson, I. (2003). Science at the crossroads? A study of trends in university science from Dawkins to now 1989 – 2002. ACDS. ISBN 0-7326-2250-6.

Dobson, I. (2007). Sustaining science: University science in the twenty-first century. ACDS. ISBN 978-0-9803939-0-3.

and subjects were aggregated, and the methodology for counting students changed. For instance, a student undertaking a 'science' degree with majors in computer science in 1989 would have enrolled in a degree in the field of education 'Information Technology' since 2001, so no perfect mapping of the current fields of education and their precursors is possible. However, by 'finessing' the figures in Tables 48 and 49 (see footnote 27 Dobson & Calderon, 1999) and data from this century, it would seem that the proportion of a 'science/IT' degree that comprised mathematics was 17 per cent, and by 2015, it was nine per cent. Equivalent figures for the disciplines of chemistry (12 per cent / seven per cent), physics (seven per cent / three per cent) and biology (20 per cent / 23 per cent). At the same time, 'computer science / IT represented 19 per cent in 1989 and 20 per cent in 2015, but had been 33 per cent in 2002, at the height of the IT university enrolments boom. Meanwhile, 'other sciences' increased from about 10 per cent to 13 per cent, and non-sciences increased from 16 per cent to 26 per cent.

These figures have been contrived by adding enrolments in Information Technology degrees and Natural and Physical Sciences degrees, but further imperfections arise from such things as 'environmental science' students in 1989 would have enrolled in a degree in Agriculture, Environmental and Related Studies from 2001.

Concentrating again on the 21st century, there are marked differences between what men and women study in their bachelor's degree in the Natural and Physical Sciences. Although there are close-to equal numbers of men and women in these degrees, the 'average science degree' for female and male students varies, with male students being more likely to undertake subjects in Mathematical Sciences, and Physics and Astronomy, and both genders have shown a similar propensity to take subjects in the Chemical Sciences. Women are more likely to be taking subjects in Biological Sciences and Other Natural and Physical Sciences, not to mention non-STEM subjects. Men are more likely to take subjects in Information Technology and Engineering and Related Technologies. A point of interest should be that the relative uptake of Mathematical Sciences stayed the same for both women and men between 2002 and 2015, but there were small declines in Physics and Astronomy and Chemical Sciences for both genders, and also a decline in taking Biological Sciences subjects. Growth occurred in subjects in Other Natural and Physical Sciences, but the proportion represented by other STEM subjects and non-STEM subjects did not change.

Looking at domestic and overseas students, the pattern has been that there is little difference between the subjects that these two groups of students undertake. There were small changes between 2002 and 2015, with the largest change for both domestic and overseas students was a relative decline in the Biological Sciences.

An additional factor that ought to be considered when reading a volume such as this one relates to the consistency of the statistics analysed. Although Australian higher education statistics are based on a detailed data element dictionary, there is scope for the data to be reported inadequately or even incorrectly. Examples have been mentioned in the text as the came to light, such as when universities have described course completions more broadly than they should have. For example, in some places, PhD completions have been described simply as 'Natural and Physical Sciences', rather than at the Narrow Field of Education groupings such as 'Mathematical Sciences' or 'Physics and Astronomy' (etc.).

Another game changer in how one should interpret Australian university statistics has been the so-called Melbourne Model and the subsequent 'UWA Model'. Perhaps there are good reasons for adopting a version of the European Bologna system of course structures, or even the US-style graduate school model, and for their own reasons, two out of Australia's 38 universities decided it was a good idea to do so. One of the ways in which these models have the capacity to perturb university enrolment patterns a student seeking to qualify for professions such as engineering and architecture, will now

generate two commencing enrolments rather than the single enrolment to qualify in years before these models were introduced. A student who would have qualified with a BE degree after their four years' study, is now required to commence a "master's" degree before being qualified to operate as a jobbing engineer. It also seems that many students will take an extra year before they are considered job-ready and may have paid some additional fees to boot.

