Why do they come and why do they stay? Meeting the needs and expectations of undergraduate students in the life sciences

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Abstract: *Science undergraduate enrolments have declined steadily over the last few years. The life sciences have been somewhat buffered from this trend. However, with a changing student population, it is timely to investigate why students choose to enter university study, and what motivates them to continue. We aim to identify which teaching and learning strategies are most effective in motivating students to begin, and to continue, study of the life sciences, and where additional learning support or different teaching approaches may be required to better meet student needs. In 2002, we administered anonymous surveys to undergraduates studying life sciences at the University of Tasmania. We sought information on their pre-tertiary education; factors influencing them to enroll at university, preferred learning activities and reasons for continuing/not continuing in life sciences. A total of 60% of respondents cited "interest" as their primary motivation for studying life sciences at university, with only 31% citing "career". Inspiring teachers at secondary level were clearly a major factor in influencing students' choices. Once at university, students most appreciated learning experiences offered in practical classes (39.5%), with good lectures rated as important by only 11%. Importantly, 44.5% requested more tutorials, with only 2% suggesting use of web-based teaching. In 2003, the project will be expanded through focus group interviews. As well as informing undergraduate teaching programs in life sciences, the outcomes of this project will provide future secondary school teachers with tools to help them instill in their students an enthusiasm for science.*

Keywords*: first year experience, undergraduate science, student motivation*

Introduction

Why do university students choose particular areas of study, and how can they be encouraged to continue with those studies once at university? While a great deal of attention has been focussed on the importance of the first year experience in the transition to university studies (eg. McInnis and James 1995), such research tends to take a broad perspective. However,

Peel (1999) pointed out that some transition issues may be "specific to particular institutional environments and student groups". With science enrolments declining nationally and locally, we felt it was timely to begin an investigation of what motivates students to study life sciences (ie. Zoology and Plant Science) at the University of Tasmania (UTas). Our aim was to better understand why current students had chosen to enrol in life sciences, and to develop effective strategies to encourage others to do likewise. We hypothesised that high school teachers could play a pivotal motivational role. Importantly, therefore, the research team includes an academic (Brown) who teaches science education students: a planned outcome of the project is better information for potential high school teachers on how best to motivate their students at this key stage.

We were also interested in how we could best support our students' learning, and encourage them to continue study in our subject area, once they had taken the step to enrol at our university. As first year co-ordinators for Zoology and Plant Science, we (Jones and Koutoulis, respectively) have responded to changes in the student population through the development of programs such as a Life Sciences bridging unit and mentoring for mature age students. However, such initiatives have been based on our own perceptions of the students' needs: we had no evidence that we were responding most effectively, or providing what they really require. As pointed out in *Beyond Bio 101*, a report on the transformation of biological education in the USA, "commitment to good teaching implies a constant willingness to look for what works and what does not work". We therefore sought input from the students themselves, on a broader scale than that of individual unit evaluations, to provide an important perspective complementary to that of the academics teaching them. This paper reports on the first stage of our project: a survey of all undergraduate life science students currently enrolled at UTas.

Methodology

In 2002, we surveyed students studying at least one life science (Plant Science or Zoology) unit at 1st, 2nd, 3rd or 4th (Honours) level at UTas. There is considerable overlap in enrolment between Plant Science and Zoology, so students were asked to complete one questionnaire only. The survey questions are presented in Appendix 1: the form provided space for extra comments. Our research assistant administered the anonymous questionnaires during practical classes (1st and 2nd years) or lectures (3rd year), while 4th year (Honours) students were sent questionnaires by mail. The completed forms were returned via locked boxes in laboratories or pre-addressed internal mail envelopes. To preserve the anonymity of the respondents, we did not view the survey forms: the results were collated and summarised by our research assistant. She also removed all references to specific academics from the qualitative comments before presenting only the collated data to us. While we had originally planned to also conduct focus groups, delays in obtaining ethical clearance prevented this for 2002.

Responses and Results

The return rate for the questionnaire was 49% across all year groups (Table 1). While the majority of our life science students are school leavers, a substantial proportion (49 = 27%) have had a break of 2 or more years between school and entering university.

Table 1. Demographics of respondents

	1st year	2nd year	3rd year	Honours	**Total**
No. of students who returned surveys	87	55	25	12	**179**
Returns as % of total enrolled	53%	46%	46%*	52%	**49%**
No. of school leavers	59	38	22	2	**121**
No. of students with more than 2 years since school	27	17	3	2	**49**

*based on the third year unit with highest enrolment (48)

We asked what had motivated them to enrol in life sciences at UTas (Qu. 3). Students often cited more than one factor, but *interest in the subject area* was most often cited as a primary motivation, particularly by 2nd and 3rd year students (Table 2). About one third of the students mentioned *career aspirations*.

