Australian Council of Deans of Science

Staffing university science in the twenty-first century

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Educational Policy Institute Pty Ltd

A study commissioned by the
Australian Council of Deans of Science – March 2014

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Table of Contents

List of Figures

List of Tables

Foreword from the Australian Council of Deans of Science

In this report Ian Dobson analyses the official Commonwealth Government statistics on university staff in science over the period from 2002 to 2012. Remarkably it finds that while student load in the sciences grew by 46 per cent during this period, full-time & fractional full-time time teaching staff grew by only 10 per cent.

These 'science' figures are those for the Natural and Physical Sciences field of education (N&PS). By contrast, across all fields of education student load increased by only 37 per cent during the same period while teaching staff grew by 22 per cent.

The disparity between growth in student load and teaching staff in N&PS is even more extreme if one focuses on the years 2008 to 2012, when universities were moving towards deregulated student load. N&PS load grew by over 25 per cent during this period, while full and fractional teaching staff growth virtually stagnated, increasing by less than one per cent. Casual staff increased dramatically to deal with this. From 2002 to 2012 casual staff have virtually trebled.

These statistics are masked if one does not distinguish between the roles of staff, which broadly are teaching, research and general staff in a variety of organisational roles. Indeed, university staff grew overall by 36 per cent during 2002-2012, comparing well with the 37 per cent increase in student load. The general staff proportion remained at roughly 55 per cent. However, research-only staff, those with no formal teaching role, grew by 60 per cent. In N&PS research-only staff grew by 67 per cent.

Teaching staff in this report refers to any staff that have a teaching role. Most of them are engaged in teaching and research, so that there could well be shifts towards or away from teaching within that role. It is widely considered that if there has been any shift during the period of this study it is towards research, in line with trends revealed in this report.

It would be easy to suggest from these data that universities were simply transferring money meant for teaching positions into research-only positions. However the growth in research only positions is mainly from research grants. In science, 93 per cent of research-only positions are limited-term contracts funded generally from external agencies. The growth in their number correlates with a more than doubling of ARC funds and nearly tripling of NHMRC funds during this period.

It would appear that while research has had funding and significant incentives for it to expand, such as ERA and international rankings, teaching has been left behind. The 22 per cent increase in full-time & fractional full-time teaching staff in response to a 37 per cent increase in student load corresponds to a depreciation rate over 10 years of about 1.2 per cent. This possibly represents the gap between the funding adjustments to account for inflation and increases in staff costs, which run at around four per cent or more.

However, this does not explain the more extreme disparity between student load and teaching staff apparent in N&PS, one that, as the study shows, occurs also in the fields of Health and Engineering. Significantly these are precisely the fields of education that attract the lion's share of prestigious research funds and where most of the over-enrolment occurred in the lead up to the removal of caps on student load.

It is well recognised that transfers of funding from teaching income do occur in order to support research. The review of base funding in 2011 estimated it as varying between 6-10 per cent of base funding and regarded it as a reasonable thing. However, many science faculties and schools

report much larger impacts on their operating budgets to support research initiatives. These result from a need, amongst other things, to invest in research infrastructure, to establish new research initiatives, or to provide salary loadings and fellowships in order to attract higher calibre researchers among their teaching and research staff.

It is an attitude, regrettably all too common, that undergraduate science teaching, particularly in the early years, is about inculcating a host of basic facts, processes and techniques. This drives the view that such teaching is routine and can be accomplished via an army of casual staff. The Hackling, Goodrum and Rennie report[1] identifies exactly this kind of thinking as being behind the flight of students from science in secondary school. There is the potential for a similar outcome at undergraduate level, not only through students abandoning science degrees, but through other disciplines abandoning service teaching.

The challenges for science teaching, however, extend far beyond this. Like all other disciplines science has to adapt to the revolutionary changes occurring via on-line delivery. It also has yet to embrace fully a shift towards translational research and catering to the diversity of student aspirations beyond discovery research. These challenges require substantial innovation in approaches to learning science, in diversifying learning environments and in teaching delivery. Such changes in culture and approach can't be brought about by simply writing new curriculum and posting it to an army of casual staff.

This report highlights the longstanding 'magic pudding syndrome' to which undergraduate science teaching is subject: the view that slices can be endlessly removed from teaching budgets and applied to other purposes without affecting capacity to deliver outcomes. Teaching and learning leaders in science and mathematics have played a remarkable role in sustaining quality in the face of these pressures. The report sends a strong message that the time has come to identify and arrest the forces that are draining resources out of science teaching and learning. It is time to recreate balance, to reinvest, to recognise and support the work of teaching and learning leaders, and to meet the significant challenges faced by undergraduate teaching in science and mathematics.

As well as analysing the distribution of staff according to teaching and research function, the report also provides data on a range of other matters of interest: tenure status, seniority, age and gender. It further pursues these questions at the broad discipline level, where unfortunately, and surprisingly, data collection does not appear to be adequate to the task.

The ACDS would like to thank the Chief Scientist for his generous contribution towards funding this work, and to both Roslyn Prinsley and Ewan Johnston from his Office for their support. Above all the ACDS would like to thank the author, Ian Dobson, for once again producing a splendid and informative analysis of statistics that transforms our perceptions of the situation of science in Australia's universities.

John Rice
Executive Director
Australian Council of Deans of Science

1 Hackling, M., Goodrum, D. & Rennie, L.J. (2001). The state of science in Australian secondary schools. Australian Science Teachers' Journal, 47 (4), 6-17.

Chapter 1

Background and introduction

Staffing university science in the twenty-first century presents analysis of university staffing, looking particularly at academic staffing in the *Natural & Physical Sciences* since 2002. This study provides another stanza in the Australian Council of Deans of Science's promotion of fundamental analysis of issues and trends relevant to higher education science in Australia.

The ACDS has been responsible for detailed analysis of matters relating to university science on a number of occasions. Their first foray into patterns of enrolments in science occurred in 1998, with the commissioning of *Trends in science education: Learning, teaching and outcomes 1989 – 1997* (Dobson & Calderon, 1999). This was the first study to present statistical evidence that there had been a relative decline of student interest in the enabling sciences of chemistry, mathematics and physics. Although there had been strong growth in science enrolments during the 1990s, they had mainly had gone into the behavioural and biological sciences. Given that these disciplines are also taught by other than faculties of science, deans of science were presented with an increasing number of students to manage, with the funding associated with the teaching flowing to say, faculties of arts (behavioural sciences), or faculties of medicine (biological sciences). The ACDS followed up this study with two others, in 2003 and 2007 (Dobson, 2003; 2007) that further examined the pattern of enrolments in university science. The most recent detailed analysis of university science enrolments was a report commissioned by the Office of the Chief Scientist (Dobson, 2012) and used in the Chief Scientist's 2012 report *Health of Australian Science* (Office of the Chief Scientist, 2012).

Other studies undertaken by the ACDS have included extensions of enrolments studies 'What did you do with your science degree?' (McInnis, Hartley & Anderson, 2001), and 'Why do a Science Degree?' (ACDS, 2001). There have also been studies on the preparation of school science teachers (Harris, Jensz & Baldwin, 2005) and mathematics teachers (Harris & Jensz, 2006).

This report differs from its predecessors in that its prime focus is university staff, particularly the academic staff involved in teaching and/or research. Although both teaching and research are major components of an academic career, it is important for any analysis to distinguish between academic teachers, academic researchers and staff not directly engaged in 'academic' work. Failure to do so will lead to the pitfalls often associated with averaging data across unlike subpopulations. As some of the tables below make clear, to plot the growth in numbers of science academics overall is to fail to realise that much of the increase has gone into hiring 'research only' academics, and these staff are not typically involved in teaching. It has been suggested by some that teaching is undervalued compared with research in the typical academic career. (See, for example, Norton, 2013).

One should also be aware of trends in the staffing that is needed to support academic activities and to maintain the general amenity of universities. It should be noted that staff occupying academic posts are in the minority among university staff, representing around 43 per cent of all full-time equivalent staff[1]. The majority have been referred to here as 'general' staff, but they are increasingly being described by universities as 'professional' staff. Unfortunately, many, including education and other ministries, continue to refer to general staff as 'non-academic' staff, apparently oblivious of the fact that in most, if not all, contexts it is no longer considered appropriate to describe people or groups of people in terms of what they are not. It was an

1 Calculated from uCube http://www.highereducationstatistics.deewr.gov.au/Default.aspx

interesting regression to 'non-academic', because the term 'general staff' was used in official government publications of university statistics in the early 1980s[2]. There is now a considerable body of literature on this matter (including Allen-Collinson, 2006; Conway, 2000; Dobson, 2000; Dobson & Conway, 2003; Lauwerys, 2002; Szekeres, 2004; 2006; Whitchurch, 2008a; 2008b). It is to be hoped that those in government or elsewhere can bring themselves to stop describing the majority of university staff in oppositional terms.

The chapters that follow present a description of university staff statistics and analysis at several levels, concluding with analysis of academic staffing in teaching or research at the level that is described in the staff statistics collection as 'narrow academic organisational unit (AOU) group', an aggregation that approximates university departments, but could also have local names such as school or faculty. In the Natural & Physical Sciences, these AOU groups are the Biological Sciences, Chemical Sciences, Earth Sciences, Mathematical Sciences, Physics and Astronomy and Other Natural & Physical Sciences.

One of the challenges in writing up the sort of material in this study is to maintain consistency in style and usage. A work like this contains many defined terms, and it is possible to cause confusion if certain defined terms are also accorded their broader meanings elsewhere in the text. An effort has been made to use terminology consistently, and to assist in this regard, the ampersand (&) has been used consistently in defined expressions. For example, 'teaching & research' consistently refers to the defined staff function, whereas 'teaching and research' refers to those mutually exclusive activities as undertaken by various university members of staff. (See Chapter 2 for more explanation of the terminology of staff statistics).

The next chapter seeks to explain the nature of Australian university staffing statistics, to explain the challenges that confront analysts. As is explained elsewhere in this study, analysing staff statistics is not as precise a 'science' as analysing student statistics is.

2 See for example, CTEC, 1985, Table 14

Chapter 2

Higher education statistics: a description

Background

Since their inception, universities and other Australian tertiary education institutions have provided government agencies with statistics. Typically, these were published at least by the Commonwealth Bureau of Census and Statistics, and its successor, the Australian Bureau of Statistics, in special statistical series and in (almost) annual Commonwealth / Australian Year Books. For example, the Commonwealth Year Book for 1923 (to pick a volume at random) reveals that in 1921, Australia's six universities had 8,000 students, 104 professors, 378 lecturers and demonstrators, and spent about £505,000[3] (over $1 million in decimal currency terms). This can be contrasted with the situation almost 90 years later, in which higher education boasts a student population of about 1.2 million, provided for by about 5,600 professors, 35,000 other academic and 57,000 general staff[4], spending over $21 billion[5] (ABS, n.d.).

Among other things, history has seen the establishment of binary higher education following the Martin Report (Martin, 1964), and its subsequent disestablishment and winding into a unitary system of universities through the so-called Dawkins reforms effected from 1989 (Dawkins, 1988). More recently private providers have been accepted into the Australian higher education system.

In the pre-Dawkins binary period during the 1980s, the former colleges of advanced education (CAEs) reported on their 'teaching staff' and their 'other staff', whereas universities had 'teaching & research' staff, 'research only' staff and several categories comprising staff not directly involved in undertaking academic activities. The system ushered in was a hybrid of the slightly different systems previously used by CAEs and universities, consisting of staff categories for the functions of 'teaching only', teaching & research', 'research only' and 'other' staff. From a university perspective, the 'teaching only' category was a new one, and in the early years of the new staff reporting format, most pre-Dawkins universities reported few or no full-time & fractional full-time 'teaching only' staff[6]. By 2012, over 2,300 full-time & fractional full-time staff members in academic departments were classified as 'teaching only', up from fewer than 800 in 2002[7].

Some universities have only started to report that they have 'teaching only' staff in recent years. Monash University, for example, had no full-time & fractional full-time staff in this category in 2008, but had 239 in 2012; and Melbourne's numbers increased from 15 to 202 in the same period (see also Table 4.1). Several other universities also increased their reportage of 'teaching only' staff between 2008 and 2012, including Australian Catholic University (+93), Queensland University of Technology (+85) Swinburne (+118), and the University of Western Australia (+69). Across Australia, there were 1,484 more teaching only staff in 2012 c.f. 2008 and 1,630 more than there had been in 2002[8].

The reasons for the expansion of the 'teaching only' category in recent years could include

3 Year Book Australia, 1923, Ch. 9, Tables on pp. 468 and 469.

4 Staff Aggregated data set 2010

5 DIISRTE (2012). Finance 2010, Table 1.

6 See, for example, DEET, 1990, Table 23

7 Calculated from uCube. http://www.highereducationstatistics.deewr.gov.au/

8 Calculated from uCube. http://www.highereducationstatistics.deewr.gov.au/

universities' desire to recognise new academics not expected to undertake research. Previously it had been generally understood in traditional universities that all teaching staff would concurrently undertake research, hence the category 'teaching & research' that dates back several decades. However, it is also the case that 'teaching only' staff are not included in the denominator for assessing research productivity (of research income, research publications and PhD students per capita). Junior teaching staff typically have higher teaching loads, and therefore have less capacity to produce the research outputs than their more senior colleagues. If academic staff are excluded in sufficient numbers from the 'teaching & research' category, apparent research productivity rises.

Over time, universities have done their compulsory statistical reporting about the students, staff and operations via a range of state and commonwealth clearing houses. These have included the Australian Bureau of Statistics (ABS), the Commonwealth Tertiary Education Commission and since the late 1980s, the Commonwealth government ministry responsible for higher education. The form of reporting depended on the times. With the advent of mainframe and then office-based computing on personal computers, the collection of higher education statistics changed from paper-based formats through several versions of evolving digital technologies. Dissemination of statistics occurred (and continues to occur) through a range of ABS tables and Year Books, and print-based publications from the various education authorities of the day. From about 1990, users of Australian higher education planners and researchers had access to a set of aggregated data files, collated by a 'university statistics' section of the federal education department[9] (described hereafter as 'the Department'). Until sometime during 2011, it was possible to download aggregated data files of student *enrolments* (headcounts of students enrolled in university programmes), *student load* (a measure of the number of equivalent full-time students), *course completions* (degree graduations, and diploma and certificate completions) and *staff* (including those with academic appointments: the prime focus of this study, expressed both as headcounts and as full-time equivalents – FTE). There is a slightly more thorough explanation of the differences between the number (headcount) and full-time equivalent of staff later in this chapter, under *Work Contract*.

During 2011, someone in the Department decided that this arrangement breached Australian privacy legislation, and the data files were summarily removed from the Department's website. The issue was probably not put up for public discussion, and no indication has been given of how many university students or staff members had alleged that their privacy had been breached by the availability of aggregated data files.

The system of providing data files has been replaced by a publicly-available, online cross tabulation programme known as uCube. This programme allows users to produce a range of tables for the period since 2001, but unfortunately, the detail that can be derived from uCube is a fraction of what had been available in the past. Users requiring more detailed information can (for a fee) order tables that staff from the Department will produce. At time of writing, a notice on the Department's website suggested that those wishing to purchase customised tables of higher education would have to wait six to eight weeks (Department of Industry, (n.d)), an indication, perhaps, that too few staff have been allocated to do this work.

9 Several acronyms have been used over time to represent the 'education' ministry. These have included DEET (Department of Employment, Education & Training), DEETYA (Department of Employment, Education, Training & Youth Affairs), DETYA (Department of Education, Training & Youth Affairs), and DEST, the Department of Education, Science and Training; DEEWR (Department of Education, Employment and Workplace Relations) and DIISRTE (Department of Innovation, Industry, Science, Research and Tertiary Education).

It is not easy to argue against motherhood statements in support of privacy, but it is equally challenging to see how (or why) Australian university statistics could become entangled in concerns about 'privacy'. To give an 'odd' example, even if we already know that each university has **one** vice-chancellor at a time, should a client request a table that shows for each university a distribution of the seven levels of academic staff by classification, the Department's interpretation of the privacy provisions is such that its staff will supply a table that shows the number of vice-chancellors to be '< 5'. Some might find this to be silly, especially given that university websites provide all such information. Is it likely that anyone trying to identify individuals from a university would use tables of university statistics as their source?

Data on AOUs

Whereas uCube will provide analysts with many of their information needs, particularly for students, this does not apply to analyses of staff. uCube provides no capacity to undertake analysis by groups of departments, even at a broadest of levels. In the Department's parlance, university departments (schools, faculties, etc.) are known as 'organisational units', and the academic ones are abbreviated to 'AOU'.

Even before the Department removed the aggregated data files from its website, analysing staff data was less open-and-shut than analysing student data. Although universities provide direct information on staff to meet most of the reporting requirements, analysis of aggregations of staff at the level of 'AOU group' is built around an algorithm that is based on distributions of student load[10] into narrow discipline groups[11]. In summary, universities report student load and staff working in academic departments according to the locally designated departments, schools or faculties. Each academic department is then linked to a four-digit narrow 'AOU group', for the purposes of enabling comparisons between institutions. In the Department's words, 'The classification provides a means of grouping AOUs which have a likeness in terms of the subject matter of units of study for which they have responsibility' (DEET, 1990, p. 105).

To explain the situation further, it is best to to continue to quote from the Department's own material:

> To enable such comparisons, an *AOU Group Code* is calculated for each AOU in each university. The calculation for each AOU takes into account the distribution of student load by discipline group within the AOU. The result of the calculation is an AOU group code for each AOU. This code indicates the 'type' of the AOU in terms of the predominant discipline for which the AOU is responsible. The typing of each AOU is only approximate. The accuracy of the typing depends on the extent to which the disciplines for which an AOU are responsible are homogenous. Where an AOU has a heterogeneous mix in disciplines, the 'typing' can be unrepresentative. The 'fuzziness' of the classification needs to be taken into account when data tabulated using the classification are being interpreted (DEET, 1990, p. 105).

The general rule to describe the situation in which an AOU is allocated to an AOU Group is that if 70 per cent of the student load in an AOU is in the same narrow (four-digit) discipline, then that AOU Group will be ascribed the same code. To give an example, if a university reported one of its academic departments (AOUs) as being 'the Department of Chemistry' and if 70 per cent or more of the student load taught in that department were '0105 Chemical Sciences', then the AOU Group code allocated to all the staff in that department would be '0105 Chemical Sciences'.

10 Student load is a measure of the number of full-time equivalent students. Its abbreviation is EFTSL – equivalent full-time student load.

11 The nomenclature for discipline groups, fields of education and AOU groups come from the same table. See Appendix 1.

Therefore, all the staff reported as being in that AOU would be allocated to '0105 Chemical Sciences', including staff in the 30 per cent that might teach subjects in narrow discipline groups not within the chemical sciences.

Greater imprecisions arise in cases in which no single narrow discipline represents 70 per cent of the student load in that AOU: in such a case, the AOU Group code attached to that AOU would be '0100 Natural Physical Sciences', described in this study as 'Natural & Physical Sciences – Not Specified'. Such an occurrence could arise if a university had (say) a 'Department of Mathematics and Physics', the student load in which was 60 per cent in narrow discipline group '0101 Mathematical Sciences' and 40 per cent was in narrow discipline group '0103 Physics & Astronomy'. If this 60/40 split were the case, the AOU Group code would default to '0100 Natural & Physical Sciences – Not Specified'; if the split had been 70/30, all the staff would have been allocated to '0101 Mathematical Sciences'.

An examination of the distribution of academic teaching staff to narrow AOU Groups in the 21st century indicates that around 35 per cent of full-time equivalent teaching academics end up being allocated to '0100 Natural & Physical Sciences – Not Specified'. However, given the primacy of student load in defining the AOU group of a department, workings in Chapter 6 redistribute these '0100 Natural & Physical Sciences – Not Specified' academics to the defined AOU groups defined within Natural & Physical Sciences. This does not provide an exact answer, but the figures derived will not be far adrift of the actual situation.

A corollary of this methodology is that it could have an impact on the apparent staff numbers involved in the teaching of narrow Natural & Physical Sciences AOUs, particularly in the Biological Sciences. The propensity of departments within medical faculties to teach subjects which are in the narrow discipline of the biological sciences means that the '70 per cent' rule explained above could see some teaching resources applied to the biological sciences recorded as being in the Health broad AOU. By way of example, if a university had a Department of Health Studies, that department would correctly be reported as falling within the '06 Health' broad AOU. If 25 per cent of that department's teaching were in subjects in '0109 – Biological Sciences', and the remaining 75 per cent was teaching in 0603 Nursing, the formula applied by the department would direct all of that teaching resource to narrow AOU 0603 Nursing. It is possible also that some teaching provided within engineering or even agriculture faculties could be similarly affected, but the chance of this occurring is less than in the case of the biological sciences.

Perhaps recognising the relative inadequacy of these situations, the Department's publications typically show staff statistics only at the broad AOU level, thereby overcoming the difficulty of having to improve the methodology and tighten up processes and definitions to distribute (particularly) academic staff in finer detail. However, only the Department has the capacity to improve the situations referred to above; they have detailed institutional data files going back to the late 1980s.

Data quality and coverage

Providing staff statistics requires less effort from universities than providing student statistics and perhaps some universities devote less time to checking the accuracy of the data they send to the Department. The principal reason for this is that student statistics MUST be exact, because in effect they provide the input for the calculation of the domestic students' fees originally known as HECS – the higher education contribution scheme. Students are therefore likely to check carefully their imputed HECS debts, and student statistics will be more accurate because of that. With staff statistics, the need for this detailed checking is not there, and more errors are likely.

For example, in 2010, one university reported two vice-chancellors at the audit date, which memory (and logic) suggests was incorrect. Meanwhile, in the same year, another university reported 14 deputy vice-chancellors, rather more than any other university, and more than the number listed on its website. A number of universities also report that their vice-chancellor as having a 'teaching & research' function, sometimes within an AOU, an unlikely situation in a modern Australian university[12].

Another thing about staff statistics is that myriad private providers report student data, but they seem not to be required to report on staff. Perhaps there is a good reason for this. Further, it is uncertain whether staff members based off-shore are included in official statistics. Such matters mean that care is required in calculations related to the ratios of students to staff.

The tables and graphs in this study are based on full-time equivalent counts of staff. A staff member working a 'normal' working week is counted as 1.0 FTE staff, whereas two staff members sharing a job by working three days and two days respectively would be counted as 0.6 FTE and 0.4 FTE. These latter staff members are defined as having a 'fractional full-time' work contract, as opposed to the 'full-time' employees who work 100 per cent of the working week. The official nomenclature adopted for enumerating staff statistics is such that 'number' is used to describe the quantity of separate individuals being counted. The fractional full-time staff members mentioned two sentences ago would therefore be enumerated as '2'. However, these two members of staff represent '1' full-time equivalent (FTE) staff member. In this report, all counting is on the basis of full-time equivalents, but occasionally 'number' and 'full-time equivalent' have been used interchangeably.

There is yet another category of staff described in Australian higher education as 'casual'. The number and proportion of these staff has increased over the past decade, and has been the subject of considerable research and commentary. (See, for example, Coates et al. (2009); Coates & Goedegebuure (2010); Gottschalk & McEachern (2010); Junor (2004); Kimber (2003); and Percy, et al. (2008)). These authors and many others have demonstrated how the proportion of casual teaching staff has been increasing in recent years. There is also a recently launched website devoted to casualisation issues[13]. Whereas universities report on full-time & fractional full-time staff in the form of anonymised but individual unit records, casual staff numbers are built up from estimated and actual numbers of hours worked by an unreported but large number of individuals.

More detail on these arrangements can be found below under 'work contract'.

It must also be noted that statistical reporting to the Department does not necessarily match the organisational arrangements within individual universities. For example, in some universities, all teaching of mathematics, whether to science, architecture, arts or engineering students might emanate from a single 'maths' department in the Faculty of Science. At another university, the mathematics taught to engineering students might come from a department within the Faculty of Engineering. However, all teaching in mathematics will be shown in official university statistics as part of narrow discipline group '0101 Mathematical Sciences', irrespective of university-specific organisation. This is another way in which staff counts by narrow AOU group become fuzzier than they would have been under a different methodology.

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12 Source: Staff Aggregated data set, 2010. Among other reporting imperfections were high rates of 'no information' about *Aboriginal or Torres Strait Islander codes*, *staff country of birth code*s, and *language spoken at home codes*. Several universities feature with low response rates for all these data variables. Responses for academic staff only for their *highest qualification codes* were also low at many universities, often in excess of 90 per cent. Why is this information collected at all if it is not vetted?

13 Go to http://actualcasuals.wordpress.com/

Universities report on their full-time & fractional full-time staff according to several variables. These include gender, the 'sector' they work in, the nature of their contract, their classification (that is, the level of their appointment, whether in the academic or general staff streams), their 'function', their age, and information about their 'tenure'. Whereas gender requires no further explanation, some of the other terms do, and brief explanations follow. The Department's current definitions of these variables can be found via its website.[14]

Work sector

In Australian staffing statistics, 'sector' refers either to university or to vocational education and training / technical and further education (VET/TAFE). Some universities are dual sector institutions (including Victorian universities Federation University, RMIT, Swinburne University of Technology and Victoria University) in that they comprise both university and VET/TAFE components, but in this report, only the 'university' sector has been taken into account. Other dual-sector institutions exist in other Australian states and territories[15].

Work contract

A work contract can be full-time, fractional full-time or casual. Paraphrasing the Department's glossary on higher education staff, staff in the first two groups are employed for a continuous period to perform duties on a regular basis. Such staff members are eligible for paid leave. Fractional full-time staff members work for fewer hours than staff with full-time contracts. Staff employed under a casual work contract are typically engaged and paid on an hourly or sessional basis, and they have no entitlement to paid leave[16]. Statistical information on full-time staff and fractional full-time staff are collected in the form of unit records. Information on casual staff, however, is collected on the basis of aggregated hours for casual staff of different types.

Official statistics on full-time & fractional full-time staff are provided as both headcounts and full-time equivalents (FTE). Basing analysis on equivalent full-time measures is generally a better way of comparing changes in staffing over time than the headcount of those involved. Table 2.1 shows that the ratio of the *number* of academic staff to the *FTE* of academic staff has increased over the period 2002 to 2012, indicating an increase in the number of academics with fractional full-time appointments in 2012 than had been the case in 2002. In fact, the *number* of academics in Australian universities increased by 46 per cent over the period, producing a 38 per cent increase in the *full-time equivalent* figure.

Table 2.1 Full-Time & Fractional Full-Time Staff by Classification – Headcount c.f. Full-Time Equivalent (FTE), 2002 – 2012

	2002	2004	2006	2008	2010	2012	Variation	
							No.	%
Academic Staff								
No. (Headcount)	34,642	37,447	40,282	43,625	47,025	50,423	15,781	46%
FTE	31,073	33,122	35,240	37,612	40,184	42,749	11,676	38%
FTE % of No.	90%	88%	87%	86%	85%	85%		
General Staff								
No. (Headcount)	46,502	50,211	51,726	54,753	58,934	63,207	16,705	36%
FTE	41,867	45,067	46,540	49,012	52,766	56,640	14,773	35%
FTE % of No.	90%	90%	90%	90%	90%	90%		

Source: uCube FTE = 'full-time equivalent'

14 http://heimshelp.deewr.gov.au/sites/heimshelp/2014_data_requirements/2014higheredstaff/pages/he-staff-2014#Elements

15 http://heimshelp.deewr.gov.au/sites/heimshelp/resources/glossary/pages/glossaryterm?title=Work%20Sector

16 http://heimshelp.deewr.gov.au/sites/heimshelp/resources/glossary/pages/ glossaryterm?title=Work%20Contract

Tenure

The definitions acknowledge three 'terms' for which staff can be employed, described in hard copy publications as tenurial term[17], limited term, or other term, but described on the Department's website as tenurable term, limited term or other term. The 'other' group contains relatively few staff. Limited term staff members have a contract with an end date, whereas those in the tenurable group do not. Staff members' tenure cannot be discerned from uCube, but published tables provide some information.

