

Career Aspirations and Employment Experience of Physics Students

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Introduction

Conflicting claims have been made recently about an alleged decline in physical science enrolments in Australian secondary schools, colleges and universities. In a previous paper (Jennings and Carras, 1979) we investigated these claims using Western Australian enrolment figures and found that there was no evidence of a decline in the numbers studying physical science in W.A. However high school enrolments in Biology have grown more rapidly than those in Physics and Chemistry. We attributed this to a number of factors including the perceived difficulty of physical science subjects and the wide range of optional courses now available to upper secondary students.

At the tertiary level Physics enrolments in W.A. and nationally have remained almost static during the seventies while Chemistry enrolments have decreased slightly after a peak in the early seventies (de Laeter and Watson-Munro, 1979; Stern, 1978). We concluded previously (Jennings and Carras, 1979) that these trends were possibly due to students' concern about employment prospects and to the development of new applied science courses at the tertiary level.

Statements continue to appear about the poor employment prospects for Physics graduates. Recently the Commonwealth Department of Employment and Youth Affairs stated in its bulletin, "Employment Prospects by Industry and Occupation", that there is "a heavy manpower surplus in Physics" (Department of Employment and Youth Affairs, 1979). On the basis of a survey of advertised vacancies in Australian daily newspapers over a twelve month period Prescott (1980) has challenged these assertions regarding poor employment opportunities for Physics graduates.

We have attempted to resolve this disagreement by conducting a survey of the career aspirations and employment experience of pass, honours and higher degree Physics graduates in W.A.

The results of this survey will be of particular interest to science teachers and educators partly because the majority of pass graduates in Physics seek employment in secondary schools as teachers, (the Department of Labor [1973] reported that 25.5% of all Physics graduates in employment in 1968 were employed in secondary teaching) and partly because teachers are often called upon to advise students about career decisions.

Objectives and Methodology

The major objectives of our survey were to determine

- (a) the reasons why students study Physics;
- (b) their career objectives at the start of their tertiary studies;
- (c) the employment experience and job satisfaction of *pass* graduates;
- (d) the employment patterns of *higher degree* graduates in Physics.

Three questionnaires were used to collect this data. The first surveyed the career objectives and the reasons why first-year students were studying for a major in Physics at the University of W.A., W.A. Institute of Technology and Murdoch University. The second surveyed the employment experience and job satisfaction of all recent pass and honours graduates in Physics in W.A. The third was directed to all higher degree graduates in Physics from the University of W.A. over the past twenty-seven years, since Ph.D.s were first awarded there.

The survey included 156 first year, 96 final year and 96 higher degree graduates. The first two questionnaires were distributed in 1977 and again in 1978 and the results were found to be very similar. A clear pattern emerged from which we were able to provide a contemporary assessment of students' reasons for studying Physics, and their career prospects in the current employment market (Dallimore, Jennings and Robins, 1979; Jennings and Zadnik, 1980).

Why Do Students Study Physics?

All first year students were asked the question, "Which of the following influences have been important in developing your interest in Physics?"

Table 1 shows that most first year Physics students were attracted to Physics by their high school studies and by books they had read.

TABLE 1
Sources of First-Year Tertiary Students' Interest in Physics*
(N = 156)

Influence	Students influenced
High school studies	77%
Books	41%
Newspapers/magazines	21%
Hobbies	19%
Teachers	17%
Radio/TV	14%

In response to the question, "Why are you studying Physics?", a majority of the undergraduate students indicated that they were studying it for aesthetic or philosophical satisfaction. The proportion which expressed this view rose from 55% of first year students to 89% of final year undergraduates. Less than 10% of all undergraduate students indicated that they thought there were good employment prospects for Physicists.

Physicists

Of approximately 3000 W.A. students who study Physics at year 12 level each year, some 1400 (about 45%) continue to study the subject at first year tertiary level as part of course requirements in fields such as engineering, medicine, agriculture and science, while only about 50 (about 1.5%) eventually graduate each year with a major in the subject.

Our survey showed that Physics majors are predominantly young males with an intense philosophical interest in the subject. We also found that 20% of

* Note that multiple responses were permitted so the sum of the percentages is greater than 100%

the year 12 Physics class in 1975 were female, while 18% of tertiary Physics majors and 8% of Physics post-graduates in W.A. were female. Almost 85% of the first year, tertiary Physics students in 1978 had left high school in the previous year while another 10% had left school less than two years before. The Williams Report (1979) indicates that overall about 40% of all University and CAE students fall into the non-school leaver category (Williams, Table 1.5) and that 39% of all University students in 1977 were female (Williams, Table 5.6).