Table 2. Motivation for enrolling in life sciences at UTas (results expressed as total numbers and as % of total responses for that group [refer to Table 1])

Motivation	1st year Responses		2nd year Responses		3rd year Responses		Honours Responses	
	No.	%	No.	%	No.	%	No.	%
Interest	45	52%	38	69%	17	68%	6	50%
Career Aspirations	29	33%	17	31%	5	20%	5	42%
Enjoyed science at school or college	11	13%	8	15%	1	4%	-	-
University location	9	10%	3	5%	3	12%	1	-
Required for other course	20	23%	3	5%	5	20%	-	-
Reputation of University or Department	5	6%	-	-	1	4%	1	8%
Open day/enrollment advice	4	5%	-	-	2	8%	-	-

Responses to Qu. 4 (Table 3) showed that *biology/science teachers* with enthusiasm and an ability to make their subject fun and interesting, encouraging their students to participate in extracurricular science activities, are important influences on a student's choices at university. Several *non-science teachers* were also nominated as influential because of their belief in the student's ability to succeed. However, the most common response to this question was that there were *no particular influences* on their choice: they presumably consider their interest in biology to be intrinsic.

Table 3. Factors cited as influencing students to study life sciences at UTas

Influences (Subject or Experiences)	1st year Responses		2nd year Responses		3rd year Responses		Honours Responses	
	No.	%	No.	%	No.	%	No.	%
Biology at school	12	14%	6	11%	4	16%	4	33%
Enjoyment/success with science at high school/CSIRO student projects/Biology Olympiad	7	8%	9	17%	1	4%	2	16%
Other (specified) Science at school	7	8%	3	5%	-	-	-	-
Non-science subject at school	2	2%	-	-	-	-	1	8%
Previous study/diploma	2	2%	3	5	2	8%	-	-
Course advice	2	2%	1	2%	2	8%	-	-
Work experience/previous job	2	2%	1	2%	2	8%	-	-
Family influences/ Lifestyle/travel	2	2%	4	7%	2	8%	1	8%
No particular influences/no response	42	39%	20	36%	11	44%	5	42%

We sought information on the students' previous background in biology/science (data not presented), and whether they felt adequately prepared for university (Table 4). Overall, 66.5% had studied biology before coming to university, while only 56% (61% of first year students) felt their previous background had prepared them well for studying biology at university. Some students stressed the importance of non-science subjects in providing support for their science studies, particularly in the area of writing skills. Generally, if students felt ill-prepared, they attributed this to their choice of pre-tertiary subjects. Student comments included:

- *It was a big jump, but I think it was because I didn't do Physics, Chemistry or Biology.*
- *I believe Botany* (ie, Plant Science) *and Zoology should be incorporated into years 11 & 12 as separate subjects.*

Table 4. Perceptions of the adequacy of their previous background as preparation for university study

		1st year Responses		2nd year Responses		3rd year Responses		Honours Responses	
		No.	%	No.	%	No.	%	No.	%
Did previous study provide adequate background?	Yes	53	61%	29	53%	14	56%	4	33%
	No	17	20%	14	25%	5	20%	-	-
	Equivocal	10	11%	8	15%	5	20%	6	50%
	No Response	6	7%	3	5%	1	4%	2	16%

The Honours students may present a different perspective, perhaps reflecting their later stage of study and the rather different demands of their research-focussed year. They provided some thoughtful comments. For example:

- *The philosophy and general thinking behind science, especially biological sciences. This tends to be implied but it is not clear unless you have specifically read about it during honours work or later. Scientific logic and methodology could and should be dealt with explicitly and in detail.*

The next set of questions focussed on the students' experiences once at university: how our teaching patterns influenced their learning, and what motivated them to continue studying life sciences. The learning activities regarded as useful by most students across all year groups were *practical classes*, particularly if they were linked to a lecture topic (Table 5). Consistent with this hands-on orientation, excursions/ fieldwork were also nominated as valuable *for maintaining interest* and for *getting the message across*. A significant number also nominated some form of *small group* learning as useful, but *lectures* were only nominated by a minority. Some differences across year groups reflect different teaching approaches (eg, no field trips in first year), while some responses indicated that some students were confused by the term *learning activity*.