Related to the introduction of the Melbourne Model is the fact that many of students who formerly enrolled in a course linked to the Architecture and Building field of education started to enrol in a course classified by that university as Agriculture, Environmental and Related Studies. This has had the impact of creating an illusion that the sector is continuing to produce agricultural, environmental (and related) scientists, when this is probably not correct. The statistics show that there was no expansion overall in Agriculture, Environmental and Related Studies, but in fact, several hundred students who are likely to become architects in the fullness of time have been included in the undergraduate 'Agriculture' count.

Similarly, the requirement in most cases for future engineers (among others) at the University of Melbourne to enrol in and complete a BSc before proceeding to a putative postgraduate professional qualification in engineering (for example) means that the number of enrolments and completions in Natural and Physical Sciences bachelor's degrees has a quite different meaning than it did in the past. Several hundred BSc graduates per year will re-enrol in a different field of education, rather than seek employment as scientists, or seek enrolment in a PhD inn Science.

Does it matter if these statistical patterns have been upended? Perhaps not, but when future analysts peruse the Department's tables, they could come to the wrong conclusion.

Appendix 1:
Glossary of Higher Education Terms

The Glossary provides definitions of terms referred to in the text. Most of the definitions have been extracted directly from the Department's on-line user manuals.

Aboriginal and Torres Strait Islanders (See also **Indigenous Students**)Persons who identify themselves as being of Australian Aboriginal and Torres Strait Islander descent.

Academic Organisational Unit (AOU)

The Department's name for what universities commonly refer to as "schools" or "departments". The concept of 'Faculty' as an aggregation of 'schools' or 'departments' does not exist in formal reporting to the Department.

Attendance Mode

A classification of the manner in which a student is undertaking a subject:

- Internal Mode of Attendance: unit of study for which the student is enrolled and is undertaken through attendance at university on a regular basis; or
- External Mode of Attendance: unit of study for which the student is enrolled involves special arrangements whereby lesson materials, assignments, etc. are delivered to the student, and any associated attendance at the institution is of an incidental, irregular, special or voluntary nature.
- Multi-modal Mode of Attendance: a unit of study is undertaken partially on an internal mode of attendance and partially on an external mode of attendance.

Attendance Type

Attendance is classified as being full-time or part-time, based on the student load for the student:

- Full-time: student load (EFTSL) aggregated for all the courses being undertaken by the student in the Collection Year is 0.75 or more.
- Part-time: student load (EFTSL) aggregated for all the courses being undertaken by the student in the Collection Year is less than 0.75.

Combined Course

A course which has been specifically designed to lead to a single combined award (eg. BSc/DipEd or BSc/LLB) or to meet the requirements of more than one award (e.g. BSc and BEng).

Commencing Student

A student is a commencing student if she/he has enrolled in the course for the first time at the institution between 1 April of the year prior to the Collection Year and 31 March of the Collection Year. A Bachelor of Science student who moves into Bachelor of Science (Honours) at the same university is NOT considered to be a commencing student.

Course

An award course, non-award course, enabling course, or cross-institution programme undertaken at a higher education institution. An award course is a programme of study formally approved/accredited by the institution or any other relevant accreditation authority and which leads to an academic award granted by the institution or which qualifies a student to enter a course at a level higher than a bachelor's degree

Course Level

The Department's terminology is 'course type'. Course level means (for example) PhD, bachelor's degree, postgraduate diploma, etc.

Course Completion

The successful completion of all the academic requirements of a course which includes any required attendance, assignments, examinations, assessments, dissertations, practical experience and work experience in industry.

Discipline Group

A discipline group is a means of classifying subjects in terms of the subject matter being taught and/or researched in them.

EFTSL / EFTSU (Equivalent Full-time Student Load / Unit)

A measure of the student load attributable to a subject or to a set of subjects. The measure indicates the notional proportion of the workload which would be applicable to a student undertaking a full year of study in a particular year, of a particular course.