The tertiary Physics enrolment pattern is thus atypical in the Australian university context because it is dominated by young, male students. Ormerod and Duckworth (1975) report that this pattern is also found in many other Western societies. On the basis of several attitude surveys, they concluded that girls are disinclined to study physical science because they perceive it to lack a human aspect and social relevance. Girls have also been found to be influenced by the prevailing opinion that the physical sciences are a male preserve. The authors state that this imbalance between the sexes is not observed in Communist countries where science is given a larger role in the educational curriculum. Societal attitudes in these countries do not discriminate against girls studying the physical sciences and scientists receive relatively greater respect and financial rewards than their Western counterparts.

Career Aspirations

Table 2 shows that at the beginning of their tertiary studies almost half of the Physics students were hoping for a career in research or development. Most of the remainder were interested in secondary or tertiary teaching. A relatively large proportion of students had given little thought to their eventual employment. Only a few students had expressed interest in any of the fields of management, sales and administration which employ large numbers of Arts graduates. Final year students showed similar preferences to those expressed by first years except for a substantial reduction in the number of students with no idea about future employment and a corresponding increase in those interested in tertiary and secondary teaching.

TABLE 2
Career Aspirations of First Year and Final Year Physics Students *

Employment Areas	First Year Students Interested	Final Year Students Interested
	(N = 156)	(N = 96)
Research or Development	46%	51%
Tertiary Teaching	20%	40%
Secondary Teaching	17%	29%
Technical Assistance	12%	9%
Administration	6%	7%
Other specified	7%	11%
No idea	18%	7%

* Percentage employed of the total of 96 higher degree graduates

Only a small proportion of first-year Physics students indicated any interest in combining Physics studies with applied skills. Table 3 indicates that the most popular applied skills (computing, electronics) were those of direct relevance to Physics. There was also a close correspondence between the preferences of first year students and the applied options which had actually been taken by final year students.

TABLE 3
Applied Courses Studied by Physics Students*

Area	First years interested (N = 156)	Final years completed (N = 96)
Computing	42%	40%
Electronics	25%	38%
Geophysics	15%	11%
Meteorology	10%	4%
Medical Physics	12%	4%
Other	4%	1%

These results indicate that most Physics students have firmly-fixed, pre-conceived ideas about their programs of study and that they deviate very little from them. They also support our earlier observation that Physics students typically are fascinated by the philosophical aspects of their subject and have no direct concern about employability or interest in subjects not directly related to Physics. This narrow outlook could be a handicap at a time when employment areas for graduates are changing.

Employment Prospects for Pass Graduates in Physics

Table 4 shows that only about 20% of the final-year class sought immediate employment. Almost half of the graduating class went on to honours or higher degree studies. This proportion is similar to the proportion of students studying Physics mainly for intellectual satisfaction. Another large group went on to Diploma or other undergraduate studies mainly in teaching and computer programming.

TABLE 4
Employment Intentions of Final Year Students Prior to Graduation
(N = 96)

	% of students
Proceeding to Honours or higher degree	46%
Further undergraduate or diploma studies	31%
Seeking employment	19%
No plans	2%

Six months after graduation only 4% of all the Physics graduates were unemployed. This proportion is well below the national average of about 9% for all graduates (Graduate Careers Council of Australia, 1979). The fields of employment for pass graduates were many and varied and drew heavily on applied skills, or further study particularly in geophysics, computing, electronics and meteorology. Most of the 31% undertaking further undergraduate studies subsequently sought employment as science teachers or computer programmers.

It is reasonable to conclude that Physics pass graduates can anticipate good employment prospects, particularly if they have acquired the additional skills listed above, and are prepared to apply them in fields other than pure Physics research.

Employment of Higher Degree Graduates

Nearly 50% of the graduating class in Physics proceeded to higher degree studies. Most of these students were interested in careers in tertiary teaching or research. Prescott (1980) has noted that employment prospects in universities, CAEs and CSIRO are poor at present. Our survey confirmed this conclusion and showed that prospects for research careers in Physics in Commonwealth government agencies are worse now than they have been at any time during the last 25 years (see Table 5). The CSIRO, in particular, employed considerably fewer recent graduates than it had done in the fifties and sixties. However new opportunities have opened up for research overseas and in State government agencies and TAFE

TABLE 5
Employers of Higher Degree Graduates from the University of Western Australia
(N = 96)

Employer	% employed†	% of recent graduates employed§
University or CAE	56%	59%
Secondary Education or TAFE	4%	8%
CSIRO	15%	5%
Commonwealth Govt	3%	5%
State Government	6%	8%
Private Industry	4%	5%
Other employed	9%	5%
Unemployed	3%	5%

Most higher degree graduates spend a short period following graduation in limited-term research appointments (tutorships and postdoctoral fellowships) before moving on to permanent employment. This explains the apparent increase in the proportion of recent graduates employed by universities and

§ Recent graduates defined as those who have graduated in the last ten years, 1970-1979.