Table 5. Learning activities perceived as useful in stimulating student learning

Useful Learning Activities at University	1st year Responses		2nd year Responses		3rd year Responses		Honours Responses	
	No.	%	No.	%	No.	%	No.	%
Practical (especially if linked to lectures)	42	48%	21	38%	10	40%	4	33%
Group work/Study groups/tutorials	18	20%	8	15%	4	16%	2	16%

Lectures/Informative lecture notes	16	18%	6	11%	2	8%	1	8%
Own study/Text Books	13	15%	3	5%	-	-	-	-
Summer School/Bridging courses	6	7%	-	-	-	-	-	-
Exams/Past exams/Practice exams	3	3%	4	7%	-	-	-	-
Videos/TV/Computer based learning	3	3%	-	-	-	-	-	-
Excursions/Field Work	1	1%	19	35%	3	12%	6	50%
Assignments/Project work	1	1%	7	13%	2	8%	-	-
No response	15	17%	10	18%	1	4%	1	8%

When asked if there were any areas where they could use extra support to assist their study (Qu. 8), many of the students nominated tutorials as a possibility, suggesting either generic tutorials, or tutorials in specific subjects (particularly chemistry), particular skills (research, data handling, or using computer software), or exam preparation (Table 6). Interestingly, only 2 students mentioned computer or web-based activities.

Table 6. Student suggestions for additional support for studies

Ideas for Extra Support	1st year Responses		2nd year Responses		3rd year Responses		Honours Responses	
	No.	%	No.	%	No.	%	No.	%
Tutorials	45	52%	24	44%	10	40%	5	42%
Additional readings	6	7%	7	13%	2	8%	-	-
Unit/lecture summaries	6	7%	3	5%	1	4%	-	-
Smaller practical classes/More staff in practical classes	4	5%	4	7%	-	-	1	8%
Take home assignments/questions	4	5%	-	-	-	-	-	-
Bridging courses	2	2%	-	-	-	-	-	-
Computer based/WebCT assignments	2	2%	-	-	-	-	-	-
No suggestions	14	16%	-	-	-	-	1	8%

The remaining questions asked about the current and intended future enrolment of the 1st, 2nd and 3rd year students. We were particularly interested in why students might *not* continue studying either or both life sciences (Table 7). The most common reason was that students were *majoring in another area*, and this was often linked to *preferring* or *needing to study other subjects*. The responses show that, largely, students do not continue because of prior decisions on course structure; few cited *do not enjoy* or *find studying difficult* as their reasons for not continuing.

Table 7. Reasons for not continuing in a life science subject

Reasons for not continuing	1st year Responses		2nd year Responses		3rd year Responses	
	No.	%	No.	%	No.	%
Majoring in another area	18	21%	10	18%	7	28%
Prefer to study other subjects	10	11%	6	11%	2	8%
Require other subjects for intended profession	10	11%	5	9%	3	12%
Do not enjoy studying Plant Science	4	5%	4	7%	1	4%
Do not enjoy studying Zoology	5	6%	6	11%	-	-
Find studying Plant Science difficult	3	3%	1	2%	-	-
Find studying Zoology difficult	2	2%	4	7%	-	-
Other	16	18%	14	25%	6	24%

Some students commented that (apparent) career prospects influenced their decisions. For example:

- *Even though I enjoy the subjects I am studying it is not something I want as a career, thus once I finish this year I am going to continue with another degree.*
- *I enjoy studying plant science and zoology but practical applications seem to be few and far between.*
- *I was discouraged from pursuing zoology in Tasmania as I was often told it would lead 'nowhere'.*

Discussion

Why do they come?

A recent study of English university students and the lecturers who teach them found that the most important factor influencing their decision to study at university was *employment prospects* (Rolfe 2002). However, McInnis et al. (2000) found that 96% of first year Australian students surveyed in 1999 rated "*studying in a field that really interests me*" as important, with 86% rating "*to improve my job prospects*" as important. Similarly, a majority of our students cited *interest* in the subject area as an important factor motivating them to study life sciences, with less than a third citing *career aspirations*.

The low rating of *career prospects* among our students may be a discipline-specific phenomenon, reflecting a general lack of information about possible career paths for biologists, among both entering students and their parents, who were not often cited as important influences on their children's choice to study life sciences. Indeed, 40% of our students cited *no particular influence* on their decision to enrol in life sciences at university. However, when school teachers were named as being especially influential, students generally commented on their enthusiasm and ability to make the subject fun and interesting. This is one message that needs to be sent strongly to our science education students.