Function

'Function' is a description of what a staff member's job duties are, and there are four self-explanatory functions: 'teaching only'; 'teaching & research'; 'research only'; and 'other'. Perhaps the main fact to be appreciated is that staff in academic classifications can occupy jobs with all four functions, whereas general staff can only occupy jobs with 'research only' or 'other' functions. Many universities do not define any of their general staff as 'research only'. This ambiguity slipped into staff statistics in about 1987, when the first personal computer staff statistics system was introduced. Perhaps this was an oversight, because at the time, the 'joint working group on university statistics' did not include any university officers who actually understood the detail of university statistics. In fact such advisory groups rarely seem to include members with any form of hands-on institutional statistical reporting knowledge or experience.

Table 2.2 provides a summary of the 2012 population of full-time & fractional full-time staff, in order to show how 'function' is distributed across universities.

Table 2.2 Full-Time & Fractional Full-Time University Staff (FTE) by Staff Type and Function, 2012

Staff Type / Function	Teaching Staff		Research Staff	Other than Teaching or Research Staff	Total
	Teaching Only Function	Teaching & Research Function	Research Only Function	Other Function	
Academic Staff	2,478	27,370	11,597	1303	42,748
General Staff			2,957	53,683	56,640
Total	**2,478**	**27,370**	**14,554**	**54,986**	**99,388**

Source: uCube. FTE = 'full-time equivalent'

In the text in this study, the staff involved in teaching are described as 'teaching staff' or occasionally as 'academic teaching staff', but in a definitional sense, teaching can only be undertaken by academics. Research, however, and the 'research only' function can be undertaken by both academic and general staff. Staff with an 'other' function can also be either academic or general staff, but there are few of the former in the total (about two per cent).

Classification

University members of staff occupy either an academic post, or what the Department describes as a 'non-academic' post. (Equally, the designations could be 'general' staff and 'non-general' staff, or 'professional' staff and 'non-professional staff). There are seven academic appointment levels: vice-chancellor, deputy vice-chancellor, and Levels E – A, in descending order of seniority. The levels within this alphabetic scale are professor, associate professor / reader, senior lecturer, lecturer and assistant lecturer, respectively. uCube provides limited access to classification information. Senior academic appointees are grouped into 'above senior lecturer'.

17 'Tenurial' is described in the 2,000-plus page Oxford Dictionary of English (2005, p. 1819) as meaning 'relating to the tenure of land'.

Senior lecturers, lecturers and 'below lecturer' staff are reported individually.

General staff are classified into one of 12 levels, with most being included in ten levels of 'higher education worker' (HEW). Typically, staff employed 'Below HEW Level 1' hold apprentice or similar training posts, whereas those employed 'Above HEW Level 10' are usually in senior management posts. For reporting purposes, uCube provides no detail as to levels within the general staff hierarchy, describing what they do merely as 'non-academic'.

Age

Universities report date of birth information on their staff to the Department, and this is rendered into a series of age groups (from < 20 to > 65), in five-year intervals. uCube provides no information on staff age groups.

Subsequent chapters provide statistical analysis, starting with a consideration of student numbers in Chapter 3. The explosion in student numbers is important, because the fact that there are more students than in the past means that more staff are required to teach them and provide administrative support. Chapters 4 – 6 provide information about how university staffing has been developing since 2002.

Chapter 3

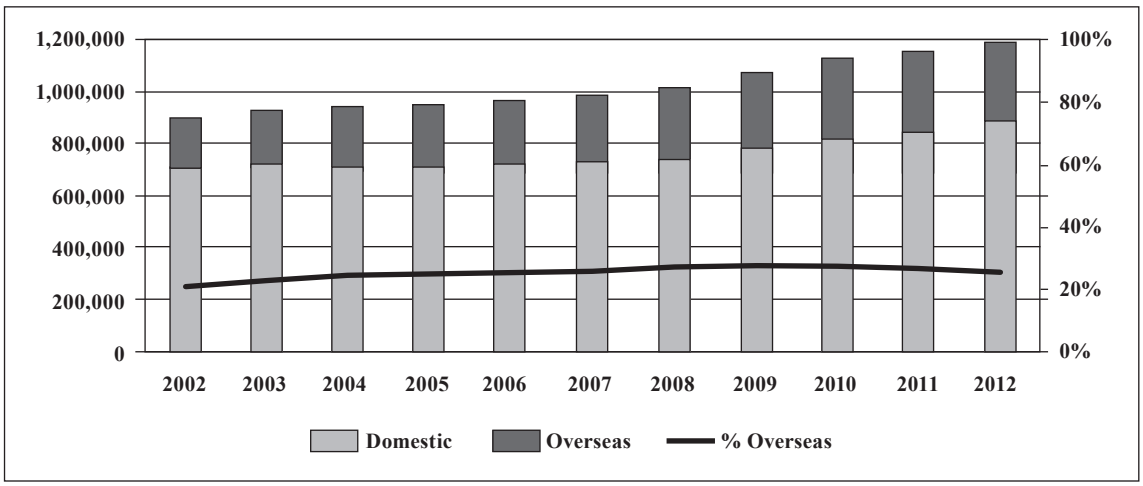
Enrolments – rapid growth in the sector

This report concerns university staffing, but if a university's primary role is to educate the coming generations for ultimate placement in the labour force, student numbers provide an appropriate starting place for a study of the staffing of 'science' within Australian universities. Without teaching staff, there would be no graduates, in science or in any other field. Australian higher education enrolment numbers have increased rapidly over the past decade, building on the massification of higher education from the end of the 1980s and the consistent increase in enrolments due to higher education being exported to overseas students.

Figure 3.1 shows that in 2002, overall enrolments (excluding private providers) numbered almost 900,000 of which about 185,000 (21 per cent) were overseas students. By 2012, these numbers had increased to nearly 1.2 million and 303,000 (25 per cent), respectively. The peak proportion of overseas students occurred in 2009 (28 per cent), and there were about 8,000 fewer overseas students in 2012 than there had been in 2011.

An additional 66,000 students were enrolled at private providers in 2012. As noted above, although students from private institutions are reported for inclusion in enrolment counts, this is not the case for staff.

Figure 3.1 Enrolments (All Fields of Education) by Domestic and Overseas Students, 2002 – 2012



Source: uCube.
Excludes Private Providers (approx.. 66,000 in 2012)

Statistics of *enrolments* in courses paint only part of the picture of university learning and teaching; *student load* provides a measure of the number equivalent full-time students. Not all students attend full-time, so comparing equivalent full-time counts of both students and staff provides a more accurate picture. There is also an 'overlap' in what students in Natural & Physical Sciences programmes study, and what Natural & Physical Sciences subjects are taught. Students enrolled in 'science' programmes (for example) enrol in subjects other than 'science' subjects, and students enrolled in programmes other than 'science' programmes undertake 'science' subjects. The point is that more 'science' is taught than there are 'science' students. Earlier analysis has demonstrated a pattern of the Natural & Physical Sciences becoming much more a service teaching discipline than in the past and greater levels of diversity in what constitutes a 'science' degree.

There is also a newer situation that affects aspects of undergraduate 'science programmes' and 'science students', and that is the advent of a system whereby considerably larger cohorts of students will enrol in and complete BSc degrees, but only as the first stage of undertaking more directly-vocational post-bachelor courses. This situation is described in the next section.

Table 3.1 shows that teaching in the Natural & Physical Sciences expanded by 46 per cent (+33,723 EFTSL) between 2002 and 2012, compared with a system-wide increase of 37 per cent. Teaching in some disciplines expanded considerably more, such as Health (+56,911 EFTSL, 99 per cent). The larger disciplines such as Management & Commerce (+48,512 EFTSL, 42 per cent) and Society & Culture (+44,838 EFTSL, 27 per cent) also grew considerably. Information Technology was the only broad discipline group to decline in size.

Table 3.1 Student Load (EFTSL) by Broad Discipline Group, 2002 – 2012

	2002	2004	2006	2008	2010	2012	Variation	
							No.	%
Natural & Physical Sci.	**73,764**	**77,421**	**81,303**	**86,195**	**98,688**	**107,487**	**33,723**	**46%**
Postgraduate	8,836	9,808	10,809	12,107	13,924	14,109	5,273	60%
Undergraduate #	64,928	67,613	70,494	74,088	84,764	93,378	28,450	44%
% Postgraduate	12%	13%	13%	14%	14%	13%		
Agriculture, Environ.	8,863	9,511	8,976	9,481	10,977	11,803	2,940	33%
Architecture & Bldg.	12,089	13,049	13,945	16,063	18,331	18,944	6,855	57%
Creative Arts	46,346	48,166	48,346	51,680	58,799	62,268	15,922	34%
Education	51,525	53,890	57,994	58,890	65,694	69,939	18,414	36%
Engineering	36,985	39,652	39,727	44,510	53,497	59,331	22,346	60%
Food Hosp. Pers. Services	120	125	232	243	238	220	100	83%
Health	57,521	63,473	72,378	85,362	99,927	114,432	56,911	99%
Information Technology	55,272	50,812	40,055	35,777	38,380	36,836	-18,436	-33%
Management & Comm.	114,409	127,602	138,733	151,706	167,084	162,921	48,512	42%
Mixed Field Programmes	407	491	603	912	1,427	2,092	1,685	414%
Society & Culture	169,106	176,326	180,896	186,375	205,864	213,944	44,838	27%
Total	**626,405**	**660,519**	**683,188**	**727,194**	**818,904**	**860,218**	**233,813**	**37%**

Source: uCube
EFTSL = Equivalent full-time student load. Excludes student load taught by private providers (approx. 48,000 EFTSL).
# Undergraduate includes 'Other' EFTSL (enabling; non-award programmes: 2.2 – 3.8 per cent)

Table 3.1 also provides a postgraduate/undergraduate distribution of student load for the Natural & Physical Sciences. Although the proportionate increase in postgraduate student load has been greater, the fundamental distribution between postgraduate and undergraduate has changed little. Undergraduates represent 87 – 88 per cent of the teaching load in the Natural & Physical Sciences.

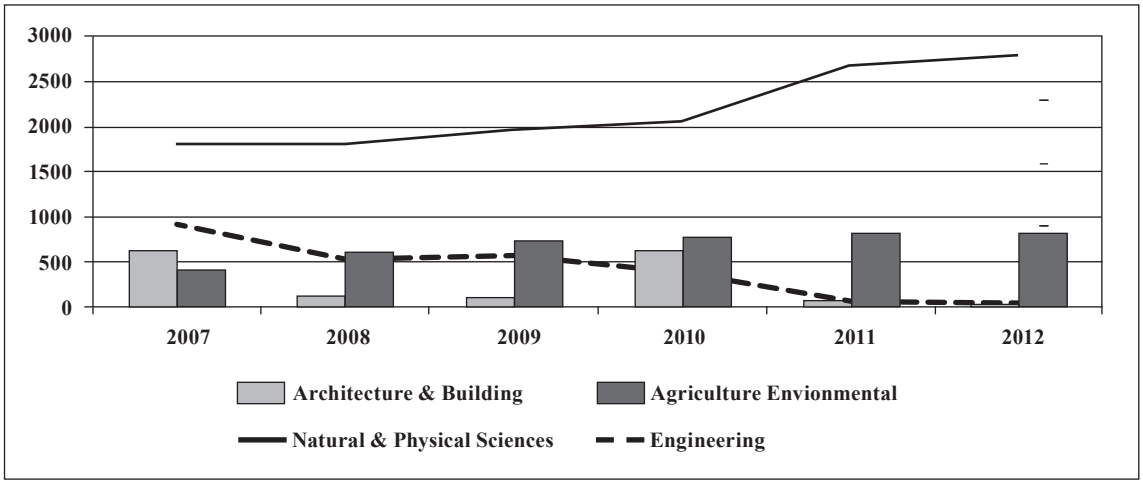
Melbourne and similar models

A major change in aspects of science enrolments has come in the form of new organisational arrangements in undergraduate programmes at some universities. A number of years ago, the University of Melbourne announced its intention to reduce the number of discrete bachelor degrees it offers. Since 2008, students wishing to qualify eventually in vocation-linked fields such as architecture, education, engineering and medicine must first complete a bachelor's degree in one of seven or eight options, before continuing on to a postgraduate-level qualification in their desired vocational field. This arrangement was initially dubbed 'the Melbourne Model' and it meant that dozens of separate bachelor's degrees offered in the past were no longer available.

One impact of this procedural change has been an expansion in the number of enrolments (and subsequently graduations) in science. In the Melbourne case, students who would have enrolled in bachelor's degrees in architecture and engineering (at least) in 2007 and earlier years, would generally enrol (respectively) in a new 'bachelor of environments' (linked to the Agriculture, Environmental and Related Studies broad field of education) or a BSc (in the Natural & Physical Sciences broad field of education) if commencing their studies in 2008 and onwards.

Figure 3.2 shows these distinctive changes in enrolment patterns at the University of Melbourne, comparing engineering / science and architecture / agriculture (environment). The lines represent commencing undergraduate enrolments in Natural & Physical Sciences and Engineering & Related Technologies programmes, respectively. The reciprocal pattern is clear. Similarly with Architecture & Building and Agriculture, Environmental & Related Studies (shown by the columns), the pattern is clear.

Figure 3.2 Enrolments by Selected Commencing Undergraduate Students, University of Melbourne: Natural & Physical Sciences/Engineering & Related Technologies; Agriculture, Environmental & Related Studies / Architecture & Building Fields of Education, 2007 – 2012



Source: uCube

The University of Western Australia changed its procedures for producing engineers and several other professional groups from 2012 along similar lines to the University of Melbourne, as summarised in Table 3.2. The table demonstrates the marked impact of the new procedure on enrolments of commencing undergraduates in the Natural & Physical Sciences. Between 2011 and 2012, the number of science students increased by 83 per cent, and there have been reciprocal decreases in commencing enrolments in several other fields of study. In coming years, there will be an equivalent spike in the number of qualified 'science' undergraduates, but not all of these will be seeking immediate entry to the labour market.

Table 3.2 Enrolments by Commencing Undergraduate Students: University of Western Australia, 2009-2012

Field of Education	2009	2010	2011	2012	Variation	
					No.	%
Natural & Physical Sciences	**1,396**	**1,499**	**1,699**	**3,111**	**1,715**	**123%**
Agriculture Environmental	145	106	107	9	-136	-94%
Architecture & Building	244	277	299	266	22	9%
Creative Arts	356	326	336	100	-256	-72%
Education	45	48	41	7	-38	-84%
Engineering	814	877	964	54	-760	-93%
Health	431	453	446	95	-336	-78%
Information Technology	105	113	136	10	-95	-90%
Management & Commerce	1,304	1,259	1,416	1,043	-261	-20%
Society & Culture	1,538	1,398	1,486	1,344	-194	-13%
Total	**5,378**	**5,423**	**5,903**	**6,019**	**641**	**12%**

Source: uCube

The reason for highlighting these new arrangements is that they change various ratios of students and staff, and in the early years at least, will probably increase the amount of teaching in science relative to the amount of teaching in say, engineering or architecture. Perhaps other universities will also start to provide initial undergraduate teaching in professional courses according to a 'Melbourne-type' model, further changing the general trend of enrolments in science programmes as they do.

One consequence of such procedural switches in enrolment patterns is that any analyst failing to appreciate the history of contemporary enrolment patterns will misinterpret the statistics that have produced those patterns. One already reads of the expansion of enrolments in Natural & Physical Sciences undergraduate programmes, when the reason relates in large part to the new organisational arrangements ushered in by the Universities of Melbourne and Western Australia-style models. Similarly, it might not be long before the 'resurgence of university agriculture' is reported, when much of the reason could be that future architects at the University of Melbourne now enrol in a programme bracketed within the 'Agriculture, Environmental & Related Studies' broad field of education.

The next chapter presents a system-wide analysis of staffing patterns since 2002.

Chapter 4

University staff statistics – a sector-wide examination

This chapter presents a summary of staff statistics for the period 2002 to 2012. Most of the tables and figures have been built from the Department's uCube software. The purpose is to demonstrate the broad sector-wide distributions of staff, to provide background to the finer-grained analysis and modelling in subsequent chapters.

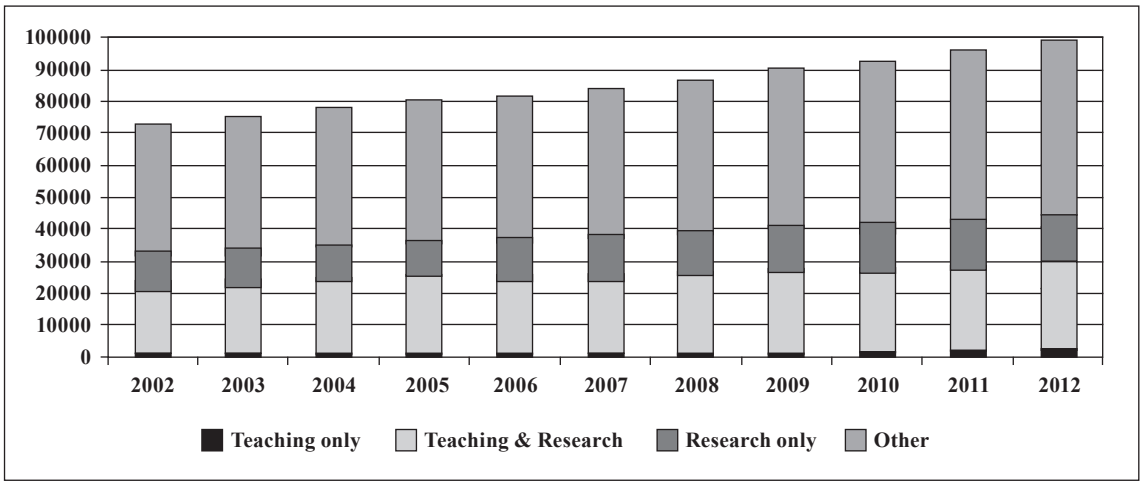
Academic and general staff by function

This is an appropriate time to reiterate the concept of 'function', because it is critical in any analysis of university academic staffing. The four functions are 'teaching only', 'teaching & research', 'research only', and 'other'. Staff with academic appointments can be engaged in jobs in any of the four functions, depending on their role. The 'vice-chancellor' classification, for instance, is one of the seven academic classification levels, but a vice-chancellor's function should be 'other' (if correctly reported by their university). Similarly, any other academically-classified staff member that ceases performing academic work and moves to a post in central administration should also be reported as having an 'other' function.

Figure 4.1 shows staff counts, expressed as full-time equivalents (FTE) for the period 2002 to 2012, considering staff *function*. All full-time & fractional full-time staff are shown, whether in academic or other OUs (organisational units). The graph shows that the staffing of the university sector expanded by more than 26,000 FTE positions between 2002 and 2012, a growth of about 36 per cent.

Table 2.2 (in Chapter 2) showed that general staff cannot be classified as having either a 'teaching only' or a 'teaching & research' function, but a complicating factor is that all staff can occupy positions that are 'research only' and 'other'. However, even if it is permissible for a university to classify general staff as 'research only', many universities do not do so. Most define all general staff working in academic departments (laboratories, etc.) as having an 'other' function.

Figure 4.1 All Staff (FTE) by Function, 2002 – 2012



Source: uCube FTE = 'full-time equivalent'

Figure 4.1 summarises the distribution of full-time & fractional full-time staff according to the function of their job. Despite being almost invisible on the graph, the number of 'teaching only'

staff has increased by the biggest proportion (+192 per cent). As noted above, among the reasons for this could be attributed to universities increasing the number of these appointments, because 'teaching only' staff are not included in the denominator for calculations relating to research productivity. Until only a few years ago, many universities used the 'teaching only' function exclusively for recording casual teaching staff.

Those in the main bloc of academic staff occupy positions with a 'teaching & research' function. This group increased by a modest 3,910 FTE positions over the period (including 145 FTE in departments that are not AOUs), or about 16 per cent. This is perhaps surprising considering that equivalent full-time student numbers increased by nearly 234,000 (+37 per cent) (see Table 3.1). As noted earlier, much of the burgeoning student body is taught by casual teachers, academics typically employed on short or otherwise precarious contracts.

The number of full-time & fractional full-time staff occupying 'research only' positions increased by over 5,800, or 67 per cent. Some of these are general staff, but most are academics. 'Research only' staff members are often hired to undertake research projects following successful applications for research funding. Typically, many of these positions are limited to the period for which the research funding was obtained, and so are relatively short-lived and are unlikely to be tenurable term positions. However, some academic researchers will also be undertaking some teaching, including the supervision of research students.

The 'other' function is the one under which nearly all general staff are reported, but in 2012 over 1,400 FTE academic staff also had a position classified as having an 'other' function. Such persons include vice-chancellors and deputy vice-chancellors (if they have been correctly coded by their universities) as well as those occupying academic posts, but usually no longer working in academic departments.

On the matter of 'teaching only' and 'teaching & research', Table 4.1 provides a distribution by university of teaching staff in all OUs according to whether they hold posts with either of these functions. As can be seen, some universities have no full-time & fractional full-time 'teaching only' academics, but at the other end of the scale, Swinburne University of Technology, Victoria University (both in Victoria) and Central Queensland University have about a quarter of their teaching staff in 'teaching only' posts. Some universities have shown a recent propensity to increase the number of appointments to 'teaching only' positions. Such changes could also occur out of whim by the staff responsible for reporting staff statistics, or because new programmes involving no research have been developed, or because there is an attempt to reduce the number of staff taken into account in calculations of per capita research outputs.

Some universities appear to have dispensed with the teaching only function. An explanation for this could be that some universities acquired teaching only staff during the process of institutional mergers with pre-Dawkins colleges of advanced education in the early 1990s, and these have either left the system, or have gradually been re-designated as teaching & research academics.

Looking at distribution changes of staff by function over the period, Figure 4.2 examines the sector's full-time & fractional full-time academic and general staff. Those staff occupying positions with academic classifications are also shown within three broad classification levels, as shown in uCube. Unfortunately, uCube provides no distributions by classification level for staff not holding an academic appointment. Counts of staff (expressed in full-time equivalents) are represented by the stacked columns and should be measured against the left axis. The proportion of general staff is represented by the broken line, to be measured against the right axis.

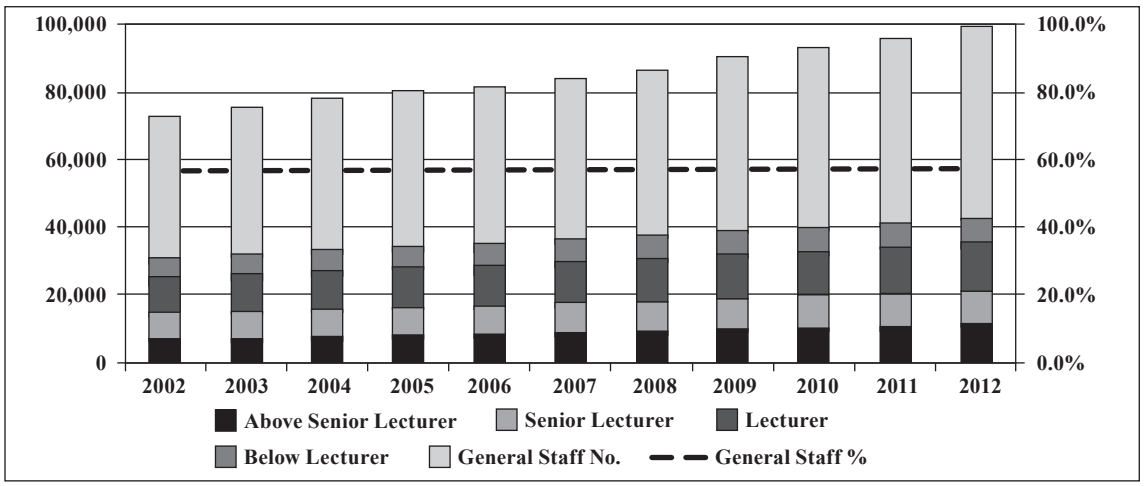
Table 4.1 Full-Time & Fractional Full-Time Teaching Only and Teaching & Research Staff (FTE) in All OUs, by University, 2002 – 2012. Ranked by Percentage of Teaching & Research in 2012

	Teaching Only			Teaching & Research			% Teaching & Research		
	2002	2008	2012	2002	2008	2012	2002	2008	2012
Sydney	23			1,560	1,648	1,881	99%	100%	100%
RMIT				903	889	945	100%	100%	100%
La Trobe	15	40		855	846	905	98%	95%	100%
Adelaide	4			650	756	867	99%	100%	100%
ANU				455	620	744	100%	100%	100%
Wollongong	15			481	634	706	97%	100%	100%
UNE		2		397	378	394	100%	99%	100%
Sunshine Coast			2	87	174	226	100%	100%	99%
James Cook	10	7	6	419	470	514	98%	99%	99%
Macquarie	41	8	11	571	699	718	93%	99%	98%
UTS		12	15	681	719	729	100%	98%	98%
Griffith		17	30	822	902	1,036	100%	98%	97%
Flinders	3	5	17	520	543	582	99%	99%	97%
Canberra	38	2	11	276	335	357	88%	99%	97%
Newcastle	11	21	31	697	655	763	98%	97%	96%
Deakin		27	42	652	756	982	100%	97%	96%
Edith Cowan	37	18	23	494	421	457	93%	96%	95%
UNSW	32	67	98	1,318	1,517	1,649	98%	96%	94%
Murdoch	24	18	28	363	377	431	94%	95%	94%
USQ	24	36	27	360	378	397	94%	91%	94%
UWA			69	748	858	831	100%	100%	92%
UniSA		3	63	674	803	713	100%	100%	92%
Australia	**848**	**994**	**2,478**	**23,460**	**26,138**	**27,370**	**97%**	**96%**	**92%**
UWS	33	23	82	824	652	736	96%	97%	90%
QUT	8	32	117	771	912	925	99%	97%	89%
Queensland		58	171	1,246	1,435	1,318	100%	96%	89%
Ballarat	26	49	25	135	167	188	84%	77%	88%
Charles Darwin	21	16	20	119	147	143	85%	90%	88%
Melbourne	69	15	202	1,354	1,525	1,403	95%	99%	87%
Monash			239	1,452	1,645	1,528	100%	100%	86%
Tasmania		45	114	487	703	688	100%	94%	86%
CSU	88	62	130	439	537	616	83%	90%	83%
Southern Cross			49	246	252	220	100%	100%	82%
ACU			93	337	402	373	100%	100%	80%
Curtin	103	137	197	735	782	782	88%	85%	80%
VU	33	95	130	479	416	411	94%	81%	76%
Swinburne	10	29	147	309	401	433	97%	93%	75%
CQU	22	16	85	295	293	249	93%	95%	75%
Other Universities	158	135	204	248	489	531	61%	78%	72%

Source: uCube FTE = 'full-time equivalent'

Figure 4.2 confirms several points made above and shows clearly that general staff represent more than 55 per cent of all staff, but that this has not really varied much over time. The figure shows that there has been 'bracket creep', in that the proportion of staff employed at 'above senior lecturer' has increased over the period. Full time equivalent numbers in the other academic classifications have also increased a little. The figure also shows that although the number of general staff has increased, its proportion has not.

