

Physics Enrolment Trends in Australian Tertiary Educational Institutions from 1980 to 1987.

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Introduction

This is the sixth survey in a series on enrolment trends in Physics in Australian Universities and Colleges of Advanced Education (CAE's) covering the period 1980 to 1987. Previous surveys have covered the periods 1963-1973 [de Laeter, 1974; Watson-Munro, 1974]; 1965-1975 [de Laeter and Watson-Munro, 1975]; 1974-1978 [de Laeter and Watson-Munro, 1979]; 1977-1981 [de Laeter and Jennings, 1982] and 1980-1984 [Jennings and de Laeter, 1984].

This survey contains information from 33 tertiary institutions comprising 22 Universities and 11 CAE's whose degrees are accepted by the Australian Institute of Physics as a professional qualification in physics. There are a number of changes with respect to the last survey [Jennings and de Laeter, 1984]:

1. The first concerns the classification of students studying physics in the Australian Defence Academies. Prior to 1986, these students took their qualifications at the Royal Australian

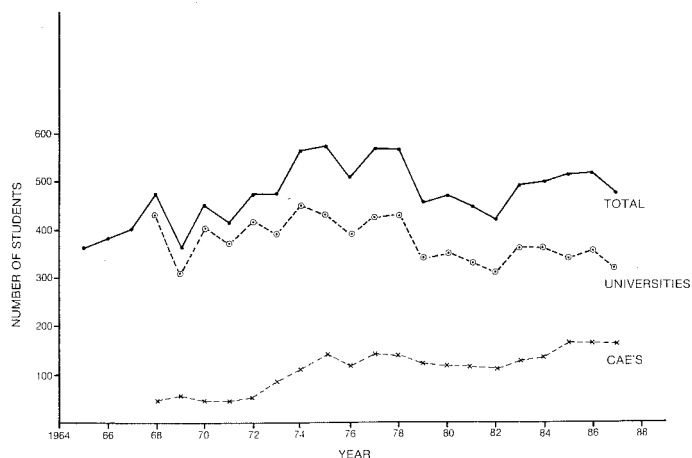


Figure 1. Enrolments in Third Year Physics at Australian Universities and Colleges of Advanced Education (CAE's) from 1965 to 1987.

TABLE 1: NUMBERS OF THIRD YEAR PHYSICS STUDENTS

	1980	1981	1982	1983	1984	1985	1986	1987
Griffith University	14	10	12	15	15	23	20	11
James Cook University	7	2	3	8	2	3	4	3
University of Queensland	17	19	13	13	19	19	17	19
Queensland Institute of Technology	5	13	10	14	11	13	14	9
Capricornia Institute of Advanced Education	17	15	11	14	12	14	16	14
Darling Downs Institute of Advanced Education	5	4	1	4	8			
Total QUEENSLAND	65	63	50	68	67	72	71	56
Macquarie University	7	16	12	6	13	10	16	9
University of Newcastle	7	7	4	7	5	3	5	2
University of New England	7	4	3	4	6	10	9	4
University of New South Wales	25	27	16	15	25	17	16	20
University of Sydney	36	33	47	48	38	45	55	57
University of Wollongong	5	5	1	5	4	5	5	3
New South Wales Institute of Technology	7	7	7	10	13	16	18	19
Total NEW SOUTH WALES	94	99	90	95	104	106	124	114
Australian Defence Force Academy							15	5
Australian National University	6	9	8	15	13	18	7	19
Royal Military College	5	0	5	8	3	2		
Canberra College of Advanced Education	17	15	15	13	17	11	6	8
Total AUSTRALIAN CAPITAL TERRITORY	28	24	28	36	33	31	28	32
Swinburne Institute of Technology						26	29	32
Deakin University	8	6	0	4	2	3	2	2
Latrobe University	12	12	18	19	15	16	24	15
University of Melbourne	50	46	42	39	36	27	43	28
Monash University	14	22	15	27	26	21	33	29
Ballarat College of Advanced Education	12	5	9	6	4	5	4	5
Chisholme Institute of Technology	16	19	19	22	24	24	24	25
Royal Melbourne Institute of Technology	23	27	21	21	13	20	20	22
RAAF Academy	32	24	24	36	38	33		
Total VICTORIA	167	161	148	174	158	175	179	158
University of Tasmania	18	13	12	9	18	14	9	6
University of Adelaide	42	34	37	39	39	31	34	46
Flinders University	8	7	7	10	5	5	11	15
South Australian Institute of Technology	4	1	6	12	19	14	4	10
Total SOUTH AUSTRALIA	54	42	50	61	63	50	49	71
Murdoch University	9	15	14	14	13	18	13	8
University of Western Australia	21	19	17	22	25	20	16	13
Western Australian Institute of Technology	11	9	9	10	13	23	15	13
Total WESTERN AUSTRALIA	41	43	40	46	51	61	44	34
Total AUSTRALIA	467	445	418	489	494	509	504	471

