



Gender Imbalances in Technology Education: An Analysis of One Programme's Enrolments

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ABSTRACT

Far fewer women than men enrol for technology education courses, but when they do they out-perform the men.

This phenomenon is worldwide and enrolments for women are still trending down. A recent article suggests however that the age of instant messaging may reverse the trends, because young women gain technical competence as a by-product of a desired social activity, thus tending to overcome the advantages young men have achieved by their liking for computer games.

This paper looks at Manukau Institute of Technology CBC-NDBC enrolments and performance by gender over two years, and points up some differences dependent on the nature of the course being enrolled for. Courses are seen by women as less or more 'technical' and they make choices as a result, and their performances show some intriguing patterns.

1. INTRODUCTION

Far fewer women than men enrol for technology education courses, but when they do, they out-perform the men.

Low female enrolment figures in engineering and Information Technology (IT), contrast strongly with those for other traditionally male domains like medicine, dentistry, veterinary science and law. In this latter group gender equality has gradually become the norm, whereas IT female enrolments are still trending down despite the ever-improving accessibility of technology. IT remains a male domain and little evidence exists to show the contrary.

With this background, I have done a first analysis of two years' statistics of students enrolled in a single programme of study, looking at both participation and performance of female and male students.

The results confirm findings of earlier research that women are seriously under-represented in IT. Performance figures show a general tendency for women to out-perform men. However this is often dependent on the nature of the course studied.

2. LITERATURE REVIEW OF GENDER AND TECHNOLOGY

Selby (1997) assembled evidence from several countries (chiefly New Zealand, Australia and the USA), for enrolment in computer-related courses that shows:

- ◆ the reduction in awards of first degrees to female



students in the USA from 30-40% in the 1980s down to 20-30% in the 1990s (Camp (2001) reinforces and updates these figures.

- ◆ the falling away of young American women from IT enrolment from 50% in high school computer science to 28% with bachelor degrees, to 15% at the doctoral level
- ◆ significant differences in female enrolments dependent on the setting of the IT course, e.g. women prefer information systems to software engineering
- ◆ low rates of female staff found in New Zealand, Australian and American institutions (e.g. typically below 20%, and sometimes down to zero).

An Australian study similarly finds a “lack of interest in professional-level IT education and work (by women), ...(and that) female participation ... has actually declined at the same time as the technology has become more pervasive” (von Hellens and Nielsen, 2001, p.48). The second part of this quotation implies that possible inherent male/female differences do not explain the low female involvement. Other factors must be involved, and the study suggests that a major factor is the cultural background of the women who do enrol in IT courses. “Women of Asian background significantly outnumber all other ethnic female students in Australian IT degree studies” (von Hellens and Nielsen, 2001, p.48).

The implications from these studies are:

- ◆ lower numbers of women in IT education reduces women’s employment opportunities.
- ◆ absence of women amongst those who develop computer systems and software in our increasingly technological world must be to society’s detriment.

Suggestions for improvement have been many, including correcting “pervasive misconceptions about IT work”, addressing the problems associated with “hostile (IT) environments”, and enabling IT personnel to “balance work and home responsibilities” (von Hellens and Nielsen, 2001, p.51, 52).

Computer games, seen as male-oriented, are credited with giving the young men who play them a head start in familiarity with technology. Instant-Messaging (IM), a growing technology used by young women as a desired social activity, appears to be giving them a similar technology ‘in’. “IM is turning into the kind of addictive application for girls that

computer games have always been for boys. They’ve got to be online” (Hayes, 2002, p.2).

3. BACKGROUND TO THIS STUDY

The Information Systems Department at Manukau Institute of Technology, (MIT), Auckland, offers several programmes of study ranging up to undergraduate degree level. The most popular programme is a staircasing set of qualifications comprising the Certificate in Business Computing (CBC), the Diploma in Business Computing (DipBC), and the National Diploma in Business Computing (NDBC). In any one year between 4000 and 5000 student-courses are taken over the three year levels. This represents the courses taken by about 300 students most of whom are full-time.

The CBC year requires enrolment in nine courses per semester with almost no choice. This is to give a grounding in all areas of Information Systems before any specialising starts. The DipBC students, in each semester, are required to enrol in one prescribed cluster of three courses, and may choose the other six from several clusters of three available in different ‘specialist’ subject areas. Typical cluster names are Networks, User Support, Database 1, Programming C++ Level 2, etc. The third (NDBC) year has some prescribed and some optional courses.

The total number of courses offered over the three year levels was 66 in 2000 and 77 in 2001. I have classified these courses into six categories, firstly to reduce the complexity of the data, and secondly to examine any contrasts there may be between the categories.