Fee-Paying Student

A student for whom a fee is paid to the institution for tuition.

Field Of Study / Field Of Education Classification

A classification of courses based on similarity in terms of the vocational field of specialisation or the principal subject matter of the course.

Indigenous Students

Persons who identify themselves as being of Australian Aboriginal and Torres Strait Islander descent.

Overseas Student

A student who is NOT one of the following:

- an Australian citizen; or
- a New Zealand citizen, or a diplomatic or consular representative of New Zealand, a member of the staff of such a representative or the spouse or dependent relative of such a representative; or
- a person entitled to stay in Australia, or to enter and stay in Australia, without any limitation as to time and resides in Australia during the semester.

Student Load See EFTSL / EFTSU.

Subject

The basic component of a course or programme, which a student may undertake and on successful completion of the unit's requirements, gain credit towards completion of the course. In this study, the term has been used interchangeably with 'unit'.

UNIT See 'Subject'

Appendix 2:
Classification of Courses and Subjects

STEM Fields of Education and Discipline Groups (Broad, Narrow and Detailed) (Source: HEIMS[28])

01 Natural and Physical Sciences
0101 Mathematical Sciences
010100 Mathematical Sciences
010101 Mathematics
010103 Statistics
010199 Mathematical Sciences not elsewhere classified
0103 Physics and Astronomy
010300 Physics and Astronomy
010301 Physics
010303 Astronomy
0105 Chemical Sciences
010500 Chemical Sciences
010501 Organic Chemistry
010503 Inorganic Chemistry
010599 Chemical Sciences not elsewhere classified
0107 Earth Sciences
010700 Earth Sciences
010701 Atmospheric Sciences
010703 Geology
010705 Geophysics
010707 Geochemistry
010709 Soil Science
010711 Hydrology
010713 Oceanography
010799 Earth Sciences not elsewhere classified
0109 Biological Sciences
010900 Biological Sciences
010901 Biochemistry and Cell Biology
010903 Botany
010905 Ecology and Evolution
010907 Marine Science
010909 Genetics
010911 Microbiology
010913 Human Biology
010915 Zoology
010999 Biological Sciences not elsewhere classified
0199 Other Natural and Physical Sciences
019900 Other Natural and Physical Sciences
019901 Medical Science
019903 Forensic Science
019905 Food Science and Biotechnology
019907 Pharmacology
019909 Laboratory Technology
019999 Natural and Physical Sciences not elsewhere classified

28 See http://heimshelp.education.gov.au/sites/heimshelp/resources/pages/field-of-education-types#Section2

02 Information Technology
0201 Computer Science
020100 Computer Science
020101 Formal Language Theory
020103 Programming
020105 Computational Theory
020107 Compiler Construction
020109 Algorithms
020111 Data Structures
020113 Networks and Communications
020115 Computer Graphics
020117 Operating Systems
020119 Artificial Intelligence
020199 Computer Science not elsewhere classified
0203 Information Systems
020300 Information Systems
020301 Conceptual Modelling
020303 Database Management
020305 Systems Analysis and Design
020307 Decision Support Systems
020399 Information Systems not elsewhere classified
0299 Other Information Technology
029900 Other Information Technology
029901 Security Science
029999 Information Technology not elsewhere classified
03 Engineering and Related Technologies
0301 Manufacturing Engineering and Technology
030100 Manufacturing Engineering and Technology
030101 Manufacturing Engineering
030199 Manufacturing Engineering and Technology not elsewhere classified
0303 Process and Resources Engineering
030300 Process and Resources Engineering
030301 Chemical Engineering
030303 Mining Engineering
030305 Materials Engineering
030307 Food Processing Technology
030399 Process and Resources Engineering not elsewhere classified
0305 Automotive Engineering and Technology
030501 Automotive Engineering
030505 Automotive Electrics and Electronics
030599 Automotive Engineering and Technology not elsewhere classified
0307 Mechanical and Industrial Engineering and Technology
030700 Mechanical and Industrial Engineering and Technology
030701 Mechanical Engineering
030703 Industrial Engineering
030799 Mechanical & Industrial Engineering and Technology not elsewhere classified
0309 Civil Engineering
030900 Civil Engineering
030901 Construction Engineering
030903 Structural Engineering
030905 Building Services Engineering
030907 Water and Sanitary Engineering