Air Force Academy or at the Royal Military College, Duntroon. However these students are now all enrolled at the Australian Defence Force Academy in Canberra. Although the Royal Military College figures have been quoted in earlier surveys, this is the first time that the RAAF Academy figures have been listed.

2. Three changes have occurred in the CAE sector. Darling Downs Institute of Advanced Education no longer offers a degree programme in physics - the last person graduated in 1984. Swinburne Institute of Technology now has a degree which is recognised by the Australian Institute of Physics, and so their third year students are listed from 1985. The Western Australian Institute of Technology has now been renamed Curtin University of Technology, but their figures are still included in the CAE sector.

3. As before, this survey includes data on third year physics enrolments, fourth year physics enrolments, post-graduate enrolments and final year radiography enrolments. In addition, we have provided the actual annual number of Masters and PhD graduates from 1981 to 1986. Jennings and de Laeter [1984] made an estimate of the number of Masters and PhD students who graduate each year, but since this information can be obtained from the various tertiary institutions, the actual numbers of Masters and PhD graduates are listed in Tables 5 and 6 respectively.

All of the data were obtained directly from the Heads of the various Physics Departments. In some cases, there may be minor inaccuracies present because of the difficulty of uniquely identifying physics students in some institutions. Thus we have included astronomy, geophysics and medical physics numbers in our statistics, as we have done in past surveys. Every endeavour has been made to adopt a consistent approach for all six surveys, and thus the data should give an accurate picture of tertiary physics enrolment

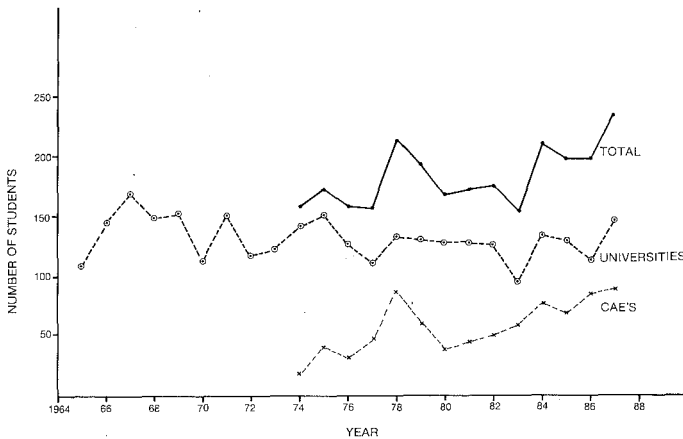


Figure 2. Enrolments in Fourth Year Physics at Australian Universities and Colleges of Advanced Education (CAE's) from 1965 to 1987.

trends in this country. Students at Canberra College of Advanced Education now study a course which could best be described as Engineering Physics, and these numbers have also been included in the tabulated data.

Third Year Enrolments

Table 1 contains the data for third year physics enrolments over the period 1980-1987. Institutions are grouped by State.

In Figure 1 we have plotted these enrolments by sector over the twenty-year period - from 1968 to 1987. The numbers for 1980-1984 differ from those given in the previous report because the RAAF Academy statistics have now been included.

The enrolments show a relatively stable situation since 1980 with an irregular upward trend and a substantial decrease in 1987. A peak in third year physics enrolments occurred in the mid-1970's, after which there was a decline until 1982 when the trend reversed. Over the period 1980-1987 approximately 2.5 times more students were enrolled in third-year physics in the Universities than in the CAE's.

Previous reports have referred to the fact that many institutions have been offering physics majors with small class sizes. The same situation is still apparent, although one programme has been terminated since our last report.

A survey of the trends of physics enrolments in secondary schools has recently been published by de Laeter and Dekkers [1987]. These authors have shown that the actual number of students studying physics as a Public Examinations subject remained steady at approximately 25,000 over the period 1976-1982, but it has since risen to over 29,000 enrolments in 1985. In addition, a relatively small number of students are now studying physical science rather than physics and/or chemistry. However, because of the increasing student population at Year 12 level, a decreasing proportion of the Year 12 cohort are now studying physics. Physics is still a male-dominated subject at the secondary level, with approximately one-quarter of the Year 12 enrolments being females.

