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Perception versus Reality: towards a profile of female computing students

Jocelyn ARMAREGO
School of Engineering
Murdoch University
Perth Western Australia
jocelyn@cs.curtin.edu.au

Abstract

Female students are strongly under represented in courses offered by the School of Computing at Curtin University of Technology. Recruitment of female students becomes an issue not only under equity concerns, but because retention within the School is higher than recruitment numbers warrant. In order to gain an insight into the background of a successful female computing student, at the end of 1997 a pilot project was undertaken through the Building Educational Diversity in Engineering and Science (BEDES) funding at Curtin. This produced a preliminary profile of the virtual undergraduate student. At the commencement of the 1998 academic year first semester, first year students were surveyed in order to capture characteristics of female students at recruitment. Information obtained should enable efforts to focus on both attracting an increasing number of like females, and on making the course more appealing to other females.

1 Introduction

The impetus for this study was attendance at WIC'97¹. Reports from universities around Australia presented at that forum indicated that Curtin University of Technology is less able to recruit females into computer science-type courses. Figures at numerous other universities indicate enrolments hover around the 20% mark compared to Curtin's 10 - 12%².

However, recruitment of females into graduate and post-graduate courses is higher at Curtin than into undergraduate courses, and retention of females in all courses is higher than expected from enrolment figures.

Consideration of the literature suggests there are many influences at play in a female student's choice of study programme. Pertinent factors would seem to include

- perception of gender bias in studying mathematics and computing (during secondary education as well tertiary)
- perception of the outcomes of computing studies (an isolated programmer/hacker or a word process operator)
- parental influence based on their perception of computing.

These are discussed in the work of Clarke and Teague [2], Fennema [3], Makrakis and Sawada [4] and Shashaani [5]. The result of all these influences, coupled with females'

¹Women in Computing Workshop, Melbourne University July 1997.

²Delegates were asked to collate student demographics - these were presented as a poster session during the Workshop.

lack of perceived usefulness of computing [2], is that females are discouraged from entering computing fields at an early stage in their education. An additional factor is that the computing that students see at secondary school has little in common with tertiary level Computer Science courses. The suggestion has been made [6] that, based on the secondary subjects offered, computing is seen as a 'weak' option. Females with strengths in the relevant subject areas prefer to target more 'professional' courses, such as medicine, law etc.

However, in spite of these negative influences, females are successful in completing tertiary computing programmes. Annual Report statistics suggest that while recruitment of females into School of Computing courses at Curtin University is poor, the retention rate is better³.

A very basic question is:

what is the background of a successful female computing student?

If it is possible to identify what it is that makes a female student successful in a computing course, it may be possible to both focus marketing to attract greater numbers of these females as students, modify the approach to recruitment to increase course attractiveness to other female students.

2 Pilot Study

As a first pass at obtaining answers to this and other such questions, a profile of a typical female computer science student, both undergraduate and graduate, was constructed, based on responses to a survey. Of particular interest was an indication of the study choices made, what influenced these choices and their timing. A questionnaire was prepared and distributed to female students enrolled in core units (courses) in each of the years of the degree and graduate courses, within the School of Computing at Curtin University, and to post-graduate students individually. From this pilot project, conducted during October-November 1997, it has been possible to commence compiling profiles for a set of virtual students. The preliminary profiles based on responses from undergraduates in the BSc (Computer Science) or (GIS) and graduates enrolled in the GradDip (Computing) were presented at the gasat/Ioste Conference in Perth in December 1997 [1]. A summary of the undergraduate profile is presented below.

2.1 The Virtual Undergraduate

Our composite retained female undergraduate student exhibits the following traits:

- is *fairly certain* she has chosen the right course, and expects to complete it
- is not stressed about being a female student in the course - one student noted

I have never had a problem associated with me being a female
another said

- agrees that she belongs at Curtin and in the course
- being in the minority has its advantages: you can get recognised early

³A summary of these statistics is presented as an appendix to [1]

- is supported in her attendance at University and in the course by family and friends, but feels that faculty and staff of the University and School do not necessarily care about her personally
- is confident to (at least) *some extent* about her mathematics and computing skills, but more ambivalent about general skills such as writing ability, problem solving and study skills
- is happy to meet with faculty and staff outside a classroom situation, to socialise informally as well as to discuss course-related issues/problems, but is more likely to discuss course-related problems with another student

male or female is essentially irrelevant

- is likely to have attended Government schooling, and
- decided to go to University during secondary school years 9-10, but chose to attend Curtin and enrol in this course later during secondary schooling, or after secondary school
- sees the course as *quite useful* for getting a really enjoyable job. One student noted

many of the more common computing jobs seem less enjoyable. But the ones I would enjoy would be helped by the course

and at least a *great deal of use* in getting a well paid job

- was not greatly influenced by, but did attend, University Open Days, Career Expos and the like
- lives with parents/relatives, and ranks her social life as making the great (if not the greatest) demands on her time during an average semester week
- is likely to be overseas born and/or not have English as her first language