030909 Transport Engineering
030911 Geotechnical Engineering
030913 Ocean Engineering
030999 Civil Engineering not elsewhere classified
0311 Geomatic Engineering
031100 Geomatic Engineering
031101 Surveying
031103 Mapping Science
031199 Geomatic Engineering not elsewhere classified
0313 Electrical and Electronic Engineering and Technology
031300 Electrical and Electronic Engineering and Technology
031301 Electrical Engineering
031303 Electronic Engineering
031305 Computer Engineering
031307 Communications Technologies
031313 Electrical Fitting, Electrical Mechanics
031317 Electronic Equipment Servicing
031399 Electrical and Electronic Engineering and Technology nec
0315 Aerospace Engineering and Technology
031500 Aerospace Engineering and Technology
031501 Aerospace Engineering
031503 Aircraft Maintenance Engineering
031505 Aircraft Operation
031599 Aerospace Engineering and Technology not elsewhere classified
0317 Maritime Engineering and Technology
031701 Maritime Engineering
031703 Marine Construction
031705 Marine Craft Operation
031799 Maritime Engineering and Technology not elsewhere classified
0399 Other Engineering and Related Technologies
039900 Other Engineering and Related Technologies
039901 Environmental Engineering
039903 Biomedical Engineering
039905 Fire Technology
039999 Engineering and Related Technologies not elsewhere classified
05 Agriculture, Environmental and Related Studies
0501 Agriculture
050100 Agriculture
050101 Agricultural Science
050103 Wool Science
050105 Animal Husbandry
050199 Agriculture not elsewhere classified
0503 Horticulture and Viticulture
050300 Horticulture and Viticulture
050301 Horticulture
050303 Viticulture
0505 Forestry Studies
050500 Forestry Studies
050501 Forestry Studies
0507 Fisheries Studies
050700 Fisheries Studies
050701 Aquaculture

050799 Fisheries Studies not elsewhere classified
0509 Environmental Studies
050900 Environmental Studies
050901 Land, Parks and Wildlife Management
050999 Environmental Studies not elsewhere classified
0599 Other Agriculture, Environmental and Related Studies
059900 Other Agriculture, Environmental and Related Studies
059901 Pest and Weed Control
059999 Agriculture, Environmental and Related Studies not elsewhere classified

Other Broad Fields of Education (Broad Discipline Groups)	
04	Architecture and Building
06	Health (see also below)
07	Education
08	Management and Commerce
09	Society and Culture (see also below)
10	Creative Arts
11	Food, Hospitality and Personal Services
12	Mixed Field Programmes

The extensions to STEM to consider aspects of Health:
0601 Medical Studies
0605 Pharmacy; 0607 Dental Studies; 0609 Optical Science
0611 Veterinary Studies

'Other Health' comprises: 0603 Nursing; 0613 Public Health; 0615 Radiography; 0617 Rehabilitation Therapies; 0619 Complementary Therapies; 0699 Other Health

The extensions to STEM to consider aspects of Society and Culture:
0907 Behavioural Science
0909 Law

'Other Society and Culture' comprises: 0901 Political Science and Policy Studies; 0903 Studies in Human Society; 0905 Human Welfare Studies and Services; 0911 Justice and Law Enforcement; 0913 Librarianship, Information Management and Curatorial Studies; 0915 Language and Literature; 0917 Philosophy and Religious Studies; 0919 Economics and Econometrics; 0921 Sport and Recreation; 0999 Other Society and Culture

Notes