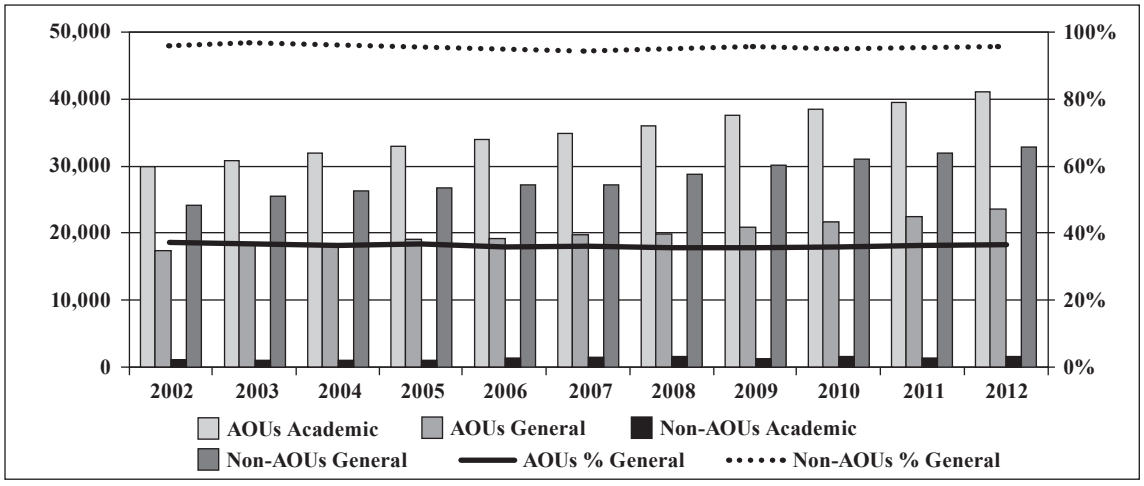
Figure 4.2 All Staff (FTE) by Academic Staff (by classification level) / General Staff and Percentage of General Staff, 2002 – 2012



Source: uCube FTE = 'full-time equivalent'

Whereas Figure 4.2 displayed university staff irrespective of where they worked within universities, Figure 4.3 distinguishes staff in academic departments (AOUs) from those in other departments (such as in service areas or in central administration).

Figure 4.3 All Staff (FTE) by AOU Type, Academic / General Staff and Percentage of General Staff, 2002 – 2012



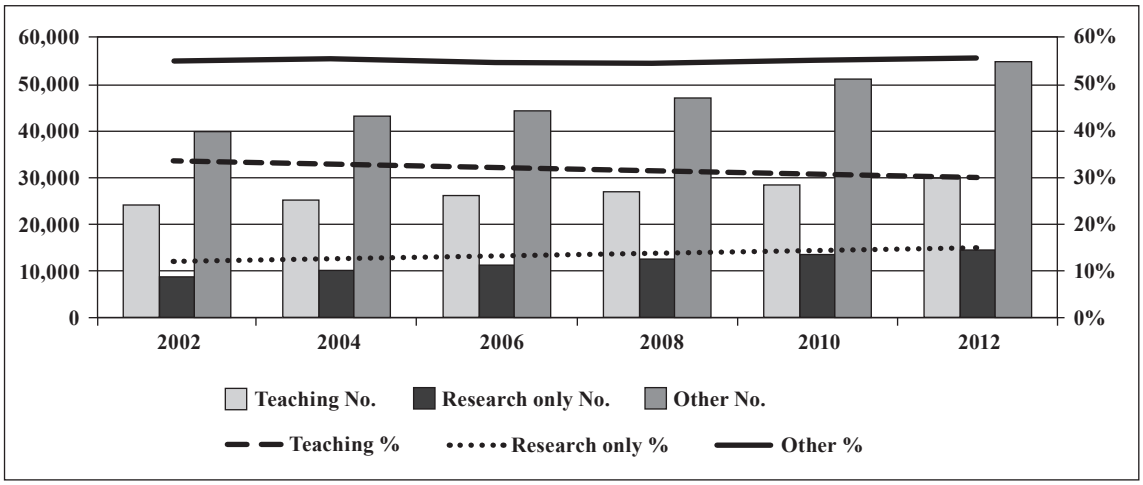
Source: uCube FTE = 'full-time equivalent'

The figure demonstrates that there has been growth across the system, in both academic and other departments. It also shows that in 2012, nearly 22,000 out of about 65,000 of the staff in AOUs were general staff. Relatively few academic staff work in departments other than academic ones: according to uCube, 1,433 FTE of this type of staff worked in central administration and various academic support areas, such as libraries and computer centres, in 2012. General staff represented less than 40 per cent of all staff in AOUs, but about 96 per cent of all staff in non-AOUs.

The next two graphs (Figures 4.4 and 4.5) also show staffing distributions by function, comparing patterns across all university departments (Figure 4.4) and academic departments (AOUs) (Figure 4.5). Numbers of staff (expressed in full-time equivalents) in each category are shown as columns and should be measured against the left axis, and percentages (the lines) against the right. Across the whole university, staff with an 'other' function are in the majority, representing well over half

in all years. Their number increased from nearly 40,000 in 2002 to nearly 55,000 in 2012. Teaching staff (comprising staff with a 'teaching only' or a 'teaching and research' function) represent a declining proportion, having declined from 33 per cent to about 30 per cent. The number of teaching staff in all OUs did increase, however, from fewer than 25,000 to nearly 30,000 FTE. 'Research only' staff in all OUs have increased in number from fewer than 9,000 in 2002 to about 14,500 in 2012. As a proportion, research staff have increased from about 12 per cent to about 15 per cent.

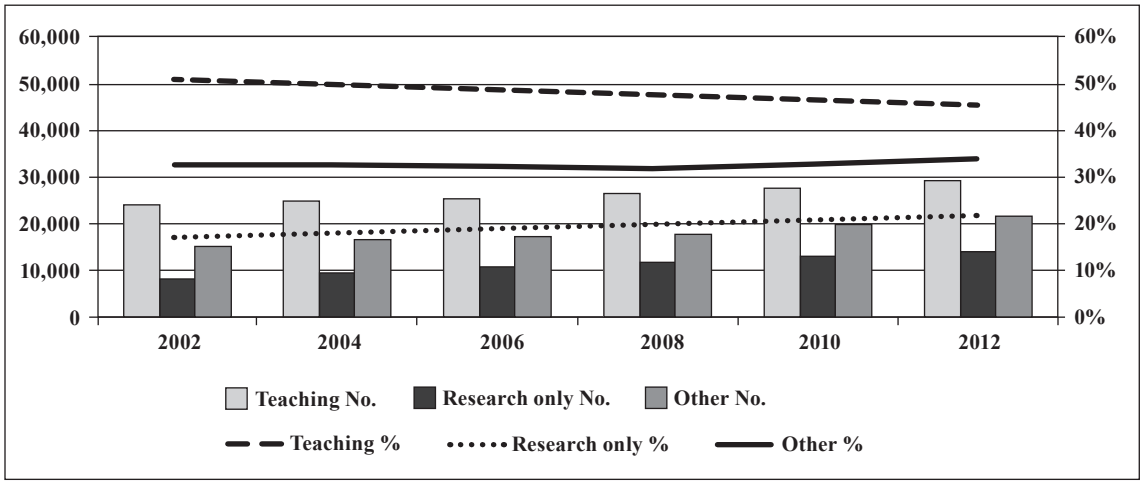
Figure 4.4 All Staff (FTE) in All OUs by Function and Percentage of All Staff, 2002 – 2012



Source: uCube FTE = 'full-time equivalent'

Figure 4.5 presents information on the same scale, but only for staff in AOUs. Therefore, the numbers of teaching staff and research staff are about the same, because teaching and research are activities which occur almost exclusively within academic departments (AOUs). The main difference between Figures 4.4 and 4.5 is that in AOUs, staff members with an 'other' function represent about one-third of all staff, rather than well over a half. The lines represent the proportions of staff with a teaching, research or other function indicate the system-wide pattern, with 'other' function staff increasing their proportion slightly, and a considerable rise in the proportion of research only staff. These proportionate increases have occurred in light of a reciprocal decline in the proportion of full-time equivalent staff involved in teaching. The decline in teaching has been from 51 per cent to 45 per cent of all staff in AOUs. Figure 4.5 makes clear the pattern over time in academic departments, with the relative growth in research. Readers should be reminded that some of the growth in the numbers of staff with an 'other' function could in fact be engaged in research-related work, because some universities classify general staff working in laboratories as having an 'other' function, whereas some categorise them as having a 'research only'. Table 5.3 (in the next chapter) provides additional advice on this matter.

Figure 4.5 All Staff (FTE) in AOUs by Function and Percentage of All Staff, 2002 – 2012



Source: uCube FTE = 'full-time equivalent'

The material above relates to staff with full-time or fractional full-time appointments, information which is more readily accessible from the Department's various outputs. The material immediately below expands the discussion to include the increasing number of casual staff employed by contemporary Australian universities.

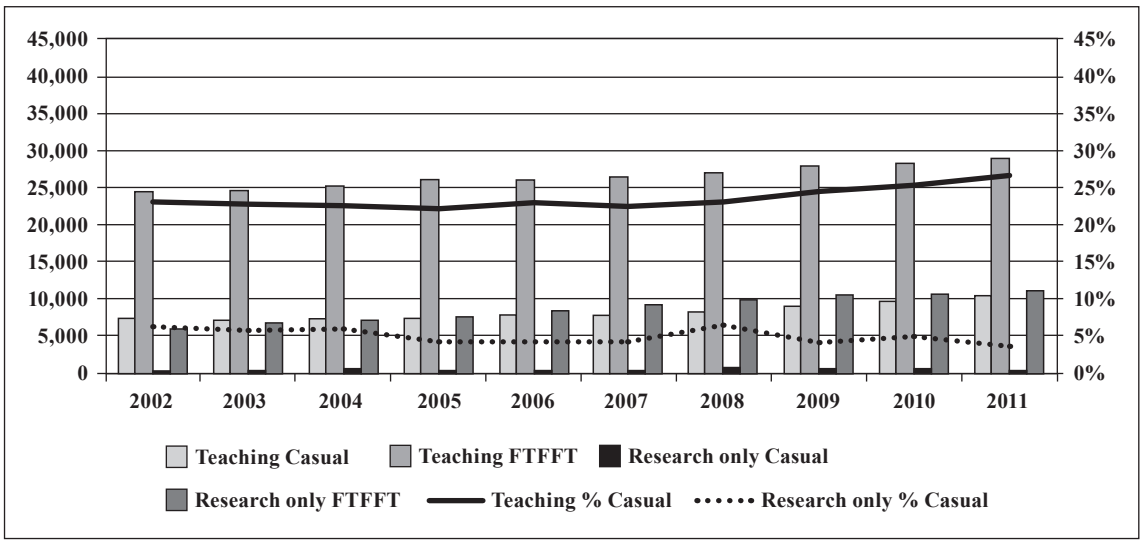
Australia's 'casual' approach to university staffing

The growing literature on this topic was mentioned in Chapter 2. The tables in this section provide information for the period 2001 to 2011, rather than 2012, because 'actual casual' numbers are reported by universities in the year following the one to which they relate. At time of writing (February, 2014), neither uCube nor web-based published tables yet show casual staff figures for 2012.

Figure 4.6 summarises the growth of full-time & fractional full-time staff, and actual casual staff, both expressed as full-time equivalents. All the staff in this figure are academic staff, and they have been divided into *teaching* academics (that is, staff with a function of 'teaching only' or 'teaching & research'), or *research only* academics (that is, staff with an academic classification and a 'research only' function). This dichotomy is not meant to suggest that teaching only staff do not also undertake research occasionally, or that some research only staff do not also teach to some extent.

In the period between 2002 and 2011, full-time equivalent staff numbers increased by about 13,000 FTE, comprising about 7,800 additional teachers and 5,200 additional research only academics. Of the teachers, over 4,500 had full-time & fractional full-time contracts (shown as the darker dotted columns) and about 3,200 FTE had casual contracts (shown as the lighter dotted columns). These columns should be measured against the left axis. The relative proportion of teaching casuals increased from about 23 per cent to nearly 27 per cent (shown as the continuous line, against the right axis). There are fewer research academics than teaching academics, but the number of those with full-time or fractional full-time posts increasing from just over 5,000, to about 10,600 by 2011 (shown by the striped columns). The full-time equivalent count of research only casual staff was relatively low throughout, and has declined in recent years. It is shown by the broken line.

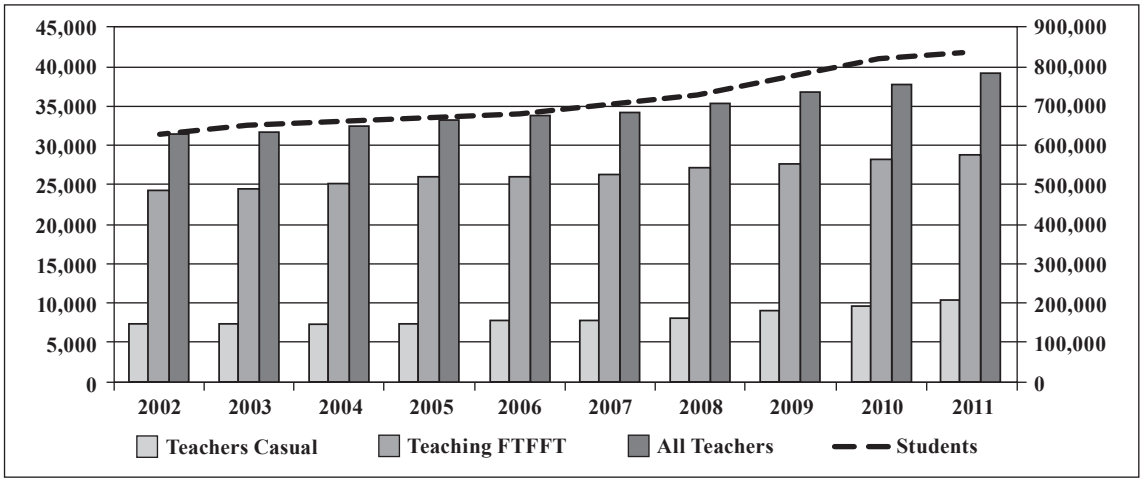
Figure 4.6 Academic Staff (FTE) by Function (excluding 'Other'): Teaching and Research Only Academics by Work Contract and Percentage of Casual Academics, 2002 – 2011



Source: uCube FTE = 'full-time equivalent'

Figure 4.7 compares the system-wide growth of student load (the broken line, to be measured against the right axis) and the columns that represent actual casual teachers, full-time & fractional full-time teachers and all teaching academics, respectively. The fact that the number of students is moving ahead of the number of teachers is clear. Staff FTE in the graph represent one-twentieth of the student EFT, so the gap is actually becoming quite marked. The increasing proportion of casual teachers should also be noted, now up to at least 27 per cent in 2011. The Australian higher education sector expanded by 211,477 equivalent full-time students (+34 per cent, excluding students enrolled with private providers) between 2002 and 2011, but the total increase in teaching staff (including casual teachers) was only 25 per cent (+7,760 FTE). Of this increase, 4,522 FTE was by full-time & fractional full-time staff, and 3,234 by casual teachers.

Figure 4.7 Teaching Staff (FTE); Students (EFTSL), 2002 – 2011

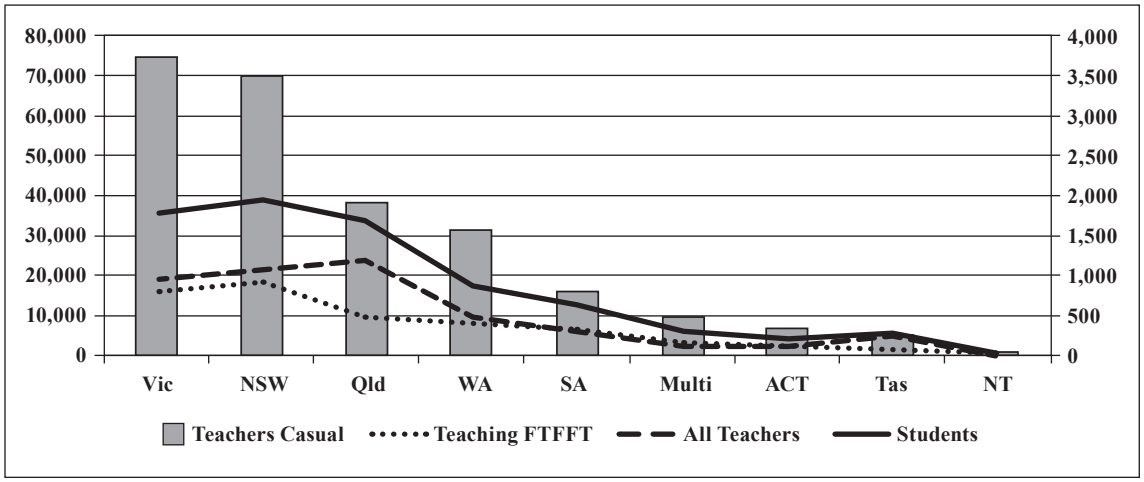


Source: uCube FTE = 'full-time equivalent' (Excludes students with private providers)

Figure 4.8 highlights the existence of state-by-state differences, showing the growth in the number of equivalent full-time students between 2002 and 2011 (the columns), and the matching increase in teaching staff: actual casual staff, full-time & fractional full-time staff and all teaching staff (the lines).

The graph shows states and territories ranked by the expansion of their student body. Student numbers should be read against the left axis, and staff numbers, against the right. Staff numbers are one-twentieth of the student numbers. Had the two stayed in kilter, the unbroken line, representing both full-time & fractional full-time teachers and casual teachers, would be at the same height as the columns that represent growth in student numbers. As can be seen, overall teaching staff numbers in Queensland, South Australia and Tasmania have roughly kept pace with the student expansion, but not so in other states and territories. It would also appear that Queensland has managed to acquire relatively more full-time & fractional full-time staff than other states and territories. In several states, the increase in numbers of casuals has been about equal to the number of full-time & fractional full-time teachers.

Figure 4.8 Students (EFTSL) and Teaching Staff (Full-Time & Fractional Full-Time and Actual Casual) (FTE): Expansion by State/Territory, 2002 – 2011



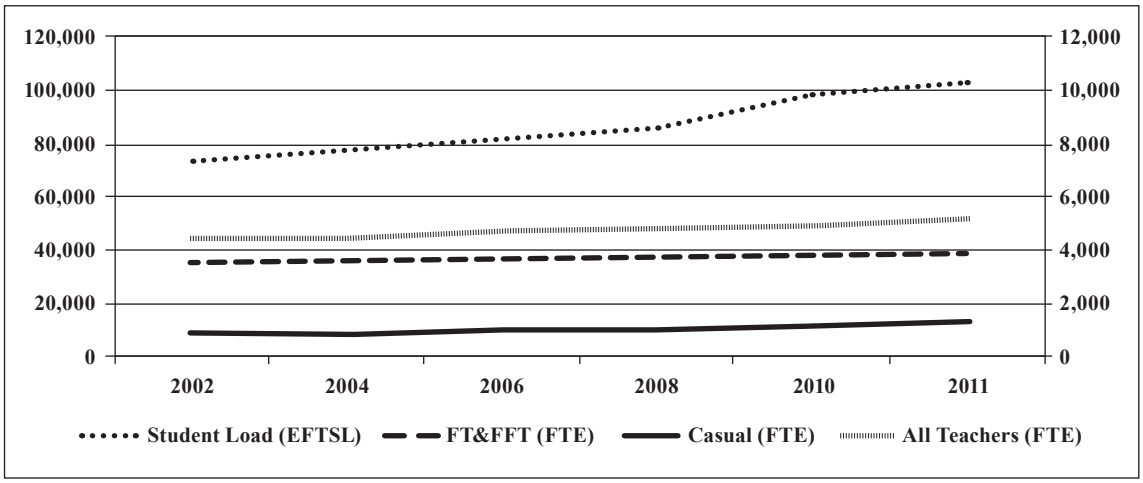
Source: uCube FTE = 'full-time equivalent' Excludes students enrolled in programmes offered by Private Providers

Students and teaching staff in Natural & Physical Sciences

Official statistics no longer provide details of casual staff by AOU group, which creates a difficulty for this report when its specific focus of this report is the Natural & Physical Sciences broad AOU group. Most of the rest of the report concerns full-time & fractional full-time staff in the Natural & Physical Sciences, but the casual staff information shown here has been derived by estimating from when such information was provided, and extrapolated to years after 2009.

Figure 4.9 and Table 4.2 compare students and staff in the Natural & Physical Sciences, with both groups being measured as full-time equivalents. Student numbers increased from less than 75,000, whereas the growth in teaching staff has been gentler. The right axis for FTE teaching staff numbers is only one-tenth of that for students (the left axis). The fact that the lines representing teaching staff are little more than horizontal demonstrates the widening gap between students and staff. The steeper gradient for students is obvious.

Figure 4.9 Student Load (EFTSL) and Teaching Staff: Full-Time and Fractional Full-Time and Actual Casual (FTE) in the Natural & Physical Sciences, 2002 – 2011



Source: Student Load: uCube (Excludes students with private providers). Staff FTE: Totals uCube; distributions by Broad AOU Group based on Table 1.5 of the Department's Staff Statistics, 2012 and staff aggregated data sets 2002 – 2008.
EFTSL = Equivalent full-time student load; FTE = 'full-time equivalent'

Table 4.2 is more specific. It shows that in the period from 2002 to 2011, teaching in the Natural & Physical Sciences disciplines increased by nearly 29,000 equivalent full-time students, or 39 per cent. The relevant comparison here is that teaching staff numbers have lagged behind. Overall teaching numbers have increased by about 16 per cent, but full-time & fractional full-time teaching numbers have increased by only ten per cent. (Note that Table 3.1 showed an increase in students of 46 per cent, but this was up to 2012. Casual staff figures were available only until 2011).

The change in the rough student to staff ratio should be noted. Overall, in the decade from 2002, there has been an increase in the overall ratio of 3.30, an increase of 20 per cent. When comparing student numbers against full-time & fractional full-time teaching staff, the increase has been about 26 per cent.

Table 4.2 Student Load (EFTSL) and Teaching Staff: FT&FFT and Actual Casual (FTE) in the Natural & Physical Sciences, 2002 – 2011

	2002	2004	2006	2008	2010	2011	Variation	
							No.	%
Student Load (EFTSL)	**73,764**	**77,421**	**81,303**	**86,195**	**98,688**	**102,612**	**28,848**	**39%**
Teaching staff (FTE):								
FT&FFT	3,526	3,593	3,696	3,844	3,865	3,881	355	10%
Casual	864	826	962	942	1,066	1,223	359	42%
All Teachers	**4,391**	**4,418**	**4,658**	**4,786**	**4,931**	**5,104**	**713**	**16%**
Ratio: EFTSL : All	16.80	17.52	17.45	18.01	20.01	20.10	3.30	20%
Ratio: EFTSL : FT&FFT	20.92	21.55	22.00	22.42	25.53	26.44	5.52	26%

Source: Student Load: uCube EFTSL = Equivalent full-time student load; FTE = 'full-time equivalent'

The rest of this report provides a consideration only of full-time & fractional full-time staff. It is important to realise, however, that an increasing proportion of the teaching provided in Australia's expanding higher education sector is provided by casual staff, as demonstrated in several of the graphs above.

Chapter 5

Science and the rest: a comparison of staffing patterns

The tables and graphs presented so far were produced directly from uCube, but tables in this chapter and the next required more detail than uCube provides. Specifically, an analysis of staff in the Natural & Physical Sciences is not possible from the limited information in uCube. However, a 99 per cent solution is available by combining uCube data with proportionate distributions that can be established from other outputs from the Department. Please note that minor rounding errors could be present in some tables, because of the way they have been assembled.

This chapter provide a comparison of staff in Natural & Physical Sciences AOUs and other academic AOUs. This definition therefore excludes academic staff in service departments (such as libraries and computer centres), central administration departments, cooperative research centres and what are known as 'independent operations', as did most of the analysis in the previous chapters.

All staff by broad AOU group and function

Table 5.1 shows all staff, whether academic or general staff working under full-time & fractional full-time contracts in academic departments. In order to produce this table, first, the totals for staff with a 'teaching only' or a 'teaching & research' function (mostly considered together), a 'research only' function or an 'other' function were extracted from uCube. Second, the proportionate distribution of the 'teaching' section of the table was calculated from the distribution by broad AOU that can be calculated from the Department's published staff statistics for 2012[18]. It should be observed that the same distribution can also be calculated by using the aggregated staff data sets previously released by the Department. Finally, the totals for staff with a 'research only' or an 'other' function were calculated from the distributions obtained from the Department's aggregated staff data sets for the years shown. Distributions for 2010 and 2012 are estimates based on patterns in earlier years.

The Natural & Physical Sciences had about 15 per cent of the sector's full-time & fractional full-time teaching staff in earlier years, and this declined slightly to 13 – 14 per cent by 2012. Calculating from Table 5.1, the proportion of teaching staff in Health increased from 14 to 16 per cent and from 12 to 13 per cent in Management & Commerce, but the proportion in Society and Culture declined from 26 per cent to 23 per cent.

Most broad AOU groups increased their number of teaching staff over the period in question, with the principal exception being Information Technology, which had fewer teaching staff and staff with an 'other' function by 2012. The Health broad AOU produced the largest absolute growth in teaching staff (+1,446 FTE) followed by Management & Commerce (1,101 FTE) and Society & Culture (+592 FTE). In research, the Natural & Physical Sciences increased the most (+1,935 FTE), followed by Health (+1,465 FTE) and Engineering (+644 FTE).

Looking at 'research only' staff, that is, those in jobs with a 'research only' function, the proportion of the total made up by staff in the Natural & Physical Sciences declined from about 38 per cent to 36 per cent, but there was a reciprocal increase in Health, from 21 to 23 per cent. Among staff with a 'research only' function working in academic departments, the proportionate growth in the Natural & Physical Sciences was 63 per cent, but the increase in Health (+85 per cent) and Engineering (+75 per cent) were greater.

18 See Table 1.5 of the tables that can be retrieved from http://www.innovation.gov.au/highereducation/HigherEducationStatistics/StatisticsPublications/Pages/Library%20Card/2012StaffFulltimeEquivalence.aspx

Among staff with an 'other' function, Health (+1,614 FTE), Society & Culture (+991 FTE) and Natural & Physical Sciences (+904 FTE) expanded the most.

Table 5.1 Full-Time & Fractional Full-Time Staff (FTE) by Broad AOU Group and Function, 2002 – 2012

Function / AOU Group	2002	2004	2006	2008	2010	2012	Variation	
							FTE	%
Teaching								
Natural & Physical Sciences	**3,534**	**3,597**	**3,696**	**3,840**	**3,865**	**3,881**	**347**	**10%**
Agriculture, Environmental	458	497	465	575	603	638	180	39%
Architecture & Building	550	525	527	581	609	644	94	17%
Creative Arts	1,639	1,708	1,763	1,919	2,010	2,127	487	30%
Education	1,835	1,854	1,920	1,859	1,947	2,060	224	12%
Engineering	1,664	1,669	1,677	1,749	1,832	1,938	274	16%
Health	3,272	3,538	3,828	4,258	4,461	4,719	1,446	44%
Information Technology	1,684	1,706	1,434	1,174	1,230	1,301	-383	-23%
Management & Commerce	2,812	3,134	3,264	3,531	3,700	3,913	1,101	39%
Society & Culture	6,120	6,175	5,976	6,057	6,346	6,713	592	10%
No Information	373	390	945	868	1,067	1,336	963	258%
Subtotal	23,942	24,794	25,494	26,411	27,670	29,269	5,327	22%
% Natural & Physical Sci.	15%	15%	14%	15%	14%	13%		
Research Only								
Natural & Physical Sciences	**3,068**	**3,318**	**3,769**	**4,244**	**4,616**	**5,003**	**1,935**	**63%**
Agriculture, Environmental	284	368	460	495	538	583	299	105%
Architecture & Building	39	32	62	56	61	67	28	72%
Creative Arts	36	45	70	121	132	143	107	299%
Education	65	100	107	134	146	158	93	144%
Engineering	855	1,027	1,140	1,272	1,383	1,499	644	75%
Health	1,716	2,089	2,294	2,698	2,934	3,181	1,465	85%
Information Technology	163	200	247	234	255	276	113	70%
Management & Commerce	135	153	202	226	246	267	132	97%
Society & Culture	857	991	1,060	1,188	1,292	1,400	543	63%
No Information	850	965	1,166	1,122	1,221	1,323	473	56%
Subtotal	8,067	9,288	10,577	11,790	12,823	13,900	5,833	72%
% Natural & Physical Sci.	38%	36%	36%	36%	36%	36%		
Other								
Natural & Physical Sciences	**2,827**	**2,703**	**2,922**	**3,060**	**3,383**	**3,731**	**904**	**32%**
Agriculture, Environmental	455	464	379	482	533	587	132	29%
Architecture & Building	216	216	226	235	260	287	71	33%
Creative Arts	646	690	867	778	860	948	302	47%
Education	766	794	805	794	878	968	202	26%
Engineering	1,450	1,471	1,371	1,587	1,754	1,934	484	33%
Health	2,500	2,921	3,077	3,375	3,731	4,114	1,614	65%
Information Technology	722	781	676	473	523	577	-145	-20%
Management & Commerce	1,243	1,378	1,504	1,608	1,778	1,960	717	58%
Society & Culture	2,203	2,210	2,272	2,620	2,896	3,194	991	45%
No Information	2,295	2,665	2,930	2,772	3,065	3,379	1,084	47%
Subtotal	15,323	16,295	17,030	17,784	19,661	21,679	6,356	41%
% Natural & Physical Sci.	18%	17%	17%	17%	17%	17%		
Total	**47,332**	**50,377**	**53,101**	**55,985**	**60,154**	**64,848**		

Source: Totals uCube; distributions by Broad AOU Group: Teaching – Table 1.5 of the Department's Staff Statistics, 2012; Research & Other – distribution calculated from staff aggregated staff data set for years 2002 – 2008. Excludes staff not in an AOU. FTE = 'full-time equivalent'

Research only – academic or general?