The caveat to the preliminary results presented was that, in addition to accepting that many factors influence the responses made to a questionnaire such as that distributed as part of this study, of primary importance was the captive nature of those students. At the time of distribution of the questionnaire (October/November 1997), they were still attending classes, still part of the student coterie of the School. This raises the question:

how different are the profiles of first semester first year students - those who have been recruited, but not yet retained - likely to be.

3 The 1998 Study

It was considered possible to gain a clearer picture of the factors that influence female student life within the School of Computing by surveying first year students, preferably before the University-set withdrawal deadline. This timing would more easily capture all students attempting the computing courses offered within the School of Computing. Follow up with those students who, for whatever reasons, are not retained within the School was expected to provide information that should prove useful to recruitment efforts.

3.1 The Survey

This phase was undertaken during first semester 1998. Using a questionnaire identical to that of the pilot project, female students undertaking the core programming

unit (course) during first semester first year were asked to comment on life within the School. The survey was administered in mid-March, before the University-set withdrawal deadline, with follow-up taking place in week 14 (ie, the penultimate week of classes). With only two weeks to the commencement of exams, any withdrawals (including special late) should have occurred. In addition, the students have undertaken some assessment by this time, and, of equal importance, feedback from the lecturer and tutors on their efforts received.

The profile compiled from this group of students exhibits some differences to the *virtual* undergraduate profile of the pilot project, as was to be expected, if only because of the noted captive nature of the former. Again looking at undergraduates in the BSc (Computer Science) (there were no BSc (GIS) students in the survey), the composite first semester, first year female undergraduate exhibits the following differences:

- she is *very certain* about her course choice and career plans, and that Curtin University was the correct choice
- was motivated to enrol by the reputation of the course rather than Open Days and the like. Several of the students had talked to employers about the various computing courses on offer, as well as to former students
- had definite expectations of completing the course in close to the minimum time required
- felt some stress related to course workload, but was definitely not stressed about being a female within the course. Comments were similar to those received during the pilot project:
 - if anything, it can occasionally be an advantage as fellow students are receptive to pleas for help
- had *great* or *very great* confidence in the skills required, with slightly lesser confidence in her computing skills
- thought the course would be very useful for getting future employment which was very enjoyable as well as well payed
- is still likely to be overseas born, but not as likely to have English as her second language.

These differences equate to a much more positive view of their study choice, and of their expectations of the outcomes of their study. This is to be expected given the timing of the initial survey.

3.2 Follow-up Discussions

These students were invited to attend a group discussion on the questionnaire at the end of week 14 of first semester. It should be noted that **no** withdrawals occurred in the survey population between the initial contact and the follow-up discussions (which was unexpected, but may, to some extent, be put down to more careful counselling at initial enrolment. While all students surveyed are enrolled full-time, not all are undertaking the maximum workload). All but one of the original respondents attended, and the latter was happy to discuss her responses during the next week. In addition, another female BSc (Computer Science) student not participating in the survey agreed to being interviewed, and subsequently completed a questionnaire.

The students were asked to look at the responses they had provided, and to make any amendments required in order to reflect their current attitude to the course and study within the School. The new participant's responses are matched to the amendments made by the others, as the timing is identical.

In general, changes in responses related to the degree of confidence in completing the course within the minimum time (with students indicating a high expectation of having to repeat at least one unit), and a lessening of their confidence in their general study skills. When it came to computing skills the consensus was that, while their skills were as good (if not better) than the males', based on material covered in the course, male students tended to be intimidating, citing prior knowledge (of computing, and in particular programming). One student commented:

I do feel I belong to the course because I am enjoying comp. sci, however, my hopes to become one of the 'best' comp. students academically has been somewhat shattered because of the intimidation from others.

This same student notes no real major problems with being a female student doing Computer Science. Male students were happy to be helpful. Other students echoed this attitude - that male students exhibited a higher level of self-confidence in their computing knowledge than was perhaps warranted, and that this tended to be based on prior study. The students perceive an advantage in having completed secondary school computing subjects; a perception certainly not supported by the lecturer of first year programming units!