Fourth Year Enrolments

The data for fourth year enrolments from 1980 to 1987 are given in Table 2, and the totals by sector are plotted from 1968 to 1987 in Figure 2. The fourth year enrolments include honours, post-graduate diploma and master's-preliminary students. The fourth year enrolments have maintained the general upward trend noted in the previous survey. This has been mainly due to the steady increase in numbers in the CAE sector, although the University numbers also reached a maximum in 1987.

The average number of students enrolled in fourth year in the past eight years has been 188 compared to approximately 170 in the 1970's. This growth has been due to the development of post-graduate diplomas in the CAE sector. In particular, the number of fourth year students enrolled at the Western Australian Institute of Technology has been remarkably high over the past eight years, although these enrolments include geophysics students who are enrolled in

TABLE 2: NUMBERS OF FOURTH YEAR PHYSICS STUDENTS
(Honours, Graduate Diploma and Master's Preliminary)

	1980	1981	1982	1983	1984	1985	1986	1987
Griffith University	3	1	2	3	2	0	7	6
James Cook University	2	2	1	3	5	2	2	2
University of Queensland	11	8	13	10	9	8	8	13
Queensland Institute of Technology	10	11	11	10	12	2	12	9
Total QUEENSLAND	26	22	27	26	28	12	29	30
Macquarie University	2	1	2	3	3	5	1	2
University of Newcastle	3	4	3	1	5	4	4	3
University of New England	2	6	2	1	3	3	5	4
University of New South Wales	6	17	17	10	15	17	10	13
University of Sydney	12	13	7	7	8	7	10	23
University of Wollongong	1	0	2	0	1	0	2	3
New South Wales Institute of Technology	2	1	3	10	12	11	12	13
Total NEW SOUTH WALES	28	42	36	32	47	47	44	61
Australian Defence Force Academy							3	2
Australian National University	4	6	3	7	11	12	5	9
Royal Military College	1	0	1	1	1	2		
Total AUSTRALIAN CAPITAL TERRITORY	5	6	4	8	12	14	8	11
Deakin University	2	1	1	0	0	1	0	0
Latrobe University	5	4	5	2	2	3	2	2
University of Melbourne	19	25	11	7	14	15	18	22
Monash University	19	8	11	7	14	12	4	9
Ballarat College of Advanced Education	1	0	0	0	0	0	0	0
Swinburne Institute of Technology	1	2	19	14	23	19	18	36
Royal Melbourne Institute of Technology						4	3	2
RAAF Academy	4	2	3	2	0	0		
Total VICTORIA	51	42	50	32	53	54	45	71
University of Tasmania	8	6	5	6	3	13	6	4
University of Adelaide	10	5	16	13	18	8	14	6
Flinders University	6	4	4	2	5	4	0	7
South Australian Institute of Technology	4	4	0	0	0	0	0	0
Total SOUTH AUSTRALIA	20	13	20	15	23	12	14	13
Murdoch University	1	2	6	2	3	1	3	3
University of Western Australia	7	13	10	7	11	12	8	13
Western Australian Institute of Technology	21	26	17	25	30	32	39	28
Total WESTERN AUSTRALIA	29	41	33	34	44	45	50	44
Total AUSTRALIA	167	172	175	153	210	197	196	234

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the Post-Graduate Diploma of Applied Physics. Swinburne Institute of Technology has also enrolled an increasing number of post-graduate diploma students in recent years. The retention rate from third to fourth year has been approximately 40% over the past eight years, and this has not shown any significant change since the first data was collected in 1968.

As noted in previous surveys, the fourth year enrolments in many institutions are very low. Thirteen institutions had an average enrolment of less than five students per year over the period 1980 to 1987. It should be noted that no distinction has been drawn between full-time and part-time students at the fourth year level. This would imply that the numbers listed in Table 2 are higher than the actual number of graduating students, although there has been a trend to full-time enrolments in recent years and the discrepancy in these numbers is probably quite small.

Masters and Doctoral Enrolments

The data on Masters and PhD enrolments for the period 1980-1987 are given in Table 3 and plotted in Figure 3. Unfortunately this data was not collected in the first three surveys.