As mentioned in several places, staff with a designated function of 'research only' can be either academic or general staff. Table 5.2 demonstrates this distribution, and indicates that the proportion of academic staff in the total is increasing. In 2002, 69 per cent of 'research only' staff held academic posts, but this proportion had risen to 80 per cent by 2012. Among the larger broad AOU groups, higher proportions of the research staff population hold academic positions in the Natural & Physical Sciences (83 per cent in 2012) and Engineering (89 per cent), and a lower proportion in Health (72 per cent). The academic proportion has increased in all broad AOU groups.

Table 5.2 Research Only Staff (FTE) by Broad AOU Group: Academic, General and Percentage Academic, 2002 – 2012

	2002	2008	2012	2002	2008	2012	2002	2008	2012
	Academic Staff			General Staff s			Academic % of All Research Staff		
Nat. & Phys. Sci.	**2,212**	**3,464**	**4,136**	**856**	**780**	**868**	**72%**	**82%**	**83%**
Agriculture, Env.	171	353	421	114	142	162	60%	71%	72%
Architecture	30	44	53	9	12	14	77%	79%	80%
Creative Arts	29	112	133	6	9	9	82%	92%	93%
Education	41	100	120	23	34	39	64%	75%	76%
Engineering	702	1,118	1,334	154	154	165	82%	88%	89%
Health	1,146	1,930	2,304	570	768	877	67%	72%	72%
Info. Technology	131	203	242	32	31	34	81%	87%	88%
Management	88	183	218	47	44	49	65%	81%	82%
Soc. & Culture	606	955	1,140	251	233	260	71%	80%	81%
No Info	418	800	955	432	322	368	49%	71%	72%
Other than N&PS	3,362	5,796	6,920	1,637	1,750	1,976	67%	77%	78%
Subtotal	5,574	9,260	11,056	2,493	2,530	2,844	69%	79%	80%
N&PS %	**40%**	**37%**	**37%**	**34%**	**31%**	**31%**			

Source: Totals uCube; distributions by Broad AOU Group: Teaching – Table 1.5 of the Department's Staff Statistics, 2012; Research & Other – distribution calculated from staff aggregated staff data set for years 2002 – 2008.
FTE = 'full-time equivalent'

Whether or not general staff are appointed to positions designated as having a 'research only' function seems to be university-related. Table 5.3 shows the variation between universities as to the distribution of 'research only' staff between academic and general staff (for universities with more than 100 FTE academic researchers in 2012). Several universities reported no or few general staff as 'research only'. In other words, in 2012, La Trobe, RMIT and the University of Tasmania reported all their laboratory-related general staff as having an 'other' function, and nearly all of these staff at the universities of Melbourne and Wollongong, as well as the universities with fewer than 100 'research only' academics in 2012.

Many universities have been consistent across the years with the way they have reported 'research only' staff. La Trobe, Deakin and the University of Melbourne have consistently reported all general staff as having an 'other' function, but Monash, for example, in 2012 reported many more general staff as being 'research only' than previously. Has this change come about randomly, because no one has been scrutinising statistical information, or does this represent a policy to appoint laboratory-based staff within the general staff structure rather than within academic ranks?

It is not easy to be sure whether anything is to be discerned from the distribution of 'research only' posts between staff classified according to either academic or general employment awards. The patterns do not appear to be state-based, so perhaps whether general staff members are reported as having a 'research only' or an 'other' function has been be based on nothing more than history or

whim. Of course, the argument mentioned earlier about the expansion in the number of staff reported as 'teaching only' rather than 'teaching & research' might be relevant. In that instance, reducing the number of staff in the denominator used for calculating research productivity could produce an improved result in some instances. A similar impact could be had by reclassifying certain laboratory-based 'research only' staff from academic to general staff classifications. This also would reduce the denominator in research productivity calculations. However, the fact that the 'academic' proportion of the research only workforce has grown so strongly probably indicates that as universities seek to boost their research outputs they will be hiring academics rather than general staff. One would not normally expect staff with general staff classifications to be leading research projects, even if such a situation is not beyond the bounds of possibility.

Table 5.3 Academic and General Research Only Staff (FTE) in AOUs by University. Ranked by Percentage of Academic Staff, 2012

University	Academic Staff			General Staff			% Academic		
	2002	2008	2012	2002	2008	2012	2002	2008	2012
La Trobe	128	199	228				100%	100%	100%
RMIT	98	150	222	30	17		77%	90%	100%
Tasmania	122	141	182	36	23		77%	86%	100%
Deakin	95	150	266			3	100%	100%	99%
Melbourne	801	1,318	1,255	36	57	34	96%	96%	97%
Wollongong	73	168	256	7	5	7	91%	97%	97%
Other Universities #	262	495	536	147	88	48	64%	85%	92%
South Australia	129	222	269	20	44	31	87%	83%	90%
Macquarie	75	130	216	27	12	26	74%	92%	89%
Curtin	95	199	261	29	17	52	77%	92%	83%
UTS	35	104	211	44	50	45	44%	68%	82%
Australia	**5,574**	**9,260**	**11,056**	**2,493**	**2,530**	**2,843**	**69%**	**79%**	**80%**
Monash	682	1,205	946	16		254	98%	100%	79%
Adelaide	236	384	576	211	272	174	53%	59%	77%
Sydney	394	723	873	136	252	268	74%	74%	77%
UNSW	358	673	936	164	197	301	69%	77%	76%
Flinders	84	148	208	78	83	67	52%	64%	76%
UWA	312	465	593	178	185	195	64%	72%	75%
QUT	76	203	258	65	92	91	54%	69%	74%
ANU	691	850	832	647	388	305	52%	69%	73%
Griffith	79	196	299	99	110	127	44%	64%	70%
James Cook	47	88	101	35	40	44	57%	69%	70%
Queensland	639	876	1,313	379	492	632	63%	64%	68%
Newcastle	61	172	220	109	106	137	36%	62%	62%

Source: uCube FTE = 'full-time equivalent'
Fewer than 100 academic 'research only' staff in 2012

Academics only: teaching or research?

The tables that follow consider only academic staff, mostly according to whether they are *teaching* academics (that is, those with functions of either 'teaching only' or 'teaching & research'), or *research only* academics (that is, those academics in a position with a 'research only' function. Without drawing a distinction between the teaching and the research functions, two quite different patterns would be rendered into a meaningless average.

Table 5.4 provides a summary of the populations considered in this and the next chapter. The totals for teaching staff (which by definition, can only be academic staff) and academic research only staff have been taken from uCube.

The proportion that teachers make up of all full-time & fractional full-time academic staff has declined from about 81 per cent to about 73 per cent, as a larger proportion of new academic posts is devoted to research (calculated from Table 5.4). This observation can be made about academics whether in the Natural & Physical Sciences or other AOU groups. The proportion that academics classified as research in Natural & Physical Sciences AOUs (37 – 40 per cent) is rather higher than the proportion its teaching academics make up (14 – 15 per cent). The number of full-time equivalent teaching academics increased by 22 per cent between 2002 and 2012, which was higher than that achieved in the Natural & Physical Sciences (+10 per cent). As can be seen, the nominal and relative growth among research academics exceeds that among teachers. The number of university research only academics almost doubled between 2002 and 2012. The increase was 98 per cent overall and 87 per cent within Natural & Physical Sciences AOUs. This simple table shows clearly that changes in academic staff would be misleading if it were not divided between teaching academics and research only academics. Numbers of research only academics have increased strongly, but not so numbers of teaching academics, especially when the expansion in student numbers is taken into consideration. Table 3.1 (in Chapter 3) showed that the number of equivalent full-time students increased by 37 per cent, and by 46 per cent in the case of the Natural & Physical Sciences.

Table 5.4 Full Time & Fractional Full Time Academic Staff (FTE): All Academic Staff in Natural & Physical Sciences AOUs and Other AOUs, 2002 – 2012

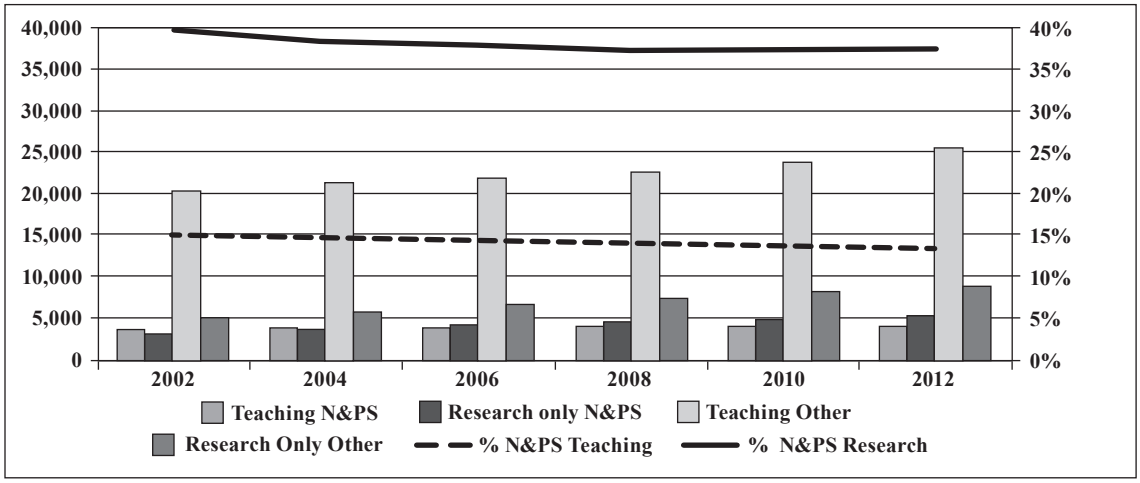
Function / AOU Group	2002	2004	2006	2008	2010	2012	Variation	
							FTE	%
Total Teaching Staff	**23,943**	**24,794**	**25,494**	**26,410**	**27,670**	**29,269**	**5,326**	**22%**
% Natural & Physical Sciences #	**15%**	**15%**	**14%**	**15%**	**15%**	**14%**		
No. Natural & Physical Sciences	3,531	3,602	3,694	3,839	3,865	3,881	350	10%
No. Other AOUs	20,412	21,192	21,800	22,571	23,805	25,388	4,976	24%
Total Research Only Staff	**5,574**	**6,655**	**8,063**	**9,260**	**10,100**	**11,056**	**5,482**	**98%**
% Natural & Physical Sciences #	**40%**	**39%**	**38%**	**37%**	**37%**	**37%**		
No. Natural & Physical Sciences	2,210	2,570	3,061	3,465	3,780	4,137	1,927	87%
No. Other AOUs	3,364	4,085	5,002	5,795	6,320	6,919	3,555	106%

Source: Totals uCube; distributions by Broad AOU Group: Teaching – Table 1.5 of the Department's Staff Statistics, 2012; Research & Other – distribution calculated from staff aggregated staff data sets for years 2002 – 2008.
FTE = 'full-time equivalent'

The information in Table 5.4 is also presented graphically in Figure 5.1, which shows academic staff involved in teaching or research in the Natural & Physical Sciences AOUs and all other AOUs. The numbers of staff, expressed in full-time equivalents are shown as columns, to be measured against the left axis, whereas the percentages of staff are shown by lines, to be measured against the right axis. The dotted line shows the proportion of that teaching staff in Natural & Physical Sciences AOUs are as a proportion of all teaching academics. According to other statistics produced by the Department, the Natural & Physical Sciences component of teaching academics has been fairly consistently around 15 per cent during the period shown.

Figure 5.1 also shows academics occupying 'research only' positions. The proportion of all research academic appointments in the Natural & Physical Sciences is rather higher than is the case in teaching, starting at around 40 per cent of the total being in 'science' departments in 2002. The figure also demonstrates the extent to which research appointments in the Natural & Physical Sciences have grown relative to teaching.

Figure 5.1 Academic Staff (FTE) in Natural & Physical Sciences AOUs and All Other AOUs, 2002 – 2012



Source: Totals uCube; distributions by Broad AOU Group: Teaching – Table 1.5 of the Department's Staff Statistics, 2012; Research & Other – distribution calculated from staff aggregated staff data set for years 2002 – 2008.
FTE = 'full-time equivalent'

Tables 5.5 to 5.8 compare patterns in the staffing of Natural & Physical Sciences AOUs with those in other AOUs, examining tenure, classification level, age group, and gender respectively.

Academic tenure

Table 5.5 considers tenure rates in Natural & Physical Sciences AOUs and all other AOU groups. At the start of the period in question, the proportion of teaching academics in tenurable positions was 84 per cent in the Natural & Physical Sciences, and 77 per cent in other AOU groups. By 2012, however, the gap had all but closed, with the proportion of teaching academics in tenurable positions being 74 – 75 per cent across the board, on average. Tenurable posts would appear to be less common in the second decade of the 21st Century than at its start. In the Natural & Physical Sciences, there was a decline in the number of teaching staff in tenurable positions (-74 FTE; two per cent). This should be compared with growth of 76 per cent among those positions with a limited term. In other AOU groups, equivalent figures were 19 per cent and 43 per cent, respectively.

Rates of tenure are typically much lower for academic researchers, due to the nature of these appointments. Many occupants of these positions have been hired on short-term contacts that match the duration of funding that has been granted by funding organisations such as the Australian Research Council and the National Health and Medical Research Council. In the Natural & Physical Sciences, around 93 per cent of 'research only' academics held limited term positions, with a similarly high proportion in other AOU groups.

Table 5.5 Full Time & Fractional Full Time Academic Staff (FTE): All Academic Staff in Natural & Physical Sciences AOUs and Other AOUs by Tenure, 2002 – 2012

Function / AOU Group	2002	2004	2006	2008	2010	2012	Variation	
							FTE	%
Teaching								
Natural & Physical Sciences								
Tenurable	2,971	2,976	2,928	2,866	2,885	2,897	-74	-2%
Untenured	560	625	766	973	980	984	424	76%
Sub total	3,531	3,602	3,694	3,839	3,865	3,881	350	10%
% Tenurable	84%	83%	79%	75%	75%	75%		
Other AOU Groups								
Tenurable	15,795	16,777	16,912	16,777	17,616	18,787	2,992	19%
Untenured	4,616	4,415	4,888	5,793	6,189	6,601	1,985	43%
Sub total	20,412	21,192	21,800	22,571	23,805	25,388	4,976	24%
% Tenurable	77%	79%	78%	74%	74%	74%		
Research Only								
Natural & Physical Sciences								
Tenurable	153	152	199	244	266	292	139	91%
Untenured	2,057	2,418	2,862	3,221	3,513	3,846	1,789	87%
Sub total	2,210	2,570	3,061	3,465	3,780	4,137	1,927	87%
% Tenurable	7%	6%	6%	7%	7%	7%		
Other AOU Groups								
Tenurable	288	383	416	456	497	544	256	89%
Untenured	3,076	3,702	4,587	5,339	5,823	6,374	3,298	107%
Sub total	3,364	4,085	5,002	5,795	6,320	6,919	3,555	106%
% Tenurable	9%	9%	8%	8%	8%	8%		

Source: Totals uCube; distributions by Broad AOU Group: Teaching – Table 1.5 of the Department's Staff Statistics, 2012; Research & Other – distribution calculated from staff aggregated staff data set for years 2002 – 2008. FTE = 'full-time equivalent'

Seniority

Table 5.6 compares seniority levels within the Natural & Physical Sciences and all other AOU groups. Among teachers, only nine or ten per cent are in the 'below lecturer' (Level A classification), both in Natural & Physical Sciences and other AOU Groups. At the other end of the scale, the proportion of professors (Level E) is higher in the Natural & Physical Sciences than in other AOU groups. The proportion of 'science' professors increased by about 202 FTE between 2002 and 2012, an increase of 41 per cent, and the proportion of professors of all Natural & Physical Sciences teaching academics increased from 14 per cent to 18 per cent over the period. Figures for professorial staff in other AOU groups indicate an increase of about 63 per cent, but the proportion of professors was over 13 per cent in 2012, up from 10 per cent in 2002. Among teaching academics across the sector, there has clearly been 'bracket creep' at Level E. In the Natural & Physical Sciences, expansion in professor numbers represented 58 per cent of all increases in full-time & fractional full-time teachers (202 out of a total increase of 350 FTE). In other AOU groups, the expansion in the number of professors was also substantial, at about 27 per cent (1,323 out of 4,976 FTE).

There appears to have been no growth at the associate professor level (Level D) in the Natural & Physical Sciences, whereas in other AOU groups, growth at Level D had been 38 per cent. Among staff in Level B and Level C positions, the rate of growth in AOUs other than the Natural & Physical Sciences was greater.

Among research only academics, a higher proportion of appointments are at Level A, the most junior rank. In the Natural & Physical Sciences about 53 – 55 per cent of academic research only staff were at Level A, compared with 42 to 47 per cent in other AOU groups. In both instances, the proportion of all research staff at Level A seems to have decreased a little.

Table 5.6 Full Time & Fractional Full Time Academic Staff (FTE): All Academic Staff in Natural & Physical Sciences AOUs and Other AOUs by Classification Level, 2002 – 2012

Function / Classification	2002	2004	2006	2008	2010	2012	Variation	
							FTE	%
Teaching								
Natural & Physical Sciences								
Level A	315	328	284	331	333	335	20	6%
Level B	902	955	973	967	974	978	76	8%
Level C	1,051	1,043	1,079	1,087	1,095	1,099	48	5%
Level D	776	755	747	771	776	780	4	0%
Level E	488	520	611	682	687	690	202	41%
Sub total	3,531	3,602	3,694	3,839	3,865	3,881	350	10%
% Level A	9%	9%	8%	9%	9%	9%		
Other AOU Groups								
Level A	2,120	2,168	2,063	2,061	2,174	2,318	198	9%
Level B	7,662	7,853	7,893	7,940	8,375	8,932	1,270	17%
Level C	6,009	6,172	6,334	6,426	6,777	7,228	1,219	20%
Level D	2,538	2,717	2,944	3,116	3,286	3,505	967	38%
Level E	2,083	2,282	2,566	3,028	3,193	3,406	1,323	63%
Sub total	20,412	21,192	21,800	22,571	23,805	25,388	4,976	24%
% Level A	10%	10%	9%	9%	9%	9%		
Research Only	**2,210**	**2,570**	**3,061**	**3,465**	**3,780**	**4,137**	**1,927**	**87%**
Natural & Physical Sciences								
Level A	1,224	1,409	1,742	1,828	1,994	2,183	959	78%
Level B	568	669	760	958	1,045	1,143	575	101%
Level C	207	233	258	314	343	375	168	81%
Level D	109	130	138	140	153	168	59	54%
Level E	102	130	163	225	245	268	166	163%
Sub total	2,210	2,570	3,061	3,465	3,780	4,137	1,927	87%
% Level A	55%	55%	57%	53%	53%	53%		
Other AOU Groups								
Level A	1,581	1,836	2,230	2,436	2,657	2,909	1,328	84%
Level B	957	1,210	1,517	1,887	2,059	2,253	1,296	135%
Level C	458	573	668	764	833	912	454	99%
Level D	190	229	263	324	353	386	196	103%
Level E	178	237	324	384	419	458	280	157%
Sub total	3,364	4,085	5,002	5,795	6,320	6,919	3,555	106%
% Level A	47%	45%	45%	42%	42%	42%		

Source: Totals uCube; distributions by Broad AOU Group: Teaching – Table 1.5 of the Department's Staff Statistics, 2012; Research & Other – distribution calculated from staff aggregated staff data set for years 2002 – 2008.
FTE = 'full-time equivalent'

Age

Natural & Physical Sciences teachers tended to be older than their colleagues from other AOU groups in 2002, but in more recent years, the pattern has shifted. As can be seen in Table 5.7, over the period, 26 to 28 per cent of teachers were aged over 54 years. Growth in the number of teachers younger than 35 years in the Natural & Physical Sciences was stronger than for this age

group in other AOU groups. There was an expansion of 41 per cent here, compared with 24 per cent for younger academics in other AOU groups. There was a quite different pattern in the expansion in the numbers of older academics. In the Natural & Physical Sciences, the above 54 years age group increased in size by three per cent, compared with a 55 per cent spurt in the number of older academics in other AOU groups.

Research, however, can be seen as a younger person's game. Six or seven percent of 'science' research academics were aged over 54 years, compared with up to 11 per cent in other AOU groups. The proportion of younger research only science academics had been 41 per cent in 2002, rising to about 44 per cent a decade later. Equivalent figures for research only academics in other AOU groups were 35 – 36 per cent across the period.

Table 5.7 Full Time & Fractional Full Time Academic Staff (FTE): All Academic Staff in Natural & Physical Sciences AOUs and Other AOUs by Age Group, 2002 – 2012

Function / Age Group	2002	2004	2006	2008	2010	2012	Variation	
							FTE	%
Teaching								
Natural & Physical Sciences								
< 35	291	330	339	406	409	411	120	41%
35-54	2.250	2.249	2,319	2,419	2,435	2,445	195	9%
>54	991	1,022	1,035	1,014	1021	1,025	34	3%
Sub total	3,531	3,602	3,694	3,839	3,865	3,881	350	10%
% >54	28%	28%	28%	26%	26%	26%		
Other AOUs								
< 35	1,956	2,083	2,010	2,150	2,268	2,419	463	24%
35-54	13,692	13,638	13,656	13,872	14,631	15,604	1,912	14%
>54	4,763	5,472	6,135	6,548	6,906	7365	2,602	55%
Sub total	20,412	21,192	21,800	22,571	23,805	25,388	4,976	24%
% >54	23%	26%	28%	29%	29%	29%		
Research Only								
Natural & Physical Sciences								
< 35	907	1,122	1,369	1,522	1,660	1,817	910	100%
35-54	1,174	1,287	1,494	1,707	1,862	2,039	865	74%
>54	129	162	198	236	258	282	153	119%
Sub total	2,210	2,570	3,061	3,465	3,780	4,137	1,927	87%
% >54	6%	6%	6%	7%	7%	7%		
Other AOUs								
< 35	1,167	1,417	1,758	2,078	2,266	2,481	1,314	113%
35-54	1,923	2,295	2,702	3,055	3,332	3,647	1,724	90%
>54	274	373	543	662	722	790	516	188%
Sub total	3,364	4,085	5,002	5,795	6,320	6,919	3,555	106%
% >54	8%	9%	11%	11%	11%	11%		

Source: Totals uCube; distributions by Broad AOU Group: Teaching – Table 1.5 of the Department's Staff Statistics, 2012; Research & Other – distribution calculated from staff aggregated staff data set for years 2002 – 2008. FTE = 'full-time equivalent'

Gender

From Table 5.8 it can be seen that the female teaching contingent within Natural & Physical Sciences has expanded more strongly than its male equivalent. By 2012, there were about 397 FTE more female academics (+49 per cent) compared with the case in 2002. The number of male teachers actually declined by 47 FTE over the period, a drop of about two per cent. The proportion of female teachers increased from about 23 per cent to about 31 per cent. The growth in the number of female teaching academics over their male colleagues was also stronger in AOUs other

than the Natural & Physical Sciences, and the proportion of women increased from about 38 per cent to about 43 per cent.

The proportion of female academics in research is higher than in teaching, in all AOUs. By 2012, women made up about 40 per cent of the research academic workforce in Natural & Physical Sciences AOUs, and 46 per cent in other AOUs.

Table 5.8 Full Time & Fractional Full Time Academic Staff (FTE): All Academic Staff in Natural & Physical Sciences AOUs and Other AOUs by Gender, 2002 – 2012

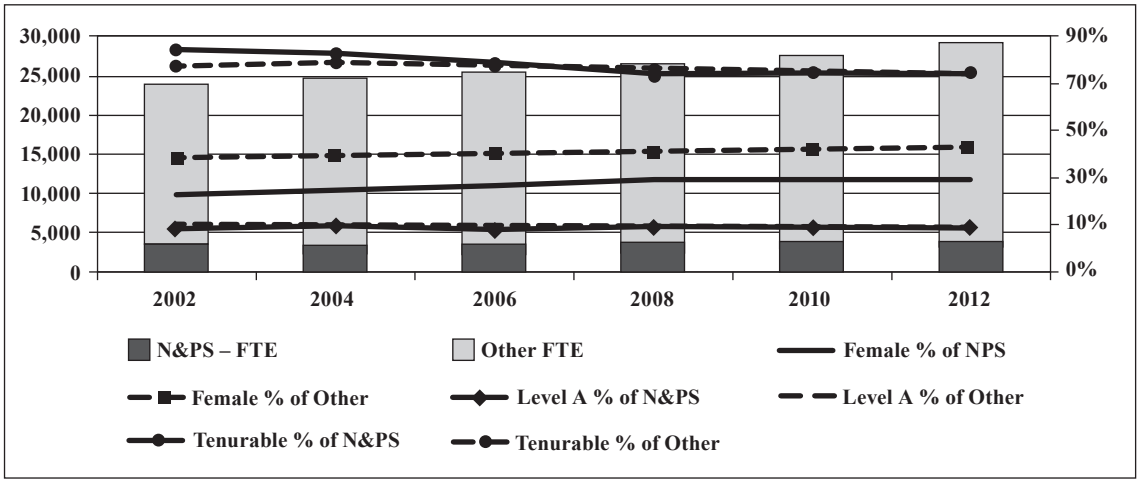
Function / Gender	2002	2004	2006	2008	2010	2012	Variation	
							FTE	%
Teaching								
Natural & Physical Sciences								
Female	818	879	984	1100	1163	1215	397	49%
Male	2713	2723	2709	2740	2702	2666	-47	-2%
Sub total	3531	3602	3694	3839	3865	3881	350	10%
% Female	23%	24%	27%	29%	30%	31%		
Other AOU Groups								
Female	7851	8444	9010	9631	10,236	10,917	3066	39%
Male	12561	12748	12790	12939	13,569	14,471	1910	15%
Sub total	20412	21192	21800	22571	23,805	25,388	4976	24%
% Female	38%	40%	41%	43%	43%	43%		
Research Only								
Natural & Physical Sciences								
Female	850	1003	1176	1371	1496	1637	787	93%
Male	1361	1567	1885	2094	2284	2500	1139	84%
Sub total	2210	2570	3061	3465	3780	4137	1927	87%
% Female	38%	39%	38%	40%	40%	40%		
Other AOUs								
Female	1437	1749	2208	2690	2933	3211	1774	123%
Male	1927	2335	2794	3105	3387	3708	1781	92%
Sub total	3364	4085	5002	5795	6320	6919	3555	106%
% Female	43%	43%	44%	46%	46%	46%		

Source: Totals uCube; distributions by Broad AOU Group: Teaching – Table 1.5 of the Department's Staff Statistics, 2012; Research & Other – distribution calculated from staff aggregated staff data set for years 2002 – 2008. FTE = 'full-time equivalent'

'Science' and the rest: a summary

Figures 5.2 and 5.3 present graphical summaries of patterns of distribution among teaching staff in the Natural & Physical Sciences and Other AOU groups (5.2), and academic 'research only' positions for the period 2002 to 2012 (5.3). In both figures, the number of academics (expressed as full-time equivalents) is indicated by the columns, which should be read against the left axis, and the percentages of those staff who are women, in junior positions ('below lecturer') and in tenurable positions. The proportions of staff in National & Physical Sciences AOUs are shown as unbroken lines, and those in Other AOUs are shown as broken lines. Line markers show triangles for the proportion of women, circles for proportions holding tenurable posts, and crosses for the proportion at the 'below lecturer' classification. These two graphs have been constructed on the same scale, so it is also possible to compare the relative counts of teaching and research academics.