When asked why they had not completed the same computing subjects at school, the response was that either they weren't on offer, or that the subjects seemed very uninteresting, and not very useful. For the majority of these females, secondary school computing subjects appeared to be a negative influence on enrolling in a Computer Science course.

Other changes in responses were linked to perceived stress in relation to the amount of time required for the course and for the other activities. Again, the consensus was that the course was harder and more time-consuming than expected. It should, however, be noted that two of the top three students enrolled into the BSc (Computer Science) - based on tertiary entrance scores - are female, and included in this study. Some of the second round responses indicated that a 6th point on a 5-point Likert scale was required (ie, *strongly agree* didn't quite express the depth of their feeling on this matter).

3.3 Enrolment Influences

What has not changed over the course of the semester is the students' expectation of the outcomes of completing a Computer Science degree. At best, recruitment events such as summer schools, career evenings/expos and University Open Days had only marginal positive influence. One student noted that participating in a summer school offered in another non-traditional area had made her determined not to enrol in the course of her first choice. Given the marginal influence of such traditional recruitment efforts, what is the decision to study Computer Science based on?

Overwhelmingly, during discussion, these students cited their experience in working with computers, either during the normal course of their schooling, or, more

likely, during part time employment, as the prime reason for enrolling in Computer Science:

how much it's going to help in anything I choose to do...
how useful computers were in the work I was doing

these sentiments were echoed by the majority of participants, as were:

the potential to work in a dynamic environment
potential for the future
potential for challenge.

Expectations remain, at this stage, very high.

The perceived stereotype of the university was a great influence on choice between the Computer Science courses on offer:

[..U] is more convenient to me than Curtin, however, the reputation of the course at Curtin motivated my enrolment
chose Curtin as it is reputed for having one of the best CompSci degrees/courses available in Perth because I believe Curtin offers the best course of the field of computer science as it gives you a greater depth of knowledge and a strongly focused degree

Invited to include any additional comments regarding experience as a student at Curtin, one student wrote in her initial response in March:

the important aspect seems to be how the public in general views the courses Curtin offers, in comparison with the other Universities. If you can get people talking about why Curtin is better than the others, especially as far as getting you a job when you graduate, most students will be sold. They will overcome small problems for the sake of going to what they feel is a better Uni (eg transport).

These perceptions are re-enforced through discussions with former students (often met through part-time employment), and with employers themselves. Only one student cited the appeal of the course outline as a major influence on her decision. Another student noted that her inability to enrol the previous year (due to incorrect advice regarding mathematics pre requisites) made her regard the course as *in demand*, and enrolment therefore worth pursuing. Her determination led to her working full-time while studying tertiary admission level calculus during 1997.

In fact, determination would possibly be the best word to describe these students' commitment to the course:

I like it here. I may not have much confidence in my abilities, but now I'm here you won't be able to get rid of me. I will not quit.

4 Conclusion

Where do we go to from here? The factors suggested by the literature as being pertinent in discouraging females in entering the computing field, for example:

- perception of gender bias in studying mathematics and computing (during secondary education as well tertiary)
- perception of the outcomes of computing studies (an isolated programmer/hacker or a word process operator)

- parental influence based on their perception of computing

did not seem to carry great influence with these students. However, students' perception of secondary school computing subjects would seem to be important. While the computing that students see at secondary school has little commonality with tertiary level Computer Science courses, it exhibits as a negative influence these students have countered.

In addition, unlike the results reported by [2], these females have a very clear perception of the usefulness of computing and its relevance in their future. They embrace future careers in computing for exactly those reasons that make women successful computing professionals: the professional women in Clarke and Teague's study expressed their enjoyment of computing jobs for their variety, challenge, opportunity for working with others and for helping people ([2] p 244). These students have been listening! It is to be hoped that the impressions and expectations they express for the future will hold.

However, the majority of females are still being discouraged from entering computing fields at an early stage in their education. It would seem that the greatest recruitment resource available to the School is the students themselves. Inclusion of past graduates in promotional efforts would enhance the potential for increased recruitment, and provide visible role models. Efforts in this area are reported in other Schools, where female post-graduates and past graduates are engaged to spend time in secondary schools, as part of such programmes as *Women in Engineering/Women in Science*. It would seem appropriate for Computer Science schools to adopt a similar approach.

The women who took part in this study show characteristics and qualities that will stand them in good stead in their chosen career. It will be of interest to watch their progress beyond semester 1 exams. Perhaps, in the future, they will be the graduates and post-graduates called on to spread the word to other female students considering study in a non-traditional area.

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