CAEs. Many higher degree graduates move overseas (25%) or interstate (35%) to find permanent employment. These patterns have remained quite stable over the past twenty-five years.

A substantial majority (75%) of higher-degree graduates in Physics remain in teaching and research while a small group (10%) eventually move into management or administration. The remaining 15% change field because of better prospects for advancement or permanent employment in some other areas.

We asked those graduates no longer working as Physicists for their opinion of the value of their Physics training. Most regarded it as valuable and even essential for their subsequent careers. Generally they emphasized the value of scientific method and quantitative analysis in many areas of human activity. A small minority considered that their Physics training was too narrow for their subsequent work.

The Present Employment Situation for Physicists

There is ample evidence available from our survey to indicate that employment prospects are favourable for at least the present number of Physics graduates. Prescott (1980) has found that there were approximately 1600 positions advertised nationally during 1979 for which the 400-450 Physics graduates could have applied. Many of these were in applied science and a recent survey (Dallimore, Jennings and Robins, 1979) showed that Physicists were strong contenders for such positions. That survey also showed that most Physics graduates found such positions challenging and satisfying. Overseas evidence (Prescott, 1980) suggests that employment prospects for Physicists in geophysics, electronics, instrumentation and process control are growing. Several private overseas firms with interests in these areas have been actively recruiting in Australia.

Many employers of Physicists do not advertise their positions in newspapers and Prescott's figures therefore underestimate the possible range of employment opportunities. In particular State Education Departments, TAFE and many State and Commonwealth Government authorities employ considerable numbers of Physicists via campus interviews or independent approaches.

Prospects for higher degree graduates are also good despite the decline in research opportunities in the CSIRO and the universities. The situation will probably improve because the number of postgraduate students has been falling in recent years, as a result of cutbacks in the value and quantity of Commonwealth postgraduate research awards and the general lack of public confidence in science.

Future Employment Prospects

The demand for Physicists in the future will depend on a number of factors including

- (a) normal replacement needs resulting from deaths and retirements;
- (b) growth in the research and education sectors;
- (c) new areas of employment resulting from new industries such as computer modelling, microprocessors, environmental monitoring and alternative energy sources; and
- (d) the general requirement for "numerate" graduates who are familiar with

computers and the analysis of statistical data.

There is a steady and continuing demand for science graduates in secondary school teaching to meet replacement needs. However the age profile of Physicists in tertiary education and research is dominated by people below the age of 50. This reflects the rapid growth in scientific activity in Australia during the early sixties. Many of these people will begin retiring during the nineties and we can expect a strong demand for specialist Physicists at that time. There is even the possibility of a shortfall of supply over demand if current low levels of postgraduate enrolments persist.

Growth in the research and education sectors has ceased over the past five years except in limited areas such as TAFE. However there is a strong public demand at present for increased research spending on high technology industries and this could lead to improved employment opportunities for Physics graduates.

At present many pass and higher degree Physics graduates are finding rewarding careers in applied areas. Generally a tertiary scientific background with knowledge of computers, statistics and experimental techniques is required. These areas have continued to grow as more funds are spent on environmental, resource and energy problems.

Summary

The typical tertiary Physics major is a male, school-leaver with a deep interest in his subject as an intellectual activity. This interest has been stimulated by high school studies and books he has read.

The vast majority of Physics majors seek careers in research or teaching. Our evidence indicates that most of them achieve their career ambitions and most remain in Physics throughout their working lives. Pass graduates need a flexible approach to employment and applied skills (such as computing, electronics and statistics) are particularly valuable to them. Higher degree graduates are predominantly employed by government agencies in teaching and research. Their careers are therefore highly dependent on government policies towards science and education. They must be prepared to take temporary appointments initially while they search overseas and interstate for a suitable, permanent position.

In this period of difficulty for young graduates our evidence suggests that the short term employment outlook for Physics graduates is relatively good. In the longer term there is a possibility of a shortage of trained Physicists unless tertiary enrolments increase considerably during the eighties.

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