The number of higher degree enrolments has been remarkably steady over the past nine years for each sector. This is, in part, due to the fact that students are enrolled over a considerable period of time for a higher degree. Jennings and de Laeter [1984] estimated a mean enrolment period of three years for a Master's degree and five years for a PhD. The total enrolments show a small but steady increase over the past eight years, which parallels the increase in fourth year enrolments.

The University of New South Wales, the Research School of Physical Sciences (RSPS) at the Australian National University, and the University of Melbourne, dominate these enrolments. Eleven of the institutions listed have less than 10 students enrolled in Master's and/or PhD programmes. A breakdown of these figures indicates that approximately two-thirds of the students are enrolled for the PhD and one-third for the Masters degree, although the relative proportions are quite different at some institutions.

Jennings and de Laeter [1984] estimated that approximately 50 Master's degree and 50 PhD physics graduates were produced each year. Tables 4 and 5 list the actual number of Master's and PhD graduates respectively from 1981 to 1986. The 1987 figures are not given as students graduate progressively during the year. The average annual number of Master's graduates over this six-year period is 27 compared to an average annual number of 58 PhD graduates over the same period. It is apparent that the overwhelming majority of graduate students in the University sector are enrolled for the PhD degrees, and that approximately 85% of Master's and PhD graduates are from this sector. This situation is unlikely to change in the immediate future. The discrepancy between our previous estimate of 50 Master's graduates per year and the actual mean figure of 27 indicates that the mean enrolment period for a

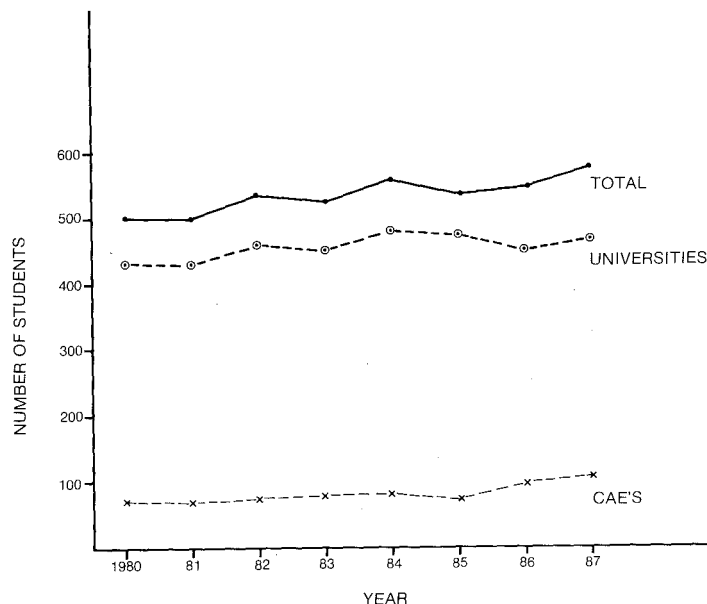


Figure 3. Post-graduate enrolments in physics at Australian Universities and Colleges of Advanced Education (CAE's) from 1980 to 1987.

TABLE 3: NUMBERS OF POSTGRADUATE PHYSICS STUDENTS (Master's and PhD Students)

	1980	1981	1982	1983	1984	1985	1986	1987
Griffith University	4	4	4	4	7	11	7	6
James Cook University	1	2	3	5	5	7	8	5
University of Queensland	17	15	17	18	24	19	18	23
Queensland Institute of Technology	16	15	14	20	23	18	30	35
Total QUEENSLAND	38	36	38	47	59	55	63	69
Macquarie University	32	33	19	14	17	21	26	30
University of Newcastle	6	7	7	5	4	3	4	8
University of New England	4	5	8	8	7	8	9	8
University of New South Wales	69	67	80	73	82	67	68	71
University of Sydney	26	26	31	29	35	35	21	22
University of Wollongong	10	9	9	8	6	2	4	5
New South Wales Institute of Technology	7	6	5	4	6	6	5	6
Total NEW SOUTH WALES	154	153	159	141	157	142	137	150
Australian National University	8	6	6	5	5	5	6	7
Australian National University (RSPS)	50	51	66	62	67	55	54	52
Royal Military College	7	7	6	3	2	4		
Australian Defence Force Academy							9	9
Total AUSTRALIAN CAPITAL TERRITORY	65	64	78	70	74	64	69	68
Deakin University	1	1	0	0	0	0	0	1
Latrobe University	21	22	18	17	18	22	16	21
University of Melbourne	44	50	49	49	57	67	74	74
Monash University	29	28	31	33	28	33	32	28
Chisholm Institute of Technology	4	7	5	4	5	5	11	10
Royal Melbourne Institute of Technology	15	13	16	16	12	15	16	18
Swinburne Institute of Technology	1	2	3	3	2	3	7	7
RAAF Academy	9	10	10	10	10	8		
Total VICTORIA	124	133	132	132	132	153	156	159
University of Tasmania	30	24	22	26	24	18	14	11
University of Adelaide	23	20	29	30	29	31	25	26
Flinders University	13	14	15	19	20	20	22	19
South Australian Institute of Technology	5	5	6	5	8	6	5	5
Total SOUTH AUSTRALIA	41	39	50	54	57	57	52	50
Murdoch University	3	4	8	7	8	5	4	6
University of Western Australia	23	24	22	26	24	27	29	32
Western Australian Institute of Technology	22	21	26	24	22	16	22	29
Total WESTERN AUSTRALIA	48	49	56	57	54	48	55	67
Total AUSTRALIA	500	498	535	527	557	537	546	574