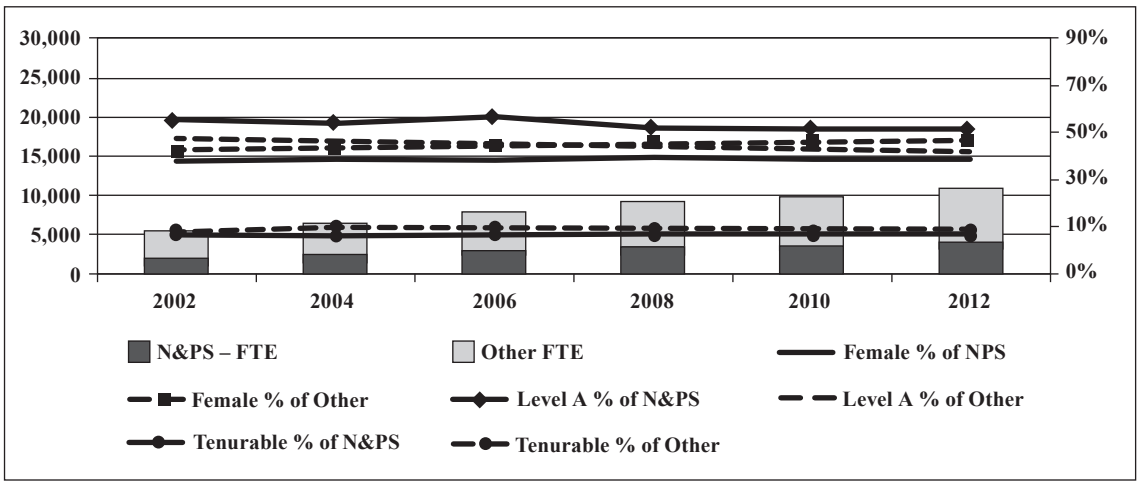
Figure 5.2 Teaching Staff (FTE) in Natural & Physical Sciences AOUs and Other AOUs: Female and Level A Proportion of Total, 2002 – 2012



Source: Totals uCube; distributions by Broad AOU Group: Teaching – Table 1.5 of the Department's Staff Statistics, 2012; Research & Other – distribution calculated from staff aggregated staff data set for years 2002 – 2008. FTE = 'full-time equivalent'

Figure 5.2 shows that there is little difference between the Natural & Physical Sciences and other AOU groups the proportions of Level A teachers and teachers holding tenurable positions, but the gap between Natural & Physical Sciences and other AOU groups with respect to gender is equally clear, at about ten percentage points.

Figure 5.3 Academic Research Only Staff (FTE) in Natural & Physical Sciences AOUs and Other AOUs: Female and Level A Proportion of Total, 2002 – 2012



Source: Totals uCube; distributions by Broad AOU Group: Teaching – Table 1.5 of the Department's Staff Statistics, 2012; Research & Other – distribution calculated from staff aggregated staff data set for years 2002 – 2008. FTE = 'full-time equivalent'

The marked difference between the Natural & Physical Sciences and other AOU groups in the proportion of women in teaching is not replicated among 'research only' academics (see Figure 5.3), but there is still a gap of about five percentage points between the two. The relatively low proportion of academic researchers in tenurable positions is evident, as is the relatively high proportion of staff at Level A.

The next chapter presents analysis of mainly academic teaching staff in the Natural & Physical Sciences, elicited by drilling down to the next level of detail, the 'narrow AOU'.

Chapter 6

A closer look at 'science'

The main aim of this chapter is to analyse patterns of academic staffing within the *narrow* academic organisational units (AOUs) that make up the broad AOU *Natural & Physical Sciences*. The narrow AOUs in question are Biological Sciences, Chemical Sciences, Earth Sciences, Mathematical Sciences, Physics & Astronomy, and Other Natural & Physical Sciences. The latter group includes medical science, forensic science, food science and biotechnology, pharmacology, and laboratory technology. This chapter also contains a section on the gender distribution of academics in the Natural & Physical Sciences.

Chapter 2 included a description of how teaching staff are allocated to narrow AOUs (see also Appendix 2). The process involves a simple algorithm based on the distribution of student load within the equivalent discipline group. The main problem with this methodology is that it can leave a relatively large proportion of teaching staff not allocated to a specific narrow AOU. There is less of an issue if 70 per cent or more of the teaching is in one narrow discipline. In such a case, all the staff linked to that AOU / discipline will be classified as being in that AOU. If no single narrow discipline group accounts for more of 69 per cent of the student load attributed to the AOU, then the staff linked to that AOU group code will be allocated to the 'not specified' narrow AOU group, which is the seventh narrow AOU within the Natural & Physical Sciences. Part of the challenge in this study has been to come up with a methodology for allocating those staff not already allocated according to the student load-based algorithm. Of course, in the situation where say, 70 per cent of student load can be attributed to a single narrow discipline group, an imprecision is created with the 30 per cent of staff *not* teaching in the discipline that makes up 70 per cent of the total. In effect, these staff are misallocated to a narrow AOU group.

Another challenge is that the Department's uCube system does not provide any staff information by AOU, not even at the broad AOU group level. Therefore, as was the case for analysis in Chapter 5, it has been necessary to augment uCube figures by using other published material. The fact that some estimating has been required means that there can be minor discrepancies between 'actual' numbers and those reported here. However, minor variability is to be expected in any case, because material produced by the Department can be subject to so-called *perturbation*[19].

Drilling down: science staffing by narrow AOU

Most of the analysis in this chapter looks at the next level of detail: by narrow AOU groups within the Natural & Physical Sciences, focussing on academic staff working in academic AOUs and involved in academic work. Staff members with an academic classification, but not reported by their university as undertaking academic work, have been excluded. These staff can be isolated because their function has been reported as having an 'Other' function, (rather than 'teaching only', 'teaching & research' or 'research only'), and they are relatively few in number.

The increased lack of precision when dealing with staffing at the level of narrow AOU becomes obvious once the data have been laid out. Natural & Physical Sciences comprises five specifically-defined narrow AOUs, plus 'Natural & Physical Sciences – Other', which consists of medical science, forensic science, food science and biotechnology, pharmacology and laboratory technology, as well as any other disciplines / fields of education in 'science' that universities felt

19 http://www.highereducationstatistics.deewr.gov.au/FAQ.aspx '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, 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 they are small, do not impair the utility of the tabular data'.

they could not otherwise define with one of the named narrow AOUs. This is also the case in other broad AOU groups. This factor reduces the precision that is possible in analysing staff in AOUs compared with analyses of patterns of enrolments, student load or course completions.

Table 6.1 shows the distribution of academic *teaching* staff between narrow AOU groups within the Natural & Physical Sciences broad AOU group. This is the distribution that can be gleaned from the Department's aggregated data files, freely available until 2011. Figures for years 2010 – 2012 are estimates. The largest single actual narrow AOU in the Natural & Physical Sciences is the Biological Sciences, followed by Mathematical Sciences. The latter had been declining in size, but teaching staff numbers started to increase again from 2006. The smaller narrow AOUs of Earth Sciences and Physics & Astronomy are also showing declining teaching staff numbers. The narrow AOU Other Natural & Physical Sciences has increased the most in proportionate terms. The number of teachers in Chemical Sciences was declining, but appears to be on the increase again.

Table 6.1 Teaching Staff (FTE) in Natural & Physical Sciences Narrow AOUs: Raw Data, 2002 – 2012

Narrow AOU Group		2002	2004	2006	2008	2010	2012	Variation	
								FTE	%
Biological Sciences	No.	924	876	946	1057	935	986	62	7%
	%	26%	24%	26%	28%	24%	25%		
Chemical Sciences	No.	242	229	208	223	224	253	11	5%
	%	7%	6%	6%	6%	6%	7%		
Earth Sciences	No.	118	118	77	95	119	95	-23	-20%
	%	3%	3%	2%	2%	3%	2%		
Mathematical Sciences	No.	544	528	402	440	496	595	51	9%
	%	15%	15%	11%	11%	13%	15%		
Physics & Astronomy	No.	202	176	152	170	150	167	-35	-17%
	%	6%	5%	4%	4%	4%	4%		
Other N&PS	No.	99	99	112	188	199	139	40	40%
	%	3%	3%	3%	5%	5%	4%		
N&PS – Not Specified	No.	1,405	1,571	1,799	1,667	1,742	1,646	241	17%
	%	40%	44%	49%	43%	45%	42%		
All N&PS AOUs	**No.**	**3,534**	**3,597**	**3,696**	**3,840**	**3,865**	**3,881**	**347**	**10%**
	%	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**		

Source: uCube and staff Aggregated Data Sets 2002 – 2008 and estimated distributions for 2010 and 2012 based on these sources.
FTE = 'full-time equivalent'

The percentage rows show the year-by-year proportion each narrow AOU made up of the total. The main thing that can be noted is that the largest 'narrow AOU Group' is 'Natural & Physical Sciences – not specified', which refers to the staff not allocated to any of the specific narrow AOU Groups, by virtue of them being reported in an AOU in which no narrow discipline group represented at least 70 per cent of the total student load of the subjects taught in that AOU. Although one can imagine a number of ways in which the calculations to link an AOU to a discipline could be made to be more specific, the remainder of the tables about teaching in this chapter are based on the actual distribution of *student load* within each narrow discipline group. The assumption being made, therefore, is that there is a strong correlation between the number of equivalent full-time students in a given narrow discipline group, and the number of full-time equivalent staff that will be needed to teach them. In fact, pro-rating the staff recorded as 'Natural & Physical Sciences – not specified' according to the distribution of teaching staff in other Natural & Physical Sciences narrow AOUs produces an almost identical pattern.

Table 6.2 presents the redistributed pattern of full-time equivalent teaching staff according to the five specifically-identified narrow fields of education, plus Other Natural & Physical Sciences.

It is these numbers that will feature in subsequent discussions about full-time & fractional full-time teaching academics.

Table 6.2 Teaching Staff (FTE) by Natural & Physical Sciences Narrow AOUs: Redistributed Data, 2002 – 2012:

Narrow AOU Group		2002	2004	2006	2008	2010	2012	Variation	
								FTE	%
Biological Sciences	No.	1,521	1,555	1,833	1,869	1,894	1,902	381	25%
	%	43%	43%	50%	49%	49%	49%		
Chemical Sciences	No.	403	402	366	393	387	388	-15	-4%
	%	11%	11%	10%	10%	10%	10%		
Earth Sciences	No.	202	208	162	167	155	155	-47	-23%
	%	6%	6%	4%	4%	4%	4%		
Mathematical Sciences	No.	907	935	779	778	773	776	-131	-14%
	%	26%	26%	21%	20%	20%	20%		
Physics & Astronomy	No.	336	320	293	301	309	310	-26	-8%
	%	10%	9%	8%	8%	8%	8%		
Other N&PS	No.	165	178	263	332	348	349	184	112%
	%	5%	5%	7%	9%	9%	9%		
All N&PS AOUs	**No.**	**3,534**	**3,597**	**3,696**	**3,840**	**3,865**	**3,881**	**347**	**10%**
	%	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**		

Source: uCube and staff Aggregated Data Sets 2002 – 2008 and estimated distributions for 2010 and 2012 based on these sources.
FTE = 'full-time equivalent'

Looking at Table 6.2, adjusted for those teaching staff not specifically allocated by the Department to a narrow AOU, it can be observed that Biological Sciences is the largest and increased by the most FTE over the period (+381 FTE, 25 per cent) followed by Natural & Physical Sciences – Other (+184, 112 per cent). It is uncertain what the reason for the expansion of Natural & Physical Sciences – Other was, but a cursory examination of the Department's aggregated staff data files for 2002 – 2008 reveals that the Universities of Queensland, Tasmania and South Australia reported increases of 91, 43, 36 FTE, respectively, and Monash University and the Australian National University showed increases of 29 and 25 FTE, respectively[20].

The other narrow AOU groups suffered a decrease in their full-time & fractional full-time teacher numbers over the period of 219 FTE. The figures for Chemical Sciences, Earth Sciences, Mathematical Sciences and Physics & Astronomy lost 15, 47, 131 and 26 FTE teachers respectively over the period. Overall, the number of full-time & fractional full-time staff teachers in Natural & Physical Sciences increased by 10 per cent, but it should be remembered that the number of equivalent full-time students in Natural & Physical Sciences programmes increased by 46 per cent (See Table 3.1). Broadly speaking, this suggests a huge increase in the size of the casual teaching workforce, particularly in the Mathematical Sciences, or a considerable expansion in class sizes or changes in teaching modalities.

Comparing the relative proportions each narrow AOU made over the period, it can be seen that the Biological Sciences and Other Natural & Physical Sciences both increased their share, relative to the other narrow AOU groups.

Perhaps there is a good reason for the relative ascendency of the Biological Sciences narrow AOU group compared with other narrow AOUs in the Natural & Physical Sciences. The biological sciences are taught widely across universities, to students in health, nursing, agriculture and environmental studies (at least), in addition to standard 'science' students.

20 The Department. Aggregated Staff Data Sets, 2002 – 2008.

Tables 6.3 and 6.4 replicate Tables 6.1 and 6.2 for academic research only staff. The Department no longer publishes separate information on the distribution of research staff by AOU group. The closest they get is a table in the annual staff statistics collections in which all academic and general staff involved in work with a 'research only' or an 'other' function are aggregated[21]. However, using the aggregated staff data sets publicly available into 2011, it is possible to use the information supplied by universities to provide a good set of figures. Table 6.3 shows the raw distribution of academic research only staff into narrow AOU groups within Natural & Physical Sciences. The AOU distribution is different from that with teaching staff. For teachers, the rank order showed 'Natural & Physical Sciences – not specified' as the largest group, but among academic research only staff, the Biological Sciences AOU group is the largest.

Table 6.3 Academic Research Only Staff (FTE) by Natural & Physical Sciences Narrow AOUs: Raw Data, 2002 – 2012

Narrow AOU Group		2002	2004	2006	2008	2010	2012	Variation	
								FTE	%
Biological Sciences	No.	870	1,058	1,211	1,379	1,504	1646	776	89%
	%	39%	41%	40%	40%	40%	40%		
Chemical Sciences	No.	179	190	243	288	314	344	165	92%
	%	8%	7%	8%	8%	8%	8%		
Earth Sciences	No.	85	97	77	111	121	132	47	55%
	%	4%	4%	3%	3%	3%	3%		
Mathematical Sciences	No.	108	129	163	191	208	228	120	112%
	%	5%	5%	5%	6%	6%	6%		
Physics & Astronomy	No.	242	296	333	359	392	429	186	77%
	%	11%	12%	11%	10%	10%	10%		
Other N&PS	No.	163	180	168	330	360	394	232	142%
	%	7%	7%	5%	10%	10%	10%		
N&PS – Not Specified	No.	564	621	866	808	881	964	401	71%
	%	25%	24%	28%	23%	23%	23%		
All N&PS AOUs	**No.**	**2,210**	**2,570**	**3,061**	**3,465**	**3,780**	**4,137**	**1927**	**87%**
	%	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**		

Source: uCube and staff Aggregated Data Sets 2002 – 2008 and estimated distributions for 2010 and 2012 based on these sources.
FTE = 'full-time equivalent'

Table 6.4 shows that the greatest numerical growth occurred in the Biological Sciences. It represented more than half of the academic research only staffing in all years of examination. This was also the largest narrow AOU after redistribution of the teachers from the 'not specified' AOU (see Table 6.2). Academic researchers in the Biological Sciences increased by about 84 per cent over the period (+978 FTE), representing just over half the growth of the academic research workforce in the Natural & Physical Sciences.

Physics & Astronomy contained the next largest group of research academics (559 FTE), representing about 14 per cent of all academic research only staff in 2012, having increased by 72 per cent. Then followed Other Natural & Physical Sciences (514 FTE in 2012), and the strongest growth AOU group over the period (+135 per cent). Chemical Sciences grew by 209 FTE, or 87 per cent, with Mathematical Sciences also growing strongly in research between 2002 and 2012 (+153, 106 per cent). The proportion each narrow AOU group made of the total remained similar over the period.

21 See Table 1.5, retrieved from http://www.innovation.gov.au/highereducation/HigherEducationStatistics/StatisticsPublications/Pages/Library%20Card/2012StaffFulltimeEquivalence.aspx

6.4 Academic Research Only Staff (FTE) in Natural & Physical Sciences Narrow AOUs: Redistributed Data, 2002 – 2012

Narrow AOU Group		2002	2004	2006	2008	2010	2012	Variation	
								FTE	%
Biological Sciences	No.	1,168	1,396	1,688	1,798	1,961	2,146	978	84%
	%	53%	54%	55%	52%	52%	52%		
Chemical Sciences	No.	240	250	339	376	410	449	209	87%
	%	11%	10%	11%	11%	11%	11%		
Earth Sciences	No.	114	127	108	144	157	172	58	51%
	%	5%	5%	4%	4%	4%	4%		
Mathematical Sciences	No.	144	170	227	249	271	297	153	106%
	%	7%	7%	7%	7%	7%	7%		
Physics & Astronomy	No.	325	390	465	468	511	559	234	72%
	%	15%	15%	15%	14%	14%	14%		
Other N&PS	No.	218	237	234	431	470	514	296	135%
	%	10%	9%	8%	12%	12%	12%		
All N&PS AOUs	**No.**	**2,210**	**2,570**	**3,061**	**3,465**	**3,780**	**4,137**	**1927**	**87%**
	%	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**		

Source: uCube and staff Aggregated Data Sets 2002 – 2008 and estimated distributions for 2010 and 2012 based on these sources.
FTE = 'full-time equivalent'

Table 6.5 brings together data from Tables 6.2 and 6.4 to present the overall academic staffing situation in narrow AOUs within Natural & Physical Sciences. The table reveals that full-time & fractional full-time academic staffing in Natural & Physical Sciences AOUs increased by 2,274 full-time equivalent academic staff between 2002 and 2012, but only 347 of the additional of these (15 per cent) were teaching staff. The number of teaching positions increased by only 10 per cent compared with an increase of 87 per cent among academic research positions. According to these figures, there was an actual decline in the number of full-time & fractional full-time teachers in Chemical Sciences, Earth Sciences, Mathematical Sciences and Physics & Astronomy.

By allowing for a comparison of teaching and research staffing, Table 6.5 shows clearly the extent of academic staffing drift towards research from teaching among full-time & fractional full-time academics. Even in the Biological Sciences, within which there was growth in teacher numbers, growth among research academics was more vigorous (25 per cent growth, c.f. 84 per cent). Even in the narrow AOU group Other Natural & Physical Sciences, in which teacher numbers grew by 112 per cent, growth in academic research numbers was 135 per cent. The other narrow fields of education, all of which 'lost' full-time & fractional full-time teachers over the period, demonstrated proportionate increases in academic research only numbers of 106 per cent (Mathematical Sciences), 87 per cent (Chemical Sciences), 72 per cent (Physics & Astronomy) and 51 per cent (Earth Sciences).

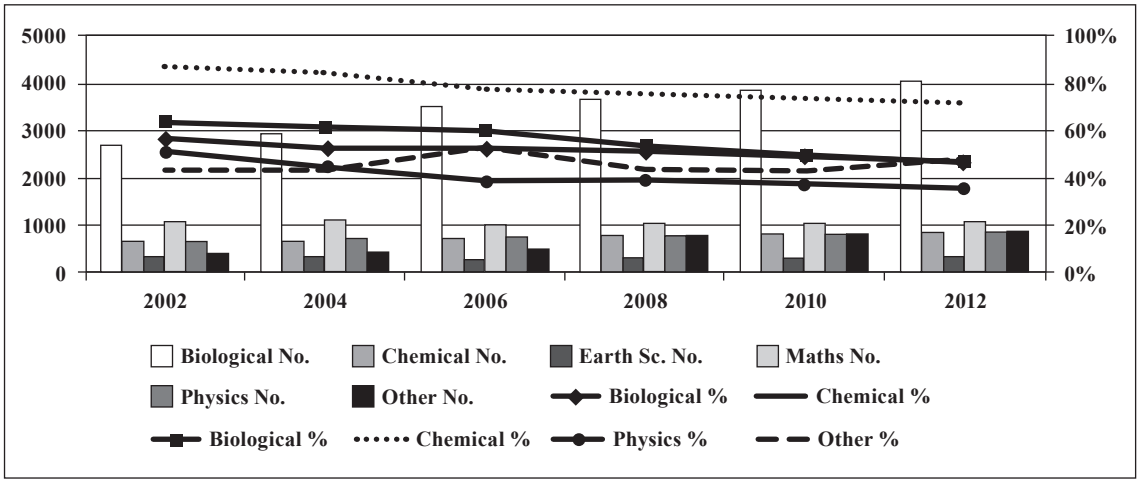
Table 6.5 Teaching Staff and Academic Research Only Staff (FTE) in Natural & Physical Sciences Narrow AOUs, 2002 – 2012

Narrow AOU Group / Function	2002	2004	2006	2008	2010	2012	Variation	
							FTE	%
Biological Sciences								
Teaching	1,521	1,555	1,833	1,869	1,894	1,902	381	25%
Research	1,168	1,396	1,688	1,798	1,961	2,146	978	84%
Subtotal	2,689	2,951	3,521	3,667	3,855	4,048	1,359	51%
% Teaching	57%	53%	52%	51%	49%	47%		
Chemical Sciences								
Teaching	403	402	366	393	387	388	-15	-4%
Research	240	250	339	376	410	449	209	87%
Subtotal	643	652	705	769	797	837	194	30%
% Teaching	63%	62%	52%	51%	49%	46%		
Earth Sciences								
Teaching	202	208	162	167	155	155	-47	-23%
Research	114	127	108	144	157	172	58	51%
Subtotal	316	335	270	311	312	328	11	4%
% Teaching	64%	62%	60%	54%	50%	47%		
Mathematical Sciences								
Teaching	907	935	779	778	773	776	-131	-14%
Research	144	170	227	249	271	297	153	106%
Subtotal	1,051	1,105	1,006	1,027	1,044	1,073	22	2%
% Teaching	86%	85%	77%	76%	74%	72%		
Physics & Astronomy								
Teaching	336	320	293	301	309	310	-26	-8%
Research	325	390	465	468	511	559	234	72%
Subtotal	661	710	758	769	820	869	208	31%
% Teaching	51%	45%	39%	39%	38%	36%		
Other N&PS								
Teaching	165	178	263	332	348	349	184	112%
Research	218	237	234	431	470	514	296	135%
Subtotal	383	415	497	763	818	864	480	125%
% Teaching	43%	43%	53%	44%	43%	40%		
All N&PS AOU Groups								
Teaching	3,534	3,597	3,696	3,840	3,865	3,881	347	10%
Research	2,210	2,570	3,061	3,465	3,780	4,137	1,927	87%
Total	5,744	6,167	6,757	7,305	7,645	8,018	2,274	40%
% Teaching	62%	58%	55%	53%	51%	48%		

Source: uCube and staff Aggregated Data Sets 2002 – 2008 and estimated distributions for 2010 and 2012 based on these sources.
FTE = 'full-time equivalent'

Figure 6.1 presents this information as a graph, with columns representing the sum of teaching and academic research only staff members, and the lines representing the percentage made up by teachers. The slowly declining proportion of academic staff devoted to teaching is quite clear, as is the numerical dominance of the Biological Sciences. It shows that Mathematical Sciences is the most teaching-oriented of all Natural & Physical Sciences narrow AOUs. Perhaps the reason for this is that mathematics is a major 'service' discipline; that is, students in many courses of study other than straight 'science' degrees undertake mathematics as part of their studies.

Figure 6.1 Teaching Staff and Academic Research Only Staff (FTE) in Natural & Physical Sciences Narrow AOUs; Teaching Percentage of Total, 2002 – 2012



Source: uCube and staff Aggregated Data Sets 2002 – 2008 and estimated distributions for 2010 and 2012 based on these sources. FTE = 'full-time equivalent'

Physics & Astronomy is the AOU with the highest proportion of its academic staff involved in research. 'Other Natural & Physical Sciences' also has a relatively high proportion of its academics involved in research. Across the broad Natural & Physical Sciences AOU, involvement of academics in research increased from less than 40 per cent in 2002 to almost 50 per cent by 2009.

Tables and graphs presented earlier have provided ample evidence of the need to consider narrow AOU-level analysis to be conducted separately for teaching academics as opposed to research academics. The tables that follow consider patterns for several variables, first for academics undertaking teaching and then for those with research only positions.

Academic tenure in the Natural & Physical Sciences

The next two tables (Tables 6.6 and 6.7) show the huge difference in tenure between teaching positions and research positions. The number of limited term research positions has increased strongly in recent years, whereas the number of tenurable teaching positions has actually declined. Limited term positions in teaching have increased significantly in number.

Reference to Table 6.6 indicates that in 2002, 84 per cent of positions were tenurable, although the proportion had dropped to 73 per cent by 2012. This distribution should be contrasted with that for research academics, the proportion of whom with tenure has ranged between six per cent and nine percent (Table 6.7).

Among teaching academics, the lowest rates of tenure occur in Other Natural & Physical Sciences and Earth Sciences AOUs, in which tenure for teachers was down at about 39 per cent. The tenure rate in other narrow AOU groups ranged from 73 per cent to 82 per cent. The decline in tenure rates in all Natural & Physical Sciences narrow AOUs since 2002 should be noted. In fact, the actual number of full-time & fractional full-time tenurable positions declined by 198 (seven per cent) between 2002 and 2012, meaning that the growth in the teaching workforce in the Natural & Physical Sciences has been in limited term positions. The net growth of academic teaching positions was only 10 per cent. This should be compared with the 46 per cent increase in the number of equivalent full-time 'science' students (see Table 3.1).