It was somewhat alarming that only 56% considered they commenced university studies with a good background. Further analysis revealed that this represented only 38% of mature age students but 73% of school leavers. The much broader study of McInnis et al. (2000) found that "around two thirds" of school leavers did not feel that their final school year was a good preparation for university. This, then, is a trend that all Australian universities need to consider. Choice of subjects at a secondary level appeared to be a determining factor in how well prepared students felt for tertiary study: the problem does not appear to be with the pre-tertiary Biology curriculum. Thus, students need careful counselling both at year 10 and at university entry. With an increasingly diverse student base, more emphasis needs to be placed on informing students of our expectations regarding prior knowledge. Remedies may include supplementary readings, or bridging courses in chemistry or mathematics.

Why do they stay?

Career aspirations may also be important factors governing a student's continuing in a line of study. McInnis and James (1999) found that students who came to university with a career in mind were less likely to seriously consider deferring their course. However, as already noted, many students do not fully appreciate the career paths available to them. Franklin and Peat (2002) describe an innovative program developed at the University of Sydney to help first year biology students conceptualise possible "pathways to professionalism". Clearly we should also provide better career advice to our undergraduates, whose comments show them generally to be ill-informed in this regard.

- *I've heard from a lot of people (peers) that it's hard to get employed with a Plant Science degree (i.e. a botanist). I don't know if this is true but I think a lot of people believe it.*

With respect to teaching and learning practices, the importance of teacher enthusiasm and approachability was again highlighted:

- *The Plant Science staff are very helpful and friendly, and they all are approachable and have a passion for teaching. I tell everyone I know going to Uni to do Plant Science.*

Students also saw more value in independent forms of learning activities rather than lectures: practicals and field trips/excursions were most often cited as useful. It is also interesting that little importance was placed on electronic learning. This is an important message in this era of reduced resources, increased economic pressure and the temptation to reduce practical experiences for science students. As one student pointed out:

- *I prefer hands on - it's a better way to learn.*

Suggestions for *additional support for studies* necessarily depend to some extent on local, current teaching patterns, but again, it is clear that students want, or feel they could benefit from, more small group activities. It is not clear, however, what they mean by *tutorials*. Do they want the reassurance of having a tutor coach them, or are they looking for the challenge of student-centred learning activities? This is something that could be probed in future focus groups. Krause (1999) also found that first year students preferred face-to-face contact within their learning communities, and were negative about online units for this reason.

This project indicates that interest in the subject area is the most common motivation for students to enrol in life sciences at UTas. This highlights the potentially vital role of secondary teachers in fostering such interest. A partnership between a high school and the medical faculty of the University of Colorado shows that focussed programs can indeed stimulate school students' interest in science and in going on to study (medical) science at university (Curran-Everett et al. 1999). Furthermore, the lack of preparedness among university entrants could be mitigated by better liaison between schools and university, as suggested in Peel (1999). Our results suggest that better career and course advice could encourage more students to choose to study, and to continue studying, life sciences at university. The value placed by students on practical classes and field excursions as learning activities was also highlighted. To build on these preliminary results, in 2003 we are carrying out a repeat survey, and central issues will be expanded through focus groups.

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Appendix 1

Survey Questions

1. What is your current level of study?
2. Did you commence your degree within two years of completing secondary school?
3. What motivated you to enrol in Life Sciences at this University?
4. Was there any particular course, experience or teacher in your secondary schooling that influenced your decision to enrol in the Life Sciences? Please explain.
5. Which (if any) science subjects did you study at TCE/HSC/Matriculation level?
6. Do you feel this background (at secondary school) adequately prepared you for your University studies in Life Sciences? Please explain.
7. What learning activities have you found to be most effective in supporting your studies in Life Sciences at secondary schooling and University?
8. Are there any areas in which you feel you could use extra support to assist your study in Life Sciences at University level? (e.g., supplementary chemistry tutorials, additional readings, etc…)
9. Are you currently enrolled in:

    Plant Science only Zoology only Both

10. Which subjects do you intend to continue studying next year:

    Plant Science Zoology Both Unsure

11. If you do not intend to continue studying in one or both Life Sciences next year, which of the following reason explains your situation:

    a. Life Science picked as a 'fourth' subject for first year
    b. Majoring in another area
    c. Do not enjoy studying Plant Science
    d. Do not enjoy studying Zoology
    e. Find studying Plant Science difficult
    f. Find studying Zoology difficult
    g. Prefer to study other subjects
    h. Need to study other subjects for my intended profession

i. Other (please explain)12. Do you intend to enrol for an Honours year?
If yes, do you anticipate doing Honours in Plant Science or Zoology?