Master's degree is in excess of three years. This reflects the fact that many Master's candidates are enrolled as part-time students, particularly in the Colleges of Advanced Education.

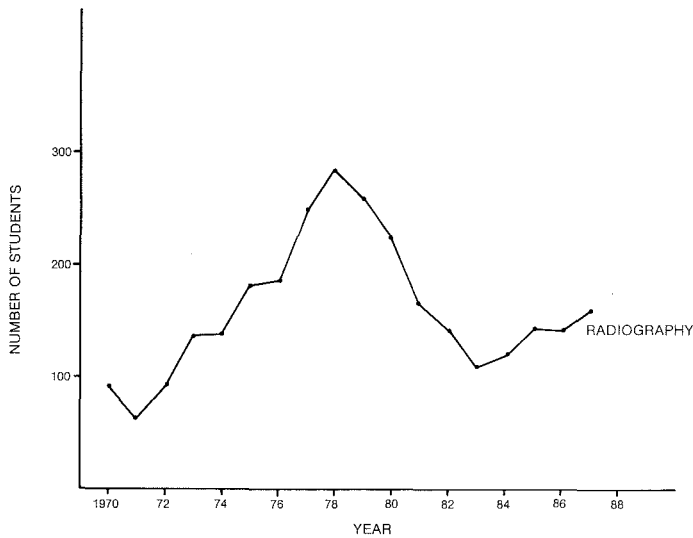


Figure 4. Enrolments in Final Year Radiography in Colleges of Advanced Education from 1970 to 1987.

Final Year Radiography Students

Table 6 provides the enrolment statistics for final year radiography students from 1980 to 1987, and Figure 4 the enrolment trends since 1970. Only four of the CAE's which have approved physics courses offer courses in radiography which are controlled by the Physics Departments in these institutions. The numbers listed in Table 6 include diagnostic and therapeutic radiographers as well as those students enrolled in nuclear medicine. In New South Wales radiography courses will in future be offered by the Cumberland College of Health Sciences.

In the early 1970's the average number of final year radiography students was approximately 100, whereas in the last three years the average number has increased to approximately 150. From 1977 to 1981 there was a significant increase in numbers which was caused by additional enrolments at the Royal Melbourne Institute of Technology. There is an increasing demand for radiographers to be involved in new modalities such as ultrasound and computed tomography, so that the number of graduates is likely to rise in the future.

TABLE 4: NUMBERS OF MASTER'S GRADUATES*

	1981	1982	1983	1984	1985	1986
Griffith University	0	0	0	0	1	1
James Cook University	0	1	0	0	0	0
University of Queensland	1	0	1	0	0	1
Queensland Institute of Technology	2	2	4	4	2	5
Total QUEENSLAND	3	3	5	4	3	7
Macquarie University	3	1	5	4	0	0
University of Newcastle	0	0	0	1	0	0
University of New England	0	0	0	0	0	1
University of New South Wales	5	3	0	1	4	1
University of Sydney	0	2	1	1	0	1
University of Wollongong	0	0	2	1	1	0
New South Wales Institute of Technology	1	1	1	2	1	1
Total NEW SOUTH WALES	9	7	9	10	5	4
Australian National University	0	0	0	0	1	0
Royal Military College	1	0	0	0	0	0
Australian National University (RSPS)	0	0	0	0	2	1
Total AUSTRALIAN CAPITAL TERRITORY	1	0	0	0	3	1
Swinburne Institute of Technology	0	0	0	1	0	2
Latrobe University	2	2	0	2	0	0
University of Melbourne	7	2	4	2	3	1
Monash University	0	1	1	1	0	1
Chisholm Institute of Technology	1	1	1	1	1	0
Royal Melbourne Institute of Technology	0	5	3	5	3	0
RAAF Academy	1	1	0	1		
Total VICTORIA	11	12	9	13	7	4
University of Tasmania	1	0	0	1	1	3
University of Adelaide	1	3	1	0	2	0
Flinders University	1	0	0	0	0	0
South Australian Institute of Technology	0	0	1	1	3	1
Total SOUTH AUSTRALIA	2	3	2	1	5	1
University of Western Australia	1	0	0	0	0	0
Western Australian Institute of Technology	3	2	2	1	1	4
Total WESTERN AUSTRALIA	4	2	2	1	1	4
Total AUSTRALIA	31	27	27	30	25	24