Table 6.6 Teaching Staff (FTE) in Natural & Physical Sciences Narrow AOUs by Tenure, 2002 – 2012

Narrow AOU Group / Tenure	2002	2004	2006	2008	2010	2012	Variation	
							FTE	%
Biological Sciences								
Tenurable term	1,301	1,322	1,481	1,412	1,384	1,390	89	7%
Limited term	220	233	352	457	510	512	292	133%
Subtotal	1,521	1,555	1,833	1,869	1,894	1,902	381	25%
% Tenurable term	86%	85%	81%	76%	73%	73%		
Chemical Sciences								
Tenurable term	334	340	310	316	300	301	-32	-10%
Limited term	69	62	56	77	86	87	17	25%
Subtotal	403	402	366	393	387	388	-15	-4%
% Tenurable term	83%	85%	85%	80%	78%	78%		
Earth Sciences								
Tenurable term	153	161	134	102	108	108	-45	-29%
Limited term	49	47	28	65	47	47	-2	-4%
Subtotal	202	208	162	167	155	155	-47	-23%
% Tenurable term	76%	78%	83%	61%	70%	70%		
Mathematical Sciences								
Tenurable term	807	813	667	638	637	639	-168	-21%
Limited term	100	122	112	140	136	137	37	37%
Subtotal	907	935	779	778	773	776	-131	-14%
% Tenurable term	89%	87%	86%	82%	82%	82%		
Physics & Astronomy								
Tenurable term	290	256	223	233	228	229	-61	-21%
Limited term	46	64	70	68	81	82	36	77%
Subtotal	336	320	293	301	309	310	-26	-8%
% Tenurable term	86%	80%	76%	78%	74%	74%		
Other N&PS								
Tenurable term	117	133	143	139	136	137	19	16%
Limited term	48	45	120	193	212	213	165	347%
Subtotal	165	178	263	332	348	349	184	112%
% Tenurable term	71%	75%	54%	42%	39%	39%		
All N&PS AOUs								
Tenurable term	3,002	3,026	2,958	2,841	2,792	2,804	-198	-7%
Limited term	532	572	738	999	1,073	1,077	545	102%
Total	3,534	3,598	3,696	3,840	3,865	3,881	347	10%
% Tenurable term	84%	83%	79%	75%	73%	73%		

Source: uCube and staff Aggregated Data Sets 2002 – 2008 and estimated distributions for 2010 and 2012 based on these sources.
FTE = 'full-time equivalent'

Table 6.7 shows plainly the relatively transitory nature of academic research only positions within the Natural & Physical Sciences. However, this is the pattern across all AOU groups, not just those that fall within the Natural & Physical Sciences. The overall tenure rate in 2012 was about eight per cent, in a range from about four per cent in the Biological Sciences, to about 17 per cent in Physics & Astronomy. The proportion of academic research only staff has increased in a couple of narrow AOU groups, and declined in others.

Figure 6.2 provides a summary of the situation in 2012, comparing rates of occupancy of tenurable positions within each narrow AOU group, for teachers and academic researchers, respectively.

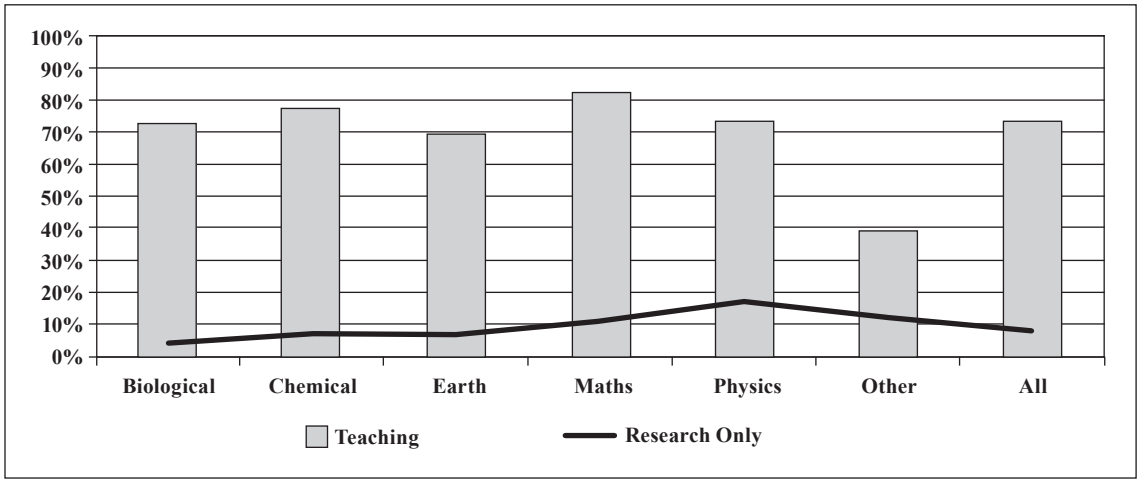
At a glance, one can see the considerably higher rate of tenure enjoyed by teachers compared with academic researchers, and that for teachers in some AOUs, the rate of tenure is quite high, such as in Physics & Astronomy.

Table 6.7 Academic Research Only Staff (FTE) in Natural & Physical Sciences Narrow AOUs by Tenure, 2001 – 2012

Narrow AOU Group / Tenure	2002	2004	2006	2008	2010	2012	Variation	
							FTE	%
Biological Sciences								
Tenurable term	23	56	84	54	78	86	33	160%
Limited term	1,144	1,340	1,604	1,744	1,882	2,060	513	60%
Subtotal	1,168	1,396	1,688	1,798	1,961	2,146	546	63%
% Tenurable term	2%	4%	5%	3%	4%	4%		
Chemical Sciences								
Tenurable term	34	15	17	23	29	31	-4	-14%
Limited term	206	235	322	353	381	417	115	74%
Subtotal	240	250	339	376	410	449	111	62%
% Tenurable term	14%	6%	5%	6%	7%	7%		
Earth Sciences								
Tenurable term	2	6	9	12	13	12	33	1650%
Limited term	112	121	99	133	145	160	7	8%
Subtotal	114	127	108	144	157	172	40	47%
% Tenurable term	2%	5%	8%	8%	8%	7%		
Mathematical Sciences								
Tenurable term	7	12	25	25	30	33	16	279%
Limited term	137	158	202	224	241	264	71	70%
Subtotal	144	170	227	249	271	297	87	81%
% Tenurable term	5%	7%	11%	10%	11%	11%		
Physics & Astronomy								
Tenurable term	55	62	79	84	87	95	24	57%
Limited term	270	328	386	384	424	464	114	57%
Subtotal	325	390	465	468	511	559	138	57%
% Tenurable term	17%	16%	17%	18%	17%	17%		
Other N&PS								
Tenurable term	41	31	42	47	56	62	5	15%
Limited term	177	206	192	383	413	453	144	109%
Subtotal	218	237	234	431	470	514	148	91%
% Tenurable term	19%	13%	18%	11%	12%	12%		
All N&PS AOUs								
Tenurable term	163	182	256	245	293	319	163	107%
Limited term	2,047	2,388	2,805	3,221	3,487	3,818	1244	60%
Total	2,210	2,570	3,061	3,465	3,780	4,137		64%
% Tenurable term	7%	6%	6%	7%	9%	8%		

Source: uCube and staff Aggregated Data Sets 2002 – 2008 and estimated distributions for 2010 and 2012 based on these sources.
FTE = 'full-time equivalent'

Figure 6.2 Teaching Staff and Academic Research Only Staff (FTE) in Natural & Physical Sciences Narrow AOUs by Percentage in Tenurable Positions, 2012



Source: uCube and staff Aggregated Data Sets 2002 – 2008 and estimated distributions for 2010 and 2012 based on these sources.
FTE = 'full-time equivalent'

Seniority in science

Table 6.8 and 6.9 examine the relative seniority of staff in each of the narrow AOU groups covered by the Natural & Physical Sciences. An earlier table showed that academic research only staff tend to be less senior on average than teaching academics (see Table 5.6). It was noted earlier that a higher proportion of teaching positions were senior levels than was the case with research positions. Table 6.8 distributes the teaching staff within each narrow AOU group with the Natural & Physical Sciences according to seniority. As can be seen, some AOUs seem to be taking in 'new blood', based on fact that some narrow AOUs have higher proportions of Level A / B teaching staff in 2012 than in 2002 and that staff usually start at the bottom and work their way up. Biological Sciences, Earth Sciences and Physics & Astronomy appear to be in such a situation, whereas the proportion of junior staff declined in the Chemical Sciences, Mathematical Sciences and Other Natural & Physical Sciences. The overall pattern for the Natural & Physical Sciences was that the proportion of Level A and B teachers remained at about 34 per cent except for a small blip in 2004.

However, there has been proportionate growth at the top (Levels D and E) in most narrow AOU groups within the Natural & Physical Sciences. Expansion occurred in all narrow AOU groups except for Biological Sciences.

There was also 'action' among those in the senior lecturer (Level C) scale. The proportion of teachers at this level decreased in all but the Other Natural & Physical Sciences AOU group.

Narrow AOUs such as Chemical, Earth and Mathematical Sciences, and Physics and Astronomy, seem to have demonstrated this push from the bottom, whereas the other two narrow AOU groups have not. At most universities, these narrow AOU groups are highly likely to be part of a 'traditional' science faculty, whereas Biological Sciences tends to be a much larger narrow AOU group that is more likely to include teaching from departments in other faculties, such as medical faculties. The same could be said about some of the component parts of Other Natural & Physical Sciences.

As noted earlier, academic research only staff are much more likely to occupy junior posts, and to have shorter tenure than teaching academics. Table 6.9 shows that the average proportion of staff at junior staff (Levels A and B) has remained at 81 per cent for most of the period under

consideration, with some variation among the comprising narrow AOU groups. In the Earth Sciences, the proportion of junior academic researchers has declined, but elsewhere, the proportion has remained relatively static. Physics & Astronomy has the lowest proportion of junior research academics and the highest proportion of senior academics, and the three levels reported in Table 6.9 have remained consistent between 2002 and 2012. The Biological Sciences had the highest proportion of junior staff followed by Chemical Sciences and Mathematical Sciences. Opposite trends can be noted in these latterly-mentioned AOU groups: the proportion of junior research academics increased in Chemical Sciences, and declined in Mathematical Sciences.

Table 6.8 Teaching Staff (FTE) in Natural & Physical Sciences AOUs by Classification, 2002 – 2012

Narrow AOU Group / Classification	2002	2004	2006	2008	2010	2012	Variation	
							FTE	%
Biological Sciences								
FTE	1,521	1,555	1,833	1,869	1,894	1,902	160	18%
% Level A or B	32%	34%	33%	34%	34%	38%		
% Level C	29%	28%	27%	26%	26%	24%		
% Level D or E	39%	38%	40%	40%	39%	38%		
Chemical Sciences								
FTE	403	402	366	393	387	388	-15	-4%
% Level A or B	27%	28%	26%	27%	22%	24%		
% Level C	31%	32%	32%	31%	32%	28%		
% Level D or E	41%	40%	43%	42%	46%	48%		
Earth Sciences								
FTE	202	208	162	167	155	155	-47	-23%
% Level A or B	23%	23%	22%	22%	26%	36%		
% Level C	35%	38%	35%	32%	28%	16%		
% Level D or E	42%	39%	44%	46%	46%	48%		
Mathematical Sciences								
FTE	907	935	779	778	773	776	-131	-14%
% Level A or B	38%	36%	30%	31%	32%	33%		
% Level C	32%	32%	33%	30%	29%	26%		
% Level D or E	30%	32%	38%	40%	39%	40%		
Physics & Astronomy								
FTE	336	320	293	301	309	310	-26	-8%
% Level A or B	18%	26%	21%	22%	22%	29%		
% Level C	34%	26%	28%	28%	27%	22%		
% Level D or E	47%	48%	51%	51%	51%	49%		
Other N&PS								
FTE	165	178	263	332	348	349	184	112%
% Level A or B	39%	32%	42%	32%	28%	23%		
% Level C	19%	24%	23%	23%	30%	28%		
% Level D or E	43%	44%	35%	45%	43%	49%		
All N&PS AOUs								
FTE	3,534	3,597	3,696	3,840	3,865	3,881	347	10%
% Level A or B	34%	36%	34%	34%	34%	34%		
% Level C	30%	29%	29%	28%	28%	28%		
% Level D or E	36%	35%	37%	38%	38%	38%		

Source: uCube and staff Aggregated Data Sets 2002 – 2008 and estimated distributions for 2010 and 2012 based on these sources.
FTE = 'full-time equivalent'

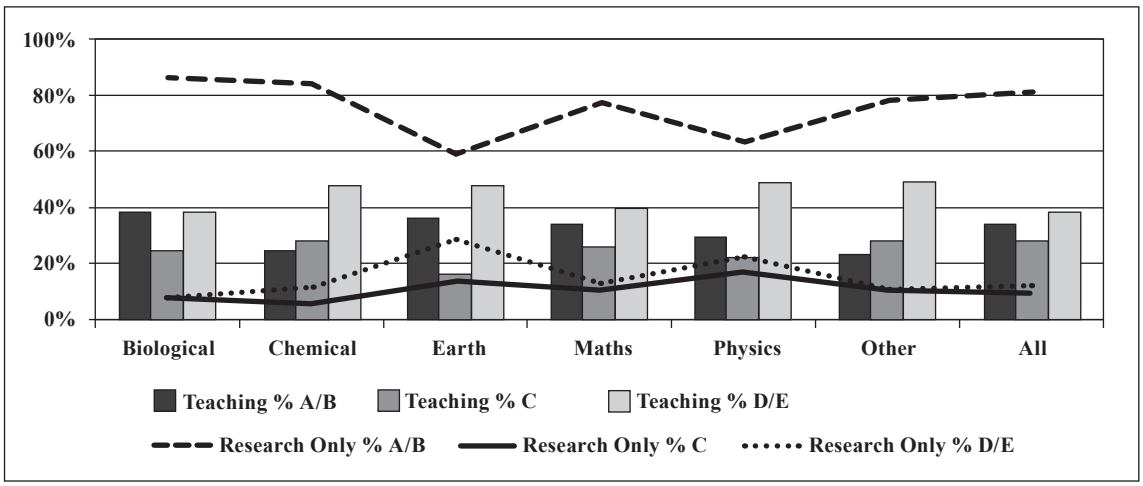
Table 6.9 Academic Research Only Staff (FTE) in Natural & Physical Sciences Narrow AOUs by Classification, 2001 – 2012

Narrow AOU Group / Classification	2002	2004	2006	2008	2010	2012	Variation	
							FTE	%
Biological Sciences								
FTE	1,168	1,396	1,688	1,798	1,961	2,146	978	84%
% Level A or B	86%	85%	87%	87%	86%	86%		
% Level C	8%	7%	7%	7%	7%	7%		
% Level D or E	6%	8%	6%	6%	7%	7%		
Chemical Sciences								
FTE	240	250	339	376	410	449	209	87%
% Level A or B	78%	88%	89%	85%	84%	84%		
% Level C	9%	6%	4%	5%	5%	5%		
% Level D or E	13%	6%	7%	10%	11%	11%		
Earth Sciences								
FTE	114	127	108	144	157	172	58	51%
% Level A or B	75%	71%	64%	52%	59%	59%		
% Level C	14%	17%	19%	17%	13%	13%		
% Level D or E	11%	12%	17%	31%	28%	28%		
Mathematical Sciences								
FTE	144	170	227	249	271	297	153	106%
% Level A or B	84%	82%	81%	80%	77%	77%		
% Level C	3%	8%	7%	8%	10%	10%		
% Level D – E+	13%	10%	12%	13%	13%	13%		
Physics & Astronomy								
FTE	325	390	465	468	511	559	234	72%
% Level A or B	63%	62%	63%	63%	63%	63%		
% Level C	16%	16%	16%	15%	16%	16%		
% Level D or E	21%	22%	21%	23%	22%	22%		
Other N&PS								
FTE	218	237	234	431	470	514	296	135%
% Level A or B	68%	71%	71%	72%	78%	78%		
% Level C	16%	10%	9%	13%	10%	10%		
% Level D or E	15%	18%	20%	15%	11%	11%		
All N&PS AOUs								
FTE	2,210	2,570	3,061	3,465	3,780	4,137	1,927	87%
% Level A or B	81%	81%	82%	80%	81%	81%		
% Level C	9%	9%	8%	9%	9%	9%		
% Level D or E	10%	10%	10%	11%	11%	11%		

Source: uCube and staff Aggregated Data Sets 2002 – 2008 and estimated distributions for 2010 and 2012 based on these sources.
FTE = 'full-time equivalent'

Finally, Figure 6.3 provides a summary by narrow AOU group for 2012. In the figure, teaching is represented by columns and research by lines. Around about half of teaching positions in Chemical Sciences, Earth Sciences, Physics & Astronomy and Other Natural & Physical Sciences were at Levels D or E. This compared with about 40 per cent of posts in the Biological Sciences, Mathematical Sciences, and in the Natural & Physical Sciences overall.

Figure 6.3 Teaching Staff and Academic Research Only Staff (FTE) in Natural & Physical Sciences Narrow AOUs: Percentage by Classification, 2012



Source: uCube and staff Aggregated Data Sets 2002 – 2008 and estimated distributions for 2010 and 2012 based on these sources. T= teaching; R = Research Only; A = Level A, etc. FTE = 'full-time equivalent'

Among researcher only positions, the proportion of senior academics was rather lower, approaching 30 per cent in Earth Sciences, 20 per cent in Physics & Astronomy, but around 10 per cent in the other narrow AOUs. The Earth Sciences had a higher proportion of research academics in positions at Levels D and E.

Age Group

Patterns of age distribution of academic staff also differ between teaching and research, as demonstrated by Tables 6.10 and 6.11. Overall, 26 – 28 per cent of teaching staff in the Natural & Physical Sciences were older than 54 years throughout the period under examination, with a higher proportion of staff in the Mathematical Sciences and Physics & Astronomy tending to be slightly older on average. The proportion of younger staff (< 35 years) increased in most narrow AOU groups within the Natural & Physical Sciences, with Mathematical Sciences appearing to be an exception.

Table 6.10 Teaching Staff (FTE) in Natural & Physical Sciences Narrow AOUs by Age Group, 2002 – 2012

Narrow AOU Group / Age Group	2002	2004	2006	2008	2010	2012	Variation	
							FTE	%
Biological Sciences								
FTE	1,521	1,555	1,833	1,869	1,894	1,902	381	25%
<35 years	7%	8%	8%	10%	10%	10%		
35-54	66%	64%	64%	63%	63%	63%		
>54	27%	27%	28%	26%	26%	26%		
Chemical Sciences								
FTE	403	402	366	393	387	388	-15	-4%
<35	10%	10%	13%	17%	17%	17%		
35-54	56%	61%	62%	63%	63%	63%		
>54	34%	29%	25%	21%	21%	21%		
Earth Sciences								
FTE	202	208	162	167	155	155	-47	-23%
<35	6%	7%	6%	11%	11%	11%		
35-54	69%	58%	62%	61%	61%	61%		
>54	26%	35%	32%	28%	28%	28%		
Mathematical Sciences								
FTE	907	935	779	778	773	776	-131	-14%
<35	9%	9%	9%	8%	8%	8%		
35-54	61%	59%	57%	59%	59%	59%		
>54	30%	32%	34%	33%	33%	33%		
Physics & Astronomy								
FTE	336	320	293	301	309	310	-26	-8%
<35	5%	11%	8%	9%	9%	9%		
35-54	62%	60%	62%	64%	64%	64%		
>54	32%	29%	30%	27%	27%	27%		
Other N&PS								
FTE	165	178	263	332	348	349	184	112%
<35	11%	13%	13%	12%	8%	12%		
35-54	40%	40%	42%	49%	53%	46%		
>54	48%	47%	45%	39%	39%	42%		
All N&PS AOUs								
FTE	3,534	3,602	3,694	3,839	3,865	3,881	347	10%
<35	8%	9%	9%	11%	11%	11%		
35-54	64%	62%	63%	63%	63%	63%		
>54	28%	28%	28%	26%	26%	26%		

Source: uCube and staff Aggregated Data Sets 2002 – 2008 and estimated distributions for 2010 and 2012 based on these sources.
FTE = 'full-time equivalent'

Table 6.11 shows that the academic research only population is much younger on average than is the teaching population. In the Natural & Physical Sciences overall, the under 35s represented about 44 per cent of all academic researchers in 2012, compared with 11 per cent among teachers. Earth Sciences, Physics & Astronomy and Other Natural & Physical Sciences tended to have lower proportions of their academic researchers in the youngest age group, whereas in the Chemical Sciences over half were in this age group by 2012.

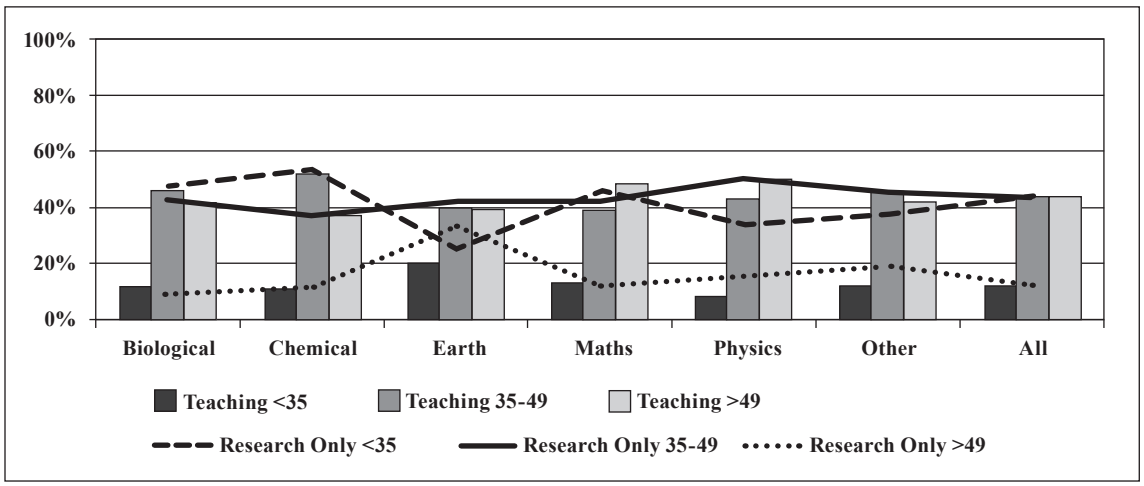
Table 6.11 Academic Research Only Staff (FTE) in Natural & Physical Sciences Narrow AOUs by Age Group, 2001 – 2012

Narrow AOU Group / Age Group	2002	2004	2006	2008	2010	2012	Variation	
							FTE	%
Biological Sciences								
FTE	1,168	1,396	1,688	1,798	1,961	2,146	978	84%
<35 years	45%	46%	49%	48%	48%	48%		
35-54	52%	49%	47%	47%	47%	47%		
>54	3%	6%	4%	5%	5%	5%		
Chemical Sciences								
FTE	240	250	339	376	410	449	209	87%
<35	41%	50%	52%	53%	53%	53%		
35-54	51%	45%	44%	41%	41%	41%		
>54	7%	5%	4%	5%	5%	5%		
Earth Sciences								
FTE	114	127	108	144	157	172	58	51%
<35	35%	35%	36%	25%	25%	25%		
35-54	59%	59%	53%	57%	57%	57%		
>54	6%	6%	11%	18%	18%	18%		
Mathematical Sciences								
FTE	144	170	227	249	271	297	153	106%
<35	40%	44%	48%	45%	45%	45%		
35-54	52%	47%	42%	46%	46%	46%		
>54	7%	8%	10%	8%	8%	8%		
Physics & Astronomy								
FTE	325	390	465	468	511	559	234	72%
<35	31%	34%	34%	34%	34%	34%		
35-54	59%	55%	55%	57%	57%	57%		
>54	10%	10%	11%	9%	9%	9%		
Other N&PS								
FTE	218	237	234	431	470	514	296	136%
<35	34%	43%	30%	37%	37%	37%		
35-54	55%	48%	56%	52%	52%	52%		
>54	10%	9%	14%	11%	11%	11%		
All N&PS AOUs								
FTE	2,209	2,570	3,061	3,466	3,780	4,137	1,928	87%
<35	41%	44%	45%	44%	44%	44%		
35-54	53%	50%	49%	49%	49%	49%		
>54	6%	6%	6%	7%	7%	7%		

Source: uCube and staff Aggregated Data Sets 2002 – 2008 and estimated distributions for 2010 and 2012 based on these sources.
FTE = 'full-time equivalent'

Finally, Figure 6.4 brings together teaching and academic research only staff for 2012. Again, teachers are represented by columns and academic research only staff by lines.

Figure 6.4 Teaching Staff and Academic Research Only Staff (FTE) in Natural & Physical Sciences Narrow AOUs: Percentage by Age Group, 2012



Source: uCube and staff Aggregated Data Sets 2002 – 2008 and estimated distributions for 2010 and 2012 based on these sources. FTE = 'full-time equivalent'

Gender and Science

This section looks at patterns of distribution by gender in combination with other variables. The fact that women are in the minority among academics overall was noted earlier. In fact, the broad-brush staff figures available from uCube indicate that in 2002, about 40 per cent of academics (all AOU groups) were women, rising to about 45 per cent in 2010, but slipping back to 43 per cent in 2012[22]. The roughly equivalent figures just for Natural & Physical Sciences departments (unfortunately not available from uCube) indicate a gender gap between 'science' and other academic departments of about 12 percentage points in teaching, and six percentage points in research (see Table 5.8).

Table 6.12 provides a gender distribution of academics in the Natural & Physical Sciences according to function. In 2002, 29 per cent of all Natural & Physical Sciences academics undertaking academic work were women, reaching 36 per cent by 2012. The relative proportion of women in the Natural & Physical Sciences increased considerably, in both teaching and research. In teaching, women's presence increased from 23 per cent to 31 per cent, and in research from 38 per cent to 40 per cent.

Among women, 49 per cent were involved in teaching in 2002, but this declined to about 43 per cent by 2012. Among men, equivalent figures were 67 per cent, declining to 52 per cent by 2012. This is a reflection of the relative growth in research, but the proportionate decline in teaching among men exceeds that in women.

The number of female teachers increased by 397 FTE (+49 per cent), whereas there was a net decline in the number of men (-47 FTE, two per cent). In research, there was strong growth among both women and men, with an additional 787 FTE women (+93 per cent), and 1,139 additional men (+84 per cent). This further emphasises the relative expansion of research compared with teaching, with research staffing now exceeding half of all academic staffing in the Natural & Physical Sciences.

22 Calculated from uCube

Table 6.12 Teaching Staff and Academic Research Only Staff (FTE) in Natural & Physical Sciences AOUs by Gender and Function, 2002 – 2012

Gender / Function	2002	2004	2006	2008	2010	2012	Variation	
							FTE	%
Women								
Teaching	818	879	984	1,100	1,163	1,215	397	49%
Research	850	1,003	1,176	1,371	1,496	1,637	787	93%
Subtotal	1,668	1,882	2,160	2,471	2,659	2,852	1,184	71%
% Teaching	49%	47%	46%	45%	44%	43%		
Men								
Teaching	2,713	2,723	2,709	2,740	2,702	2,666	-47	-2%
Research	1,361	1,567	1,885	2,094	2,284	2,500	1,139	84%
Subtotal	4,074	4,290	4,594	4,834	4,986	5,166	1092	27%
% Teaching	67%	63%	59%	57%	54%	52%		
All Academics								
Teaching	3,531	3,602	3,693	3,840	3,865	3,881	350	10%
Research	2,211	2,570	3,061	3,465	3,780	4,137	1926	87%
Total	5,742	6,172	6,754	7,305	7,645	8,018	2,276	40%
% Teaching	61%	58%	55%	53%	51%	48%		
Female % of All Academics								
Teaching	23%	24%	27%	29%	30%	31%		
Research	38%	39%	38%	40%	40%	40%		
Total	29%	30%	32%	34%	35%	36%		

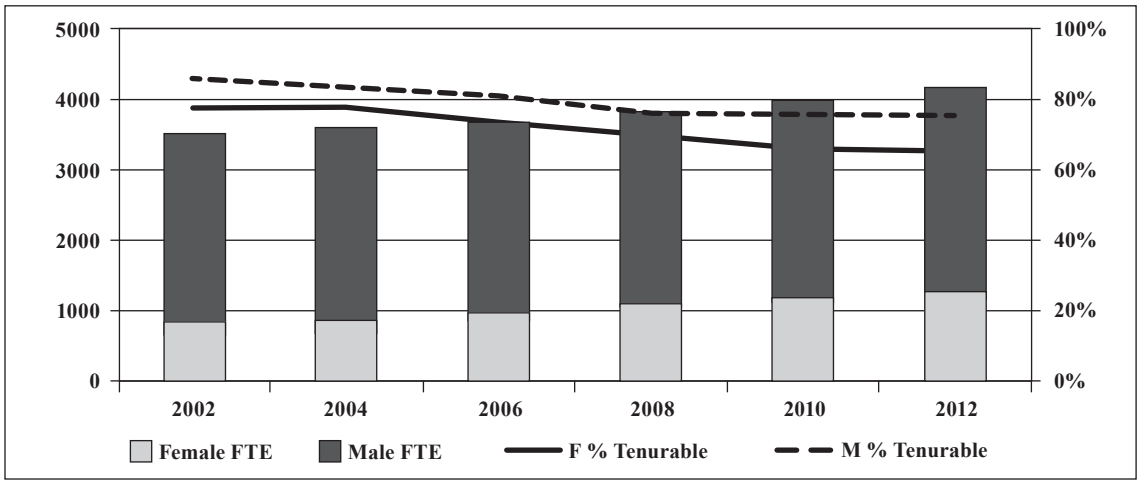
Source: uCube and staff Aggregated Data Sets 2002 – 2008 and estimated distributions for 2010 and 2012 based on these sources.
FTE = 'full-time equivalent'

Gender and tenure

It was noted above that the academic workforce at Australian universities is strongly delineated according to function and seniority (classification). It has oft been noted that women are less likely to occupy tenurable positions, and that they are more likely to occupy junior positions than their male counterparts. uCube can be used to confirm the assertion about gender and seniority. Figures 6.5 and 6.6 look at gender and tenure, for teaching staff (Figure 6.5) and academic research only staff (Figure 6.6).

Among teachers, about 78 per cent of women occupied tenurable posts in 2002, declining to about two-thirds by 2012 (indicated by the unbroken line). The equivalent figures for men were about 86 per cent and 76 per cent (the dotted line. Therefore it can be seen that the rate of occupancy of tenurable posts in the Natural & Physical Sciences is declining, but there is an eight to ten percentage point gap between men and women, to the disadvantage of the latter.

Figure 6.5 Teaching Staff (FTE) in Natural & Physical Sciences AOUs by Gender and Tenure, 2002 – 2012

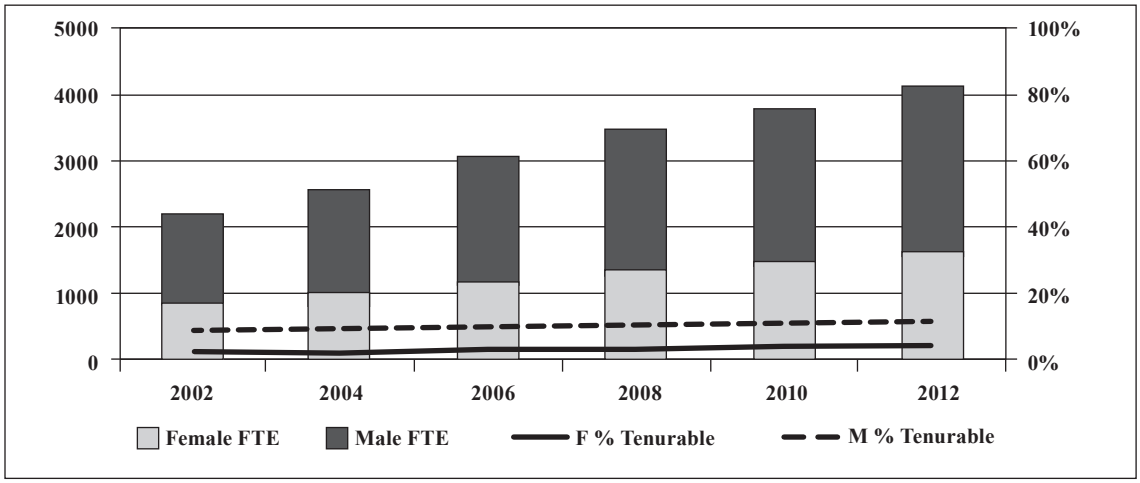


Source: uCube and staff Aggregated Data Sets 2002 – 2008 and estimated distributions for 2010 and 2012 based on these sources. FTE = 'full-time equivalent'

Among academic research only staff, the variation of pattern between men and women is similar: there is a seven or eight percentage point gap between men and women, in favour of men. This can be seen in Figure 6.6. It can also be seen that the rate of tenure is much lower among academic researchers than among teachers, and that the downward curve in the rate of tenure is much steeper among research academics.

Part of the situation women are in with respect to tenure is that the surge in female academic staff numbers has come at the same time as a general relative decline in the availability of tenurable positions for anyone, men or women.

Figure 6.6 Academic Research Only Staff (FTE) in Natural & Physical Sciences AOUs by Gender and Tenure, 2002 – 2012

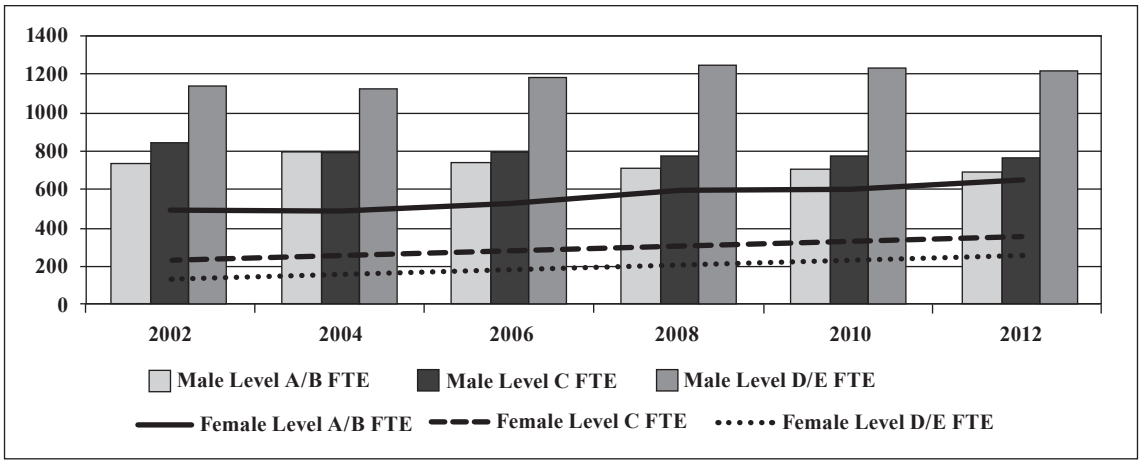


Source: uCube and staff Aggregated Data Sets 2002 – 2008 and estimated distributions for 2010 and 2012 based on these sources. FTE = 'full-time equivalent'.

Women and seniority in 'science'

Figures 6.7 to 6.10 demonstrate that women are under-represented in senior positions, and over-represented in junior posts. Figure 6.7 shows the gender-based distribution of teaching academics in the Natural & Physical Sciences, with male teachers represented by columns, and their female colleagues by lines. There are more men than women at all levels, but the gap is extreme at senior levels (Levels D and E). By 2010, the number of women in the Natural & Physical Sciences at Levels D and E was approaching 250 full-time equivalent positions, compared with the male total of over 1,200 FTE. In more junior ranks (Levels A and B), the number of women is approaching that of men, but even at Level C, there is a considerable gap between the two.

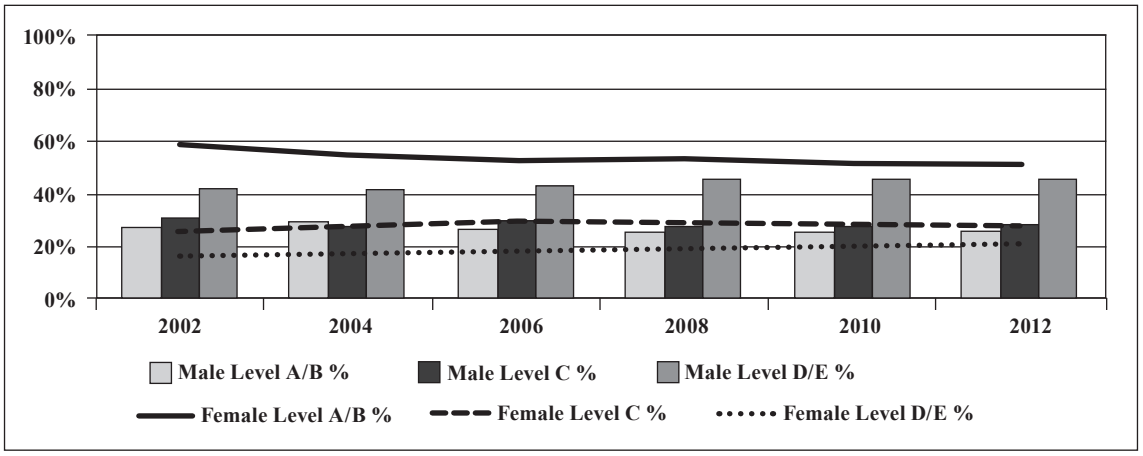
Figure 6.7 Teaching Staff (FTE) in Natural & Physical Sciences AOUs by Gender and Classification, 2002 – 2012



Source: uCube and staff Aggregated Data Sets 2002 – 2008 and estimated distributions for 2010 and 2012 based on these sources.
FTE = 'full-time equivalent'

Figure 6.8 looks at the proportionate distribution of women and men between the various classification levels. Over the period, 50 to 60 per cent of appointments by female teachers in the Natural & Physical Sciences have been at Level A. This compares with men, which have had about 30 per cent of their number in Level A positions. At Level C, there is not much difference between the two, with around 30 per cent of positions being at this Level for both. The big difference, however, is at senior levels. The proportion of men with teaching positions at Levels D or E is around 45 per cent, compared with women, about 20 per cent of which are at these senior levels.

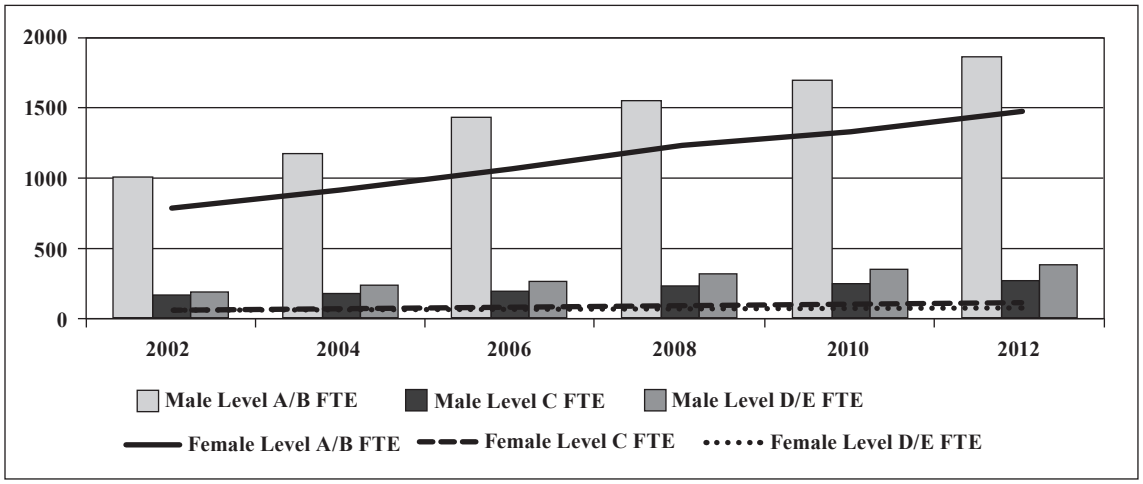
Figure 6.8 Teaching Staff (Percentage Distribution) in Natural & Physical Sciences AOUs by Gender and Classification, 2002 – 2012



Source: uCube and staff Aggregated Data Sets 2002 – 2008 and estimated distributions for 2010 and 2012 based on these sources.
FTE = 'full-time equivalent'

Figures 6.9 and 6.10 replicate this information for academic research only staff. As noted elsewhere, research staff tend to be relatively junior compared with their teaching colleagues. The nature of a great deal of university research work is that staff are hired on relatively short-term contracts to undertake research funded through competitive grants. As the graph shows, there are more male than female academic research only staff at all levels, with a considerable preponderance of staff in positions at Levels A or B.

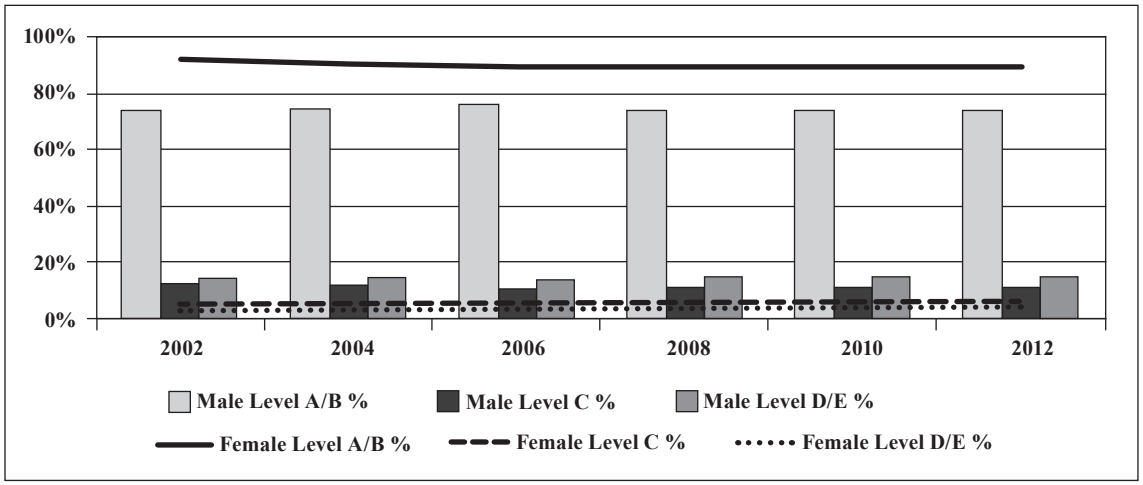
Figure 6.9 Academic Research Only Staff (FTE) in Natural & Physical Sciences AOUs by Gender and Classification, 2002 – 2012



Source: uCube and staff Aggregated Data Sets 2002 – 2008 and estimated distributions for 2010 and 2012 based on these sources.
FTE = 'full-time equivalent'

Figure 6.10 demonstrates that a higher proportion of women than men have appointments at Levels A or B. For women, around 90 per cent are at these levels, compared with just less than 75 per cent of men, a 15 percentage point gap.

Figure 6.10 Academic Research Only Staff (Percentage Distribution) in Natural & Physical Sciences AOUs by Gender and Classification, 2002 – 2012



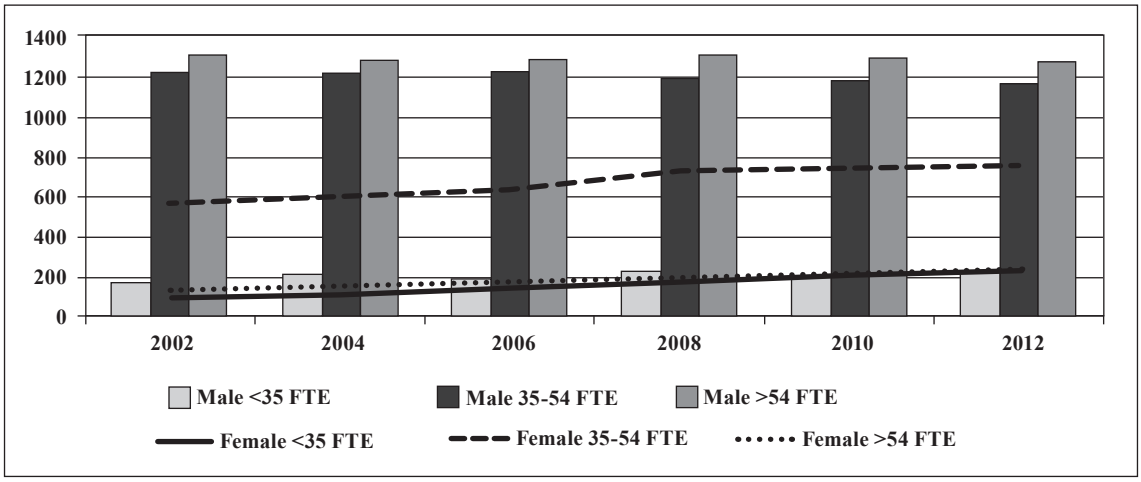
Source: uCube and staff Aggregated Data Sets 2002 – 2008 and estimated distributions for 2010 and 2012 based on these sources.
FTE = 'full-time equivalent'

Gender and Age

The graphs in this section compare the numbers and relative presence of female and male academic staff according to their age. Figures 6.11 to 6.14 consider the age distribution of teachers and academic researchers in the Natural & Physical Sciences, respectively. Figure 6.9 presents a summary of the numbers of teaching women and men by broad age group. In this figure, men are represented as columns, and women as lines. It is clear that there are more men, and that this is particularly marked in the 35 – 54 years and > 54 years groups. Although there are similar numbers of the genders among younger teaching academics in the Natural & Physical Sciences, there is a considerable numerical gap among the 35-54 years age group, and a huge gap among academics in the > 54 age group.

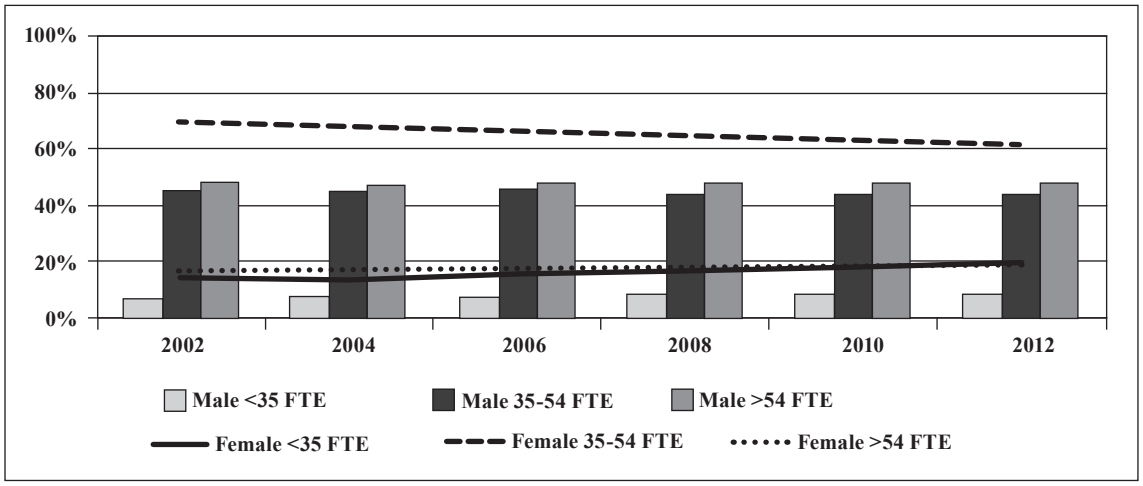
Figure 6.12 compares the distribution of women and men teaching in the Natural & Physical Sciences within each age group. Men are represented by columns and women by lines. The proportion of female teachers in the Natural & Physical Sciences from the youngest and the oldest of these three age groups are increasing, whereas proportion in the 35-54 age group is declining. For men, relatively few teaching academics are in the < 35 age group, but the proportion appears to have increased slowly over the period. Comparing men and women according to their age groups, by 2012, slightly more than 60 per cent of female teaching academics in the Natural & Physical Sciences were in the 35-53 years age group, compared to about 45 per cent of men. Among younger academics, nearly 20 per cent of women were aged <35 years, compared with about half that proportion for men. Slightly less than half of men fell into the oldest group shown here, but only about 20 per cent of women.

Figure 6.11 Teaching Staff (FTE) in Natural & Physical Sciences AOUs by Gender and Age Group, 2002 – 2012



Source: uCube and staff Aggregated Data Sets 2002 – 2008 and estimated distributions for 2010 and 2012 based on these sources.
FTE = 'full-time equivalent'

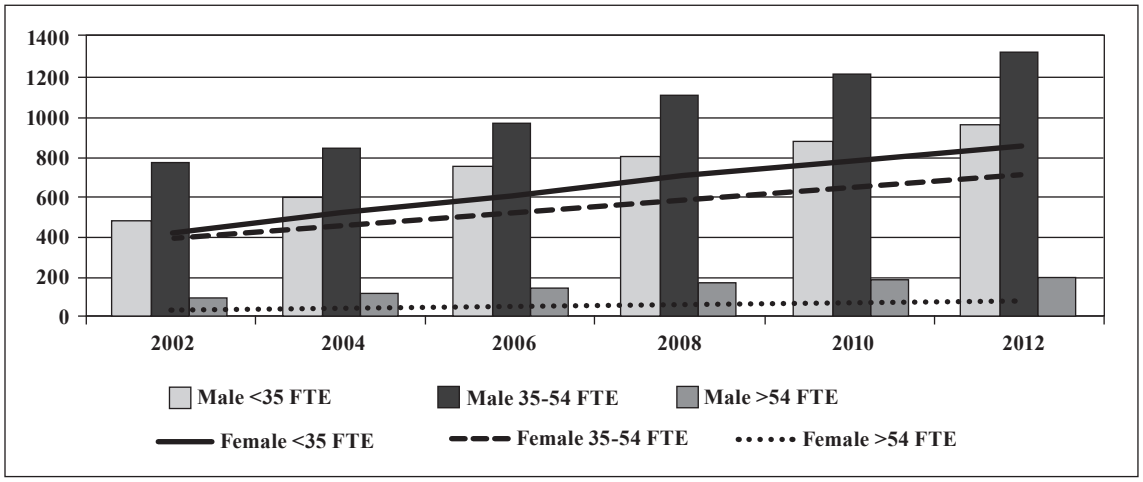
Figure 6.12 Teaching Staff (Percentage Distribution) in Natural & Physical Sciences AOUs by Gender and Age Group, 2002 – 2012



Source: uCube and staff Aggregated Data Sets 2002 – 2008 and estimated distributions for 2010 and 2012 based on these sources.
FTE = 'full-time equivalent'

Figures 6.13 and 6.14 present similar information for academic researchers. Figure 6.13 shows the number of academic research only staff in the Natural & Physical Sciences by gender. As was the case with teachers, women are fewer in number than men among academic researchers, but the number of academics in the < 35 years age group are similar in number, but nonetheless, there are more men than women. The gender gap is greater in the 35-53 year age group, and by 2012, there were over 1,300 men in this age group, and just over 700 women. Relatively few academic research only staff fall into the oldest age group examined here, because most of these are hired on relatively short-term contracts.

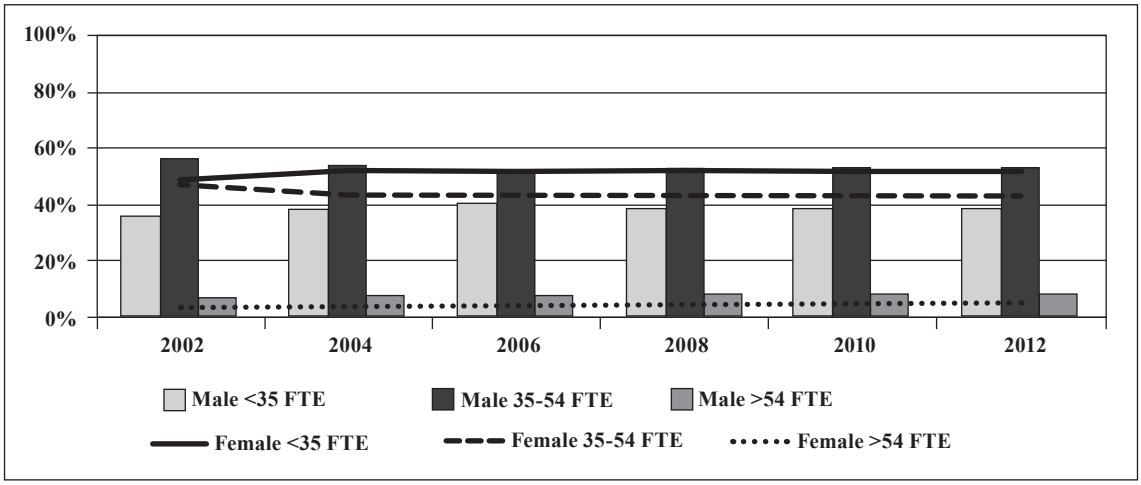
Figure 6.13 Academic Research Only Staff (FTE) in Natural & Physical Sciences AOUs by Gender and Age Group, 2002 – 2012



Source: uCube and staff Aggregated Data Sets 2002 – 2008 and estimated distributions for 2010 and 2012 based on these sources.
FTE = 'full-time equivalent'

The proportionate distributions of women and men in research also vary according to age group (Figure 6.14). A higher proportion of women than men are in the < 35 years age group, and a relatively lower proportion of the other age groups shown here. Around half of female academic research only staff were in the < 35 years age group, compared with about 40 per cent of men.

Figure 6.14 Academic Research Only Staff (Percentage Distribution) in Natural & Physical Sciences AOUs by Gender and Age Group, 2002 – 2012



Source: uCube and staff Aggregated Data Sets 2002 – 2008 and estimated distributions for 2010 and 2012 based on these sources.
FTE = 'full-time equivalent'

Gender and Narrow AOUs

Patterns of gender distribution are not the same in all narrow AOU groups in the Natural & Physical Sciences. Tables 6.13 and 6.14, and Figures 6.15 and 6.16 provide this information.

Table 6.13 shows the approximate distribution of academic staff by gender. The number of men with full-time & fractional full-time positions involved in teaching declined overall, by 47 FTE, or about two per cent. The number of men declined in the Chemical Sciences, Earth Sciences and Physics & Astronomy. The number of both male and female teachers declined in the Mathematical Sciences.

The Biological Sciences continues to be the main narrow AOU group in the Natural & Physical Sciences. By 2012, the number of teachers in the Biological Sciences represented nearly half of all teachers in the Natural & Physical Sciences, up from about 43 per cent in 2002.

The proportion of women varies considerably between narrow AOU groups. The proportion of women in 'science' teaching overall in the Natural & Physical Sciences had risen to about 31 per cent by 2012, but this was in the range 16 per cent (Physics & Astronomy) to 38 per cent (Biological Sciences).

Table 6.13 Teaching Staff (FTE) in Natural & Physical Sciences Narrow AOUs by Gender, 2001 – 2012

Narrow AOU Group / Gender	2002	2004	2006	2008	2010	2012	Variation	
							FTE	%
Biological Sciences								
Female	433	478	567	608	654	727	295	68%
Male	1,088	1,077	1,266	1,261	1,240	1,175	86	8%
Subtotal	1,521	1,555	1,833	1,869	1,894	1,902	381	25%
% Female	28%	31%	31%	33%	35%	38%		
Chemical Sciences								
Female	60	70	72	74	81	92	32	53%
Male	343	332	294	319	306	296	-47	-14%
Subtotal	403	402	366	393	387	388	-15	-4%
% Female	15%	17%	20%	19%	21%	24%		
Earth Sciences								
Female	15	28	15	18	27	38	22	144%
Male	187	180	147	149	128	117	-69	-37%
Subtotal	202	208	162	167	155	155	-47	-23%
% Female	8%	13%	9%	11%	18%	24%		
Mathematical Sciences								
Female	189	225	193	187	173	181	-8	-4%
Male	718	710	586	591	600	595	-123	-17%
Subtotal	907	935	779	778	773	776	-131	-14%
% Female	21%	24%	25%	24%	22%	23%		
Physics & Astronomy								
Female	42	49	43	50	54	50	8	20%
Male	294	271	250	251	255	260	-34	-12%
Subtotal	336	320	293	301	309	310	-26	-8%
% Female	12%	15%	15%	16%	17%	16%		
Other N&PS								
Female	57	52	88	106	98	121	64	113%
Male	108	126	175	226	250	228	120	111%
Subtotal	165	178	263	332	348	349	184	112%
% Female	34%	29%	33%	32%	28%	35%		
All N&PS AOUs								
Female	818	879	984	1,100	1,163	1,215	397	49%
Male	2,713	2,723	2,710	2,739	2,702	2,666	-47	-2%
Subtotal	3,531	3,602	3,694	3,839	3,865	3,881	350	10%
% Female	23%	24%	27%	29%	30%	31%		

Source: uCube and staff Aggregated Data Sets 2002 – 2008 and estimated distributions for 2010 and 2012 based on these sources.
FTE = 'full-time equivalent'

Table 6.14 replicates Table 6.13, but considers the gender distribution of academic research only staff. Overall, the number of women in research in the Natural & Physical Sciences almost doubled between 2002 and 2012. As was the case among teachers, there is a wide variation between narrow AOU groups so far as gender distribution is concerned. In the Biological Sciences, women represent almost half of all academic researchers, but the proportion has been typically rather lower in Physics & Astronomy and in the Mathematical Sciences. The increase in the number of women was greater than the increase in the number of men in all narrow AOU groups.