* The numbers represent those who actually graduate in each year.

Conclusions

The number of students studying physics in Year 12 at the secondary level has been approximately 25,000 over the period 1976-1982 but has subsequently increased to approximately 29,000 in 1985. The number of third year physics students has shown a slight increase in numbers over the past eight years, to reach an average enrolment of 476. It may be expected that undergraduate numbers will increase in the future because of the larger pool of secondary school students, and the employment opportunities created by Australia's economic policy, which is based to some extent on creating new technological industries. One of the challenges facing our profession is to ensure that physicists are employed in industry.

Fourth year student enrolments have increased significantly over the past eight years with much of the increase being caused by the increase in post-graduate diploma students in the CAE sector. Post-graduate enrolments have also continued to rise over the past eight years. There are about twice as many PhD graduates as there are Master's graduates with the overwhelming proportion of graduate education occurring in the University sector. Radiography enrolments have increased over the past five years, and this growth is likely to continue as new modalities are developed.

Acknowledgements

The authors are indebted to our colleagues in the various tertiary institutions who have

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kindly supplied us with the data on which this article is based. We would also like to thank Professor J. R. Prescott for providing us with the numbers of Master's and PhD graduates from 1981-1984, and to Mrs P. R. Harris for typing the manuscript.

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TABLE 5: NUMBERS OF PhD GRADUATES*

	1981	1982	1983	1984	1985	1986
Griffith University	0	3	1	0	0	1
James Cook University	1	0	0	0	0	1
University of Queensland	2	1	2	2	0	3
Total QUEENSLAND	3	4	3	2	0	5
Macquarie University	1	1	1	2	3	3
University of Newcastle	0	0	2	3	2	0
University of New England	0	1	2	0	1	1
University of New South Wales	5	7	6	6	6	7
University of Sydney	3	2	6	1	4	10
University of Wollongong	0	0	1	1	0	0
Total NEW SOUTH WALES	9	11	18	13	16	21
Australian Defence Force Academy						1
Australian National University	2	0	0	2	0	1
Australian National University (RSPS)	6	12	21	8	8	9
Royal Military College	1	2	2	0	1	0
Total AUSTRALIAN CAPITAL TERRITORY	9	14	23	10	9	11
Latrobe University	0	2	3	1	3	3
University of Melbourne	6	9	6	3	7	7
Monash University	2	8	5	6	4	4
RAAF Academy	1	0	1	1	2	
Total VICTORIA	9	19	15	11	16	14
University of Tasmania	6	2	3	3	1	2
University of Adelaide	6	10	0	4	2	4
Flinders University	4	2	2	4	3	2
Total SOUTH AUSTRALIA	10	12	2	8	5	6
Murdoch University	0	1	1	0	1	0
University of Western Australia	0	4	3	1	1	3
Total WESTERN AUSTRALIA	0	5	4	1	2	3
Total AUSTRALIA	46	67	68	48	49	62

* The numbers represent those who actually graduate in each year.

TABLE 6: NUMBERS OF FINAL YEAR RADIOGRAPHY STUDENTS IN CAE'S

	1980	1981	1982	1983	1984	1985	1986	1987
Queensland Institute of Technology	43	40	39	34	37	36	32	34
Royal Melbourne Institute of Technology	142	85	64	46	38	65	63	64
South Australian Institute of Technology	23	23	24	13	27	28	32	44
Western Australian Institute of Technology	17	15	14	14	15	14	13	16
Total AUSTRALIA	225	163	141	107	117	143	140	158

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