Table 6.14 Research Only Academic Staff (FTE) in Natural & Physical Sciences Narrow AOUs by Gender, 2001 – 2012

Narrow AOU Group / Gender	2002	2004	2006	2008	2010	2012	Variation	
							FTE	%
Biological Sciences								
Female	549	684	810	888	941	1,030	481	88%
Male	619	712	878	910	1,020	1,116	497	80%
Subtotal	1,168	1,396	1,688	1,798	1,961	2,146	978	84%
% Female	47%	49%	48%	49%	48%	48%		
Chemical Sciences								
Female	74	83	119	132	131	144	69	93%
Male	166	168	220	244	279	305	139	84%
Subtotal	240	250	339	376	410	449	209	87%
% Female	31%	33%	35%	35%	32%	32%		
Earth Sciences								
Female	24	28	25	30	44	50	26	108%
Male	90	99	83	114	113	122	32	35%
Subtotal	114	127	108	144	157	172	58	51%
% Female	21%	22%	23%	21%	28%	29%		
Mathematical Sciences								
Female	22	24	36	55	60	65	44	202%
Male	123	146	191	194	212	232	109	89%
Subtotal	144	170	227	249	271	297	153	106%
% Female	15%	14%	16%	22%	22%	22%		
Physics & Astronomy								
Female	59	74	74	80	87	95	36	62%
Male	267	316	390	388	424	464	197	74%
Subtotal	325	390	465	468	511	559	234	72%
% Female	18%	19%	16%	17%	17%	17%		
Other N&PS								
Female	92	104	100	202	249	273	181	197%
Male	127	133	133	228	221	242	115	91%
Subtotal	218	237	234	431	470	514	296	135%
% Female	42%	44%	43%	47%	53%	53%		
All N&PS AOUs								
Female	840	1,002	1,163	1,386	1,512	1,655	815	97%
Male	1,370	1,568	1,898	2,079	2,268	2,482	1112	81%
Subtotal	2,210	2,570	3,061	3,465	3,780	4,137	1927	87%
% Female	38%	39%	38%	40%	40%	40%		

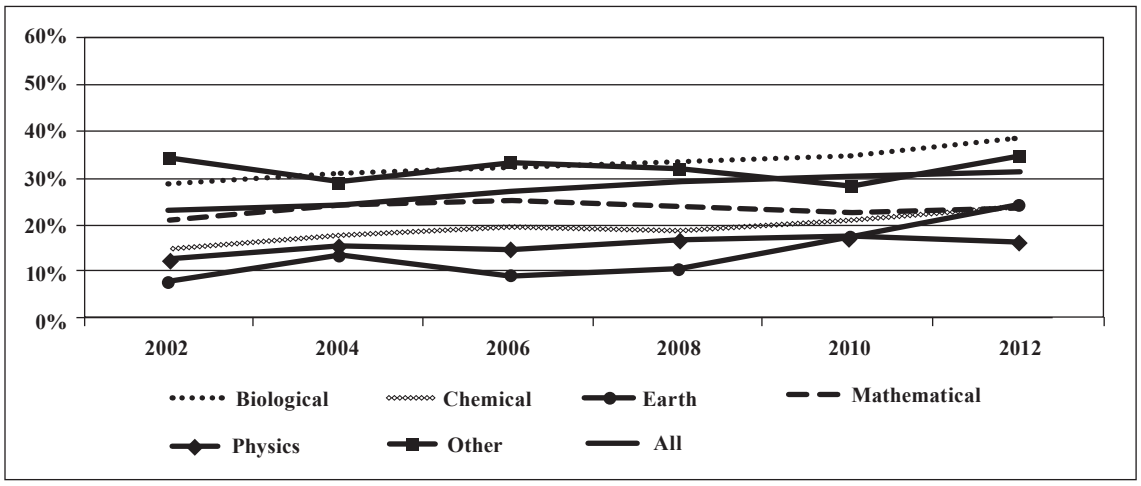
Source: uCube and staff Aggregated Data Sets 2002 – 2008 and estimated distributions for 2010 and 2012 based on these sources.
FTE = 'full-time equivalent'

To provide pictures of this information, Figures 6.15 and 6.16 summarise the gender distribution in each narrow AOU. Figure 6.15 summarises the proportion of female teachers in each of the Natural & Physical Sciences narrow AOU groups, and overall. The trend is fundamentally an upward one, but is likely to be quite a few years before the numbers of men and women are the same.

Overall, women made up just over 30 per cent of all teaching academics in the Natural & Physical Sciences in 2012, up from less than a quarter in 2002. However, this average is driven by Biological Sciences, the largest of the narrow AOUs, in which the proportion of women was approaching 40 per cent in 2012. Narrow AOU group Other Natural & Physical Sciences also has relatively more women than the average. The proportion of women is lagging in the other

narrow AOU groups: Chemical, Earth and Mathematical Sciences, and Physics & Astronomy. The trend in the relative proportion of women appears to be upward in the Chemical and Earth Sciences, but flat in Mathematical Sciences and Physics & Astronomy.

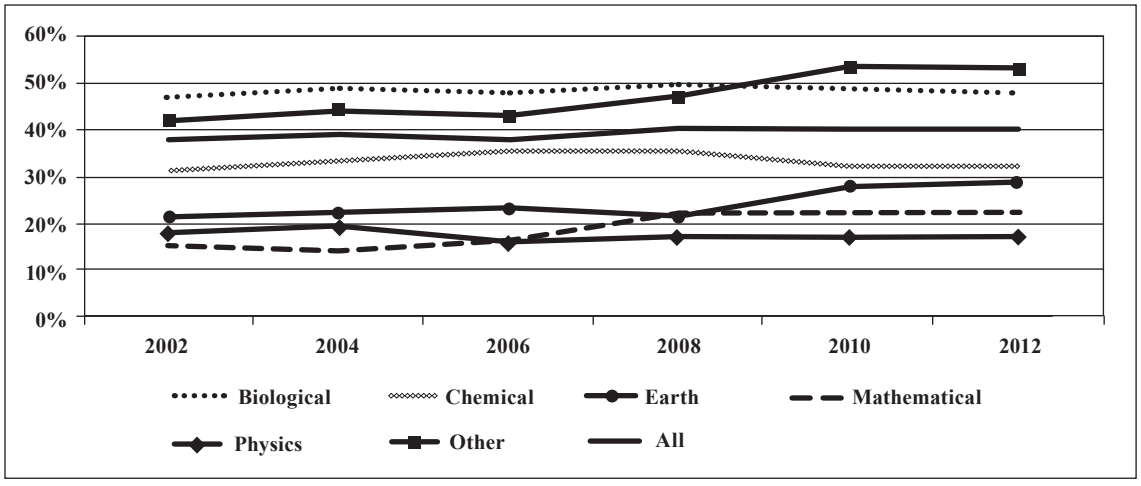
Figure 6.15 Teaching Staff (FTE) in Natural & Physical Sciences Narrow AOUs by Percentage Women, 2002 – 2012



Source: uCube and staff Aggregated Data Sets 2002 – 2008 and estimated distributions for 2010 and 2012 based on these sources.
FTE = 'full-time equivalent'

Figure 6.16 graphs the gender situation among research academics in each Natural & Physical Sciences narrow AOU group. Physics & Astronomy and Mathematical Sciences have the lowest proportion of women among their academic research only staff. Female presence in Earth Sciences was similarly low, but there has been an increase in the number and proportion of women appointed as researchers in recent years. However, numbers are small in Earth Sciences; by 2012, women made up 50 FTE out of 172 FTE academic researchers in this narrow AOU group.

Figure 6.16 Academic Research Only Staff (FTE) in Natural & Physical Sciences Narrow AOUs by Percentage Women



Source: uCube and staff Aggregated Data Sets 2002 – 2008 and estimated distributions for 2010 and 2012 based on these sources.
FTE = 'full-time equivalent'

Women in the Natural & Physical Sciences: the future?

The presence of women is increasing relatively well in the Natural & Physical Sciences, but the growth varies between narrow AOU groups. It would seem that the Biological Sciences will be the first narrow AOU in the Natural and Physical Sciences that will have equal numbers of women and men, but the other specific narrow AOU groups are likely to be far behind. The first step towards equal numbers of academics is dependent on women's uptake of PhDs in the particular narrow discipline. Unfortunately, uCube does not permit analysis of narrow fields of education, nor does it permit analysis of either enrolments or course completions at the level of 'PhD'; the most specific allowed is 'postgraduate – research'.

The tables and graphs above also showed that women, on average, are more likely to hold 'research-only' positions, to be younger, to be in junior positions, and less likely (than male counterparts) to have a tenurable position.

The last decade of university expansion has seen almost 400 FTE more women, and an absolute decline in the number of men (-47 FTE) among teachers in the Natural & Physical Sciences. In the same period, there was a decline in the number of tenurable positions (-74 FTE – see for example, Table 5.5).Therefore, it is less likely than in the past for anyone to gain a tenurable position. Given that much of the expansion in teaching is by women, but that expansion is of limited term positions, the women appointed are more likely to be in limited term positions. It seems likely that the proportion of tenurable teaching positions will continue to decline, and women are unlikely to achieve the rates of holding tenurable positions that men did in earlier decades and up to the present.

The proportion of women in Level D and E positions will increase over time, as the slight upward incline in the proportion of women at these levels indicates. There has been a slight increase in the proportion of men at Levels D and E also.

Teaching Science: where to now?

The material above demonstrated clearly the steady decline in the proportion of teaching numbers compared with the increase in academic research only staff numbers. This decline has had an impact on the relative size of the full-time & fractional-full-time teaching workforce. Table 6.15 shows that the number of equivalent full-time students increased by 46 per cent between 2002 and 2012, in the range 25 per cent (Physics & Astronomy) and 106 per cent (Other Natural & Physical Sciences). In the meantime, the full-time and fractional full-time teaching workforce increased by only ten per cent, in the range +112 per cent (Other Natural & Physical Sciences) to -23 per cent (Mathematical Sciences). Even in the narrow AOU groups that did enjoy an increase in the size of their teaching workforce, those increases did not match the expansion in student numbers, except for the catch-all Other Natural & Physical Sciences.

The so-called enabling sciences of chemistry, mathematics and physics suffered considerable declines in size of their teaching staff. Chemical Sciences lost about 15 FTE teachers, Physics & Astronomy list about 26, and the Mathematical sciences had 131 fewer full-time equivalent teachers in 2012, compared with 2002. Earth Sciences also shed full-time & fractional full-time staff, losing about 23 per cent of its teaching stock.

These changes have had a considerable impact on the ratio between students and full-time & fractional full-time teaching staff. In the worst of the cases, the ratio of Earth Sciences student to their teachers increased by 78 per cent, a massive increase. In the enabling sciences, the full-time & fractional full-time teachers in the Chemical Sciences had an extra 8.45 students per teaching staff member, whereas in Mathematical Sciences and Physics & Astronomy, there were an additional 14.54 and 5.24 students per staff member, respectively.

Much of the obvious teaching gap will have been made up by casual teaching staff, but as broader-based figures in Chapter 4 showed, even with casual teachers, there is an increasing gap between the number of students and the teachers (including casual staff) available to teach them.

Table 6.15 Student Load (EFTSL – excl. Private Providers).) and Full-Time & Fractional Teaching Staff (FTE) in Narrow Natural & Physical Sciences Narrow AOUs; Student : Staff Ratios, 2002 – 2012

	2002	2004	2006	2008	2010	2012	Variation	
							No.	%
Student Load (EFTSL)								
Biological Sciences	30,512	32,036	34510	36,813	40451	43703	13,191	43%
Chemical Sciences	7,620	8,060	8,520	8,827	9976	10613	2,993	39%
Earth Sciences	3,897	3,661	3,794	4,269	4,985	5330	1,433	37%
Mathematical Sciences	20,519	21,134	21419	23900	25725	28842	8,323	41%
Physics & Astronomy	4,994	4,970	5,029	5,305	5842	6232	1,238	25%
Other N&PS	6,192	7,560	8,034	9,079	11,907	12768	6,576	106%
All N&PS AOUs	**73,734**	**77,421**	**81,303**	**88,195**	**98,888**	**107,487**	**33,753**	**46%**
Teaching Staff (FTE)								
Biological Sciences	1,521	1,555	1,833	1,869	1,894	1,902	381	25%
Chemical Sciences	403	402	366	393	387	388	-15	-4%
Earth Sciences	202	208	162	167	155	155	-47	-23%
Mathematical Sciences	907	935	779	778	773	776	-131	-14%
Physics & Astronomy	336	320	293	301	309	310	-26	-8%
Other N&PS	165	178	263	332	348	349	184	112%
All N&PS AOUs	**3,534**	**3,597**	**3,696**	**3,840**	**3,865**	**3,881**	**347**	**10%**
Student : Staff Ratio (FT&FFT)								
Biological Sciences	20.06	20.60	18.83	19.70	21.36	22.98	2.92	15%
Chemical Sciences	18.91	20.05	23.28	22.46	25.78	27.35	8.44	45%
Earth Sciences	19.29	17.60	23.42	25.56	32.16	34.39	15.10	78%
Mathematical Sciences	22.62	22.60	27.50	30.72	33.28	37.17	14.54	64%
Physics & Astronomy	14.86	15.53	17.16	17.62	18.91	20.10	5.24	35%
Other N&PS	37.53	42.47	30.55	27.35	34.22	36.58	-0.94	-3%
All N&PS AOUs	**20.86**	**21.52**	**22.00**	**22.97**	**25.59**	**27.70**	**6.83**	**33%**

Source: Student Load – uCube; Aggregated Data Sets 2002 – 2008; estimations based on passed data 2010 – 2012
FT&FFT Staff: uCube and estimates based on Aggregated Data Sets 2002-2008
Student load provided by Non Table A/B Private Providers has been excluded to match with staff counts
FTE = 'full-time equivalent'. Minor rounding errors apply.

Research has been the winner. Table 6.5 showed that there had been strong growth in academic research only staff, and even Chemical Sciences, Mathematical Sciences and Physics & Astronomy, which 'lost' 15, 131 and 26 teachers respectively between 2002 and 2012 managed to expand their academic research staffing capacity by 209, 153 and 234 full-time equivalent academics. The academic staffing net result for the enabling sciences, therefore, has been positive, but the nearly 600 new researchers need to be considered in light of the loss of 172 teachers.

Chapter 7

Conclusions and further research

This study confirms that the emphasis in the academic staffing of Australian universities in the 2000s has been on research, and that there has been a reliance on casual staff to meet the demands of teaching the rapidly rising student body.

Looking at what has happened in academic departments, across the sector, the number of full-time and fractional full-time teaching staff increased by 22 per cent (Table 5.1), compared with an increase in the number of academic research only staff of 98 per cent (calculated from Table 5.2). The equivalent figures for Natural & Physical Sciences show an increase of only ten per cent in the full-time equivalent teacher count, but an increase of 87 per cent in research only academics.

The increase in teacher numbers, particularly those with a full-time & fractional full-time work contract needs to be compared with the increase in the body of students that must be taught. In fact, the overall increase in equivalent full time students was 37 per cent (Table 3.1), well adrift of the 22 per cent increase in full-time and fractional full-time teachers. The situation in the Natural & Physical Sciences was rather worse than this: students increased by 46 per cent (Table 3.1), with the full-time and fractional full-time teaching contingent increasing by only ten per cent. Put in a different way, the additional almost 34,000 students resulted in an increase of only 350 full-time & fractional full-time teachers, about 96 students per new teacher.

Of course, the number of these teachers has been augmented with casual staff, of which there were about 10,300 FTE in 2012, an estimate based on data from earlier years. This represents a quarter of all full-time equivalent teachers. The Natural & Physical Sciences share of this casual number is over 1,200 FTE, meaning that the teaching 'science' to over 107,000 students in 2012 was the responsibility of around 5,100 FTE teachers (Table 4.2 extrapolated to 2012). Is an increase of 16 per cent in the number of teachers (of which about half were casuals) really sufficient to match an increase of 46 per cent in student numbers? What does this say about the capacity of hard-working teachers to provide ever-improving teaching? Much has been said about the need for pedagogically-improved university teaching workforce. On the basis of the increasing gap between student and staff numbers, some might think that quantitative as well as qualitative solutions should be sought.

The figures above relate to the Natural & Physical Sciences as a bloc of narrow AOU groups. There are differences between the various narrow AOU groups. Based on full-time & fractional full-time staff, it could not be considered good news to find out that there was a decline in the teaching staff in all of the enabling sciences, despite the increase in the number of students that have to be taught. For example, there were more than 8,300 additional mathematics students, yet the number of experienced staff to teach them declined by 131 FTE (-14 per cent) (Table 6.15). A similar pattern is the case for Chemical Sciences (+39 per cent students; – four per cent teaching staff) and Physics & Astronomy (+25 per cent; – eight per cent). The biological sciences experienced an increase in its full-time & fractional full-time teaching contingent, but the increase failed to match the increase in students (+43 per cent c.f. +25 per cent). Other Natural & Physical Sciences experienced a staff increase greater than the increase in the students to be taught: + 106 per cent c.f. + 112 per cent).

With this report, it would have been useful to be able to tap more deeply into the rich data resource of staff statistics that exists. It was noted earlier that compliance with privacy legislation has been presented as the reason why it is no longer possible for general availability of aggregated data sets. But why was this reaction the immediate one of those in the Commonwealth bureaucracy?

Why not examine the data sets to see where a privacy issue could have arisen, and then do something to ensure that no such issue arose? Apart from the arrant stupidity of refusing to declare that any given university has ONE vice-chancellor when that is the case by definition, surely it would not have taken long to work out which data categories should be banded together, to ensure that there were no under-sized cells. It could be that there needs to be more than one staff file that could be accessed via uCube. Individual identifiability would be impossible if there were two files, one in which universities were not specified.

Future research?

Further research on patterns of university staffing would provide useful information about what has been happening in the university sector. A commitment and input from the Department would help on this front, however. For this study, it has been necessary to estimate the distributions of staff by narrow AOUs, because the algorithm used by the Department to do this is not sufficiently specific to provide better data. With all the university data at its disposal, the Department could eliminate many of the imprecisions that currently exist in using the limited staff statistics that are available. Rather than rely on 'privacy' to prevent making available more and better university statistics, the Department could better serve universities and the public by seeing how to resolve a bureaucratic impasse.

Universities have been providing the Department with detailed staffing information for nearly 25 years, at considerable expense to themselves. Since removing staff aggregated data sets from its website, no one else but the Department's own officers have access to the detailed version of what is submitted. It would not be difficult to come up with a system under which more and better information remained available to the public, other than having to order tables and then wait two months for them to be provided. Is privacy really the issue here, or is it control of information? This should be the topic of further investigation. In particular, the situation outlined in Chapter 2, whereby teaching in the biological sciences could be inappropriately linked to the '06 Health' broad AOU rather than to '01 Natural & Physical Sciences' broad AOU should be looked into. This should also be the topic of further investigation.

Privacy or control of information flow?

The challenges posed by privacy legislation need to be examined in the context of maximising the availability of data for research scrutiny, and not simply used as yet another way to restrict the flow of information. As things stand, the apparent policy direction at the Department makes it seem as though control of information is the main driver, not to mention providing another way to charge the public for access to information that belongs to the public and was previously available gratis.

Chapter 8

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Appendix 1

Academic Organisational Unit (AOU) Groups

01	**Natural & Physical Sciences (Broad AOU)**
	Narrow AOU codes :
0101	Mathematical Sciences
0103	Physics & Astronomy
0105	Chemical Sciences
0107	Earth Sciences
0109	Biological Sciences
0199	Other Natural & Physical Sciences #

Comprises Medical Science, Forensic Science, Food Science and Biotechnology, Pharmacology, Laboratory Technology, and Natural &d Physical Sciences not elsewhere classified)

Other Broad Academic Organisation Unit Groups	
02	Information Technology
03	Engineering & Related Technologies
04	Architecture & Building
05	Agriculture, Environmental & Related Studies
06	Health
07	Education
08	Management & Commerce
09	Society & Culture
10	Creative Arts
11	Food, Hospitality & Personal Services
12	Mixed Field Programmes

Source: The Department

Note: This nomenclature also applies to fields of education (by which university enrolments are classified), and discipline groups (by which university subjects are classified).

Appendix 2

Classification of academic organisational unit (AOU) groups

Author's preamble: This appendix has been included because it explains the basis on which staff are allocated to AOUs. Most of the text below is from a Department system called DESTPAC, superseded a number of years ago. The text remains current, however.

Introduction

Within universities, various organisational units have been formed over the years for the purposes of undertaking education and research functions. These units are referred to by various names such as schools, faculties and departments. There is considerable variation between institutions in terms of the number, functions and size of the organisational units which have been formed.

On occasions, comparisons are made between universities in terms of statistics for similar types of Academic Organisational Units (AOUs). To enable such comparisons, an *AOU Group Code* **is calculated for each AOU in each university. The calculation for each AOU takes into account the distribution of student load by discipline group within the AOU. The result of the calculation is an AOU group code for each AOU. This code indicates the 'type' of the AOU in terms of the predominant discipline for which the AOU is responsible.**

The 'typing' of each AOU is only approximate. The accuracy of the 'typing' depends on the extent to which the disciplines for which an AOU are responsible are homogenous. Where an AOU has a heterogeneous mix in disciplines, the 'typing' can be unrepresentative. The 'fuzziness' of the classification needs to be taken into account when data tabulated using the classification are being interpreted.

Structure of the classification

The classification has a two-tiered structure:

Broad AOU groups (see Appendix 1)

Narrow AOU groups: within each broad AOU group there are a number of narrow AOU groups (each of which is a 4 digit numeric code). The names and codes match those used for the first four digits of discipline groups with the exception that there is a 'General' minor AOU group within each major AOU group.

Coding AOUs to the classification

a. Method

The code to be assigned to an AOU is determined from an analysis of the distribution of student load within narrow discipline groups. The student load (EFTSL) attributed to the functioning of the AOU is calculated, with the EFTSL associated with different narrow discipline groups separately identified.

- If 70 per cent or more of the EFTSU attributed to the AOU is accounted for by one narrow discipline group, then the AOU group code is identical to the code for that narrow discipline group.
- If no single narrow discipline group accounts for 70 per cent or more of the EFTSU attributed to the AOU, then the AOU group code is determined in the following way:

- the broad discipline group which accounts for the largest share of the EFTSL is then determined.
- the first 2 digits of the AOU group code are set equal to the code for the broad discipline group.
- the second 2 digits of the AOU group code are set equal to '00'. In effect, this assigns a 'General' AOU group code to the AOU.

b. Examples of calculation

As the first example, the following data might be generated for an AOU with an industrial engineering orientation:

Broad Discipline group	Narrow Discipline group	Narrow Discipline group name	EFTSL Value	EFTSL %
05	0501	Agriculture	102	4
05	0505	Forestry	254	10
06	0603	Nursing	260	11
06	0605	Pharmacy	1853	75
			2436	**100**

In the above example, the single narrow discipline group 0605 – Pharmacy – accounts for 75 per cent of the AOU's EFTSU and hence the appropriate AOU group code would be 0605.

As a second example, the following data might be generated from an AOU with a less homogeneous orientation:

Broad Discipline group	Narrow Discipline group	Narrow Discipline group name	EFTSL Value	EFTSL %
06	0603	Nursing	1245	40
06	0605	Teacher Education	250	8
07	0701	Nursing	804	25
08	0801	Accountancy	346	11
08	0807	Tourism	500	16
			3145	**100**

In this example, no single narrow discipline group accounts for 70 per cent or more of the AOU's EFTSU. The branch of learning with the largest share of the AOU's EFTSL is 06 – Health. This branch of learning accounts for 48 per cent of the AOU's EFTSL. Therefore, in this case the AOU group code would be formed by taking the digits 06 corresponding to the Health branch of learning code, following them with 00, the 'General' code. The full AOU group code would therefore be 0600. Using the classification, the name of the AOU group in this case would be 'Health – General'.

Source: The Department

Appendix 3

University Names and Abbreviations Used[23]

Abbreviated Name	Full Name (excluding articles)
ACU	Australian Catholic University
Adelaide	University of Adelaide
ADFA	Australian Defence Force Academy
AMC	Australian Maritime College
ANU	Australian National University
Avondale	Avondale College of Higher Education
Ballarat	University of Ballarat
Batchelor	Batchelor Institute of Indigenous Tertiary Education
Canberra	University of Canberra
Charles Darwin	Charles Darwin University
CQU	Central Queensland University
CSU	Charles Sturt University
Curtin	Curtin University of Tech.
Deakin	Deakin University
Edith Cowan	Edith Cowan University
Federation[24]	Federation University
Flinders	Flinders University
Griffith	Griffith University
James Cook	James Cook University
La Trobe	La Trobe University
Macquarie	Macquarie University
Melbourne	University of Melbourne
Melbourne Divinity	Melbourne Divinity
Monash	Monash University
Murdoch	Murdoch University
Newcastle	University of Newcastle
Notre Dame	University of Notre Dame Australia
Queensland	University of Queensland
QUT	Queensland University of Technology
RMIT	Royal Melbourne Institute of Technology
Southern Cross	Southern Cross University
Sunshine Coast	University of the Sunshine Coast
Swinburne	Swinburne University of Technology
Sydney	University of Sydney
Tasmania	University of Tasmania
UNE	University of New England
UniSA	University of South Australia
UNSW	University of New South Wales
USQ	University of Southern Queensland
UTS	University of Technology, Sydney
UWA	University of Western Australia
UWS	University of Western Sydney
VU	Victoria University
Wollongong	University of Wollongong

23 Some smaller institutions are not specifically identified in tables in this report, having been aggregated into 'Other Universities'.

24 Federation University came into being from the start of 2014, having been created from a merger between the University of Ballarat and Monash University's Gippsland Campus. (See http://federation.edu.au/about-feduni/our-university/welcome-from-the-vice-chancellor).

Notes

Notes

About the author

Ian R. Dobson (PhD, Monash; Grad.Dip.Lib'ship, RMIT; BCom, Melb) worked in Australian higher education from 1971 until 2005, and currently holds an honorary academic post with the School of Education and Arts at Federation University, and an adjunct professional staff position with Monash University. An administrative career in planning and statistics from 1971 to 1995 at RMIT, Melbourne and Monash preceded nearly ten years as associate to a former Monash D-VC then VC. Now a co-resident of Australia and Finland, he worked as research director at the University of Helsinki's Higher Education Governance, Organisation and Management unit from mid-2010 until the end of 2012.

He has been accepting commissioned analytical and other projects since the mid-1990s, with clients that have included the Australian Council of Deans of Science, the Australian Academy of the Humanities, the Australian Council of Learned Academies, the Office of the Chief Scientist and universities including Ballarat, Griffith, Melbourne, Monash and Victoria.

Although spending much of his career university administration, he has authored or co-authored about 80 refereed journal articles and 14 book chapters. He has presented papers at a wide range of conferences in Australia and abroad. Current formal editorial activities include being editor of the Journal of Higher Education Policy and Management (Taylor & Francis) and the Australian Universities' Review (NTEU). He also works as an English language reviser of PhDs, academic papers, policy documents, user manuals and websites. Clients have included Finland's Universities of Helsinki, Turku and Tampere, Hanken School of Economics, the Theatre Academy, the Sibelius Academy and the Ministry of Education and Culture; Norway's NIFU Step; and CIPES in Portugal. In Australia, he has revised the English in PhDs for students at Ballarat, Macquarie and Monash.

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