4. METHOD

The students chosen for this research study are those who enrolled in any semester of the years 2000 and 2001 in any of the courses that contribute to CBC, DipBC and NDBC. The classification of the courses into six categories was done by first isolating out the ‘compulsory’ courses, then by separating the ‘optional’ courses into broad subject areas. ‘Compulsory’ in this context applies to a course that a student has little choice about taking. All 18 of the CBC year and six of the DipBC year courses are compulsory in this way. The NDBC year courses are all classified as optional because only about 12% of all students who

	Female						Male					
Code	Fails	Passes	Total	Enrol	Pass Rate	Fails Rate	Passes	Total	Enrol	Pass Rate	Totals Rate	
1	214	720	934	26.3%	77.1%	845	1773	2618	73.7%	67.7%	3552	
	221	589	810	23.8%	72.7%	883	1714	2597	76.2%	66.0%	3407	
2	2	7	9	12.2%	77.8%	15	50	65	87.8%	76.9%	74	
	2	22	24	20.2%	91.7%	23	72	95	79.8%	75.8%	119	
3	26	122	148	34.7%	82.4%	35	244	279	65.3%	87.5%	427	
	12	153	165	29.6%	92.7%	78	314	392	70.4%	80.1%	557	
4	9	62	71	33.2%	87.3%	24	119	143	66.8%	83.2%	214	
	11	52	63	19.4%	82.5%	72	189	261	80.6%	72.4%	324	
5	14	47	61	19.2%	77.0%	85	172	257	80.8%	66.9%	318	
	10	22	32	12.5%	68.8%	67	157	224	87.5%	70.1%	256	
6	5	15	20	18.7%	75.0%	16	71	87	81.3%	81.6%	107	
	4	23	27	34.6%	85.2%	20	31	51	65.4%	60.8%	78	
Totals												
2000	270	973	1243	26.5%	78.3%	1020	2429	3449	73.5%	70.4%	4692	
2001	260	861	1121	23.6%	76.8%	1143	2477	3620	76.4%	68.4%	4741	
both	530	1834	2364	25.1%	77.6%	2163	4906	7069	74.9%	69.4%	9433	

Table 1. Summary of Passes and Fails by Coded Course Category for 2000 and 2001

begin CBC continue to NDBC. Apart from fails or dropouts students are choosing to finish their study with a CBC or a DipBC qualification.

Category codes and names are shown in Table 1, together with summary results for the years 2000 and 2001. These results show passes and fails for female students, and for male students, with calculated enrolment rates and pass rates for both sexes, for each of the coded categories and years and in total.

Code Meaning

- 1. Compulsory courses
- 2. Programming courses
- 3. Database&Systems
- 4. Internet&MultiMedia
- 5. NetworksOpSystemsCompArchitecture
- 6. Business&UserSupport

It is recognised that the classification could be done differently. It is also worth stating that programming courses are present within Database, Internet and Computer Architecture courses, as well as within code 2 specialist programming. This may be an anomaly, but courses have been coded like this on the assumption that a student choosing, say, a database cluster is doing so for the database context not because it includes a programming course.

5. RESULTS AND DISCUSSION OF RESULTS

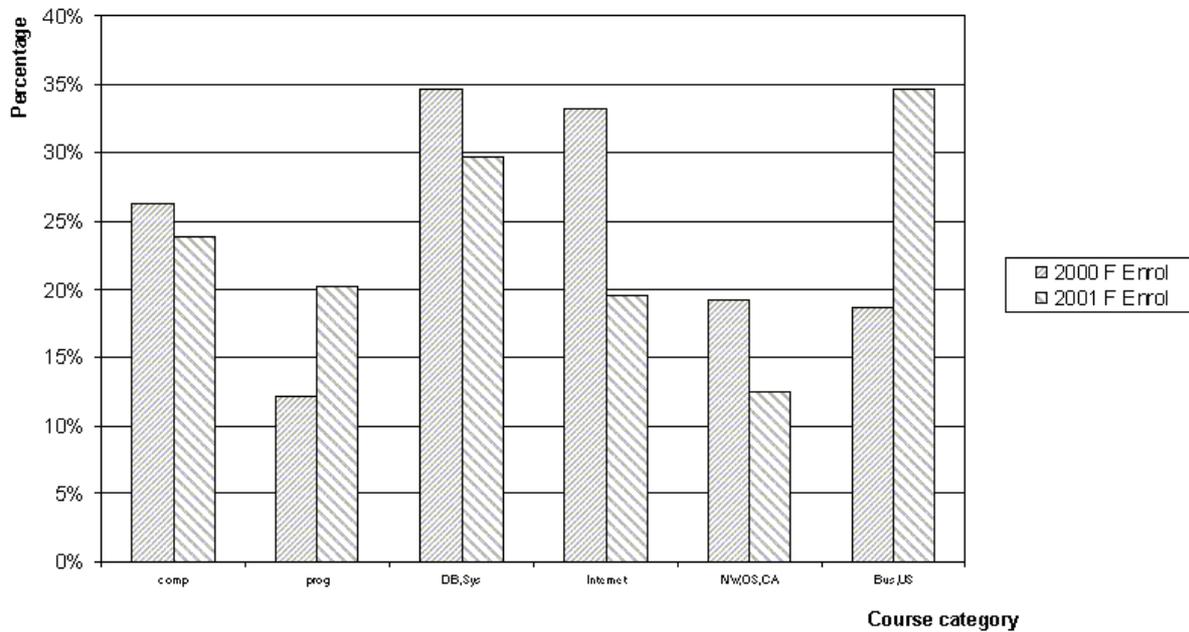
5.1 ENROLMENT PATTERNS

The overall enrolment rate for females at 25.1% confirms the widespread under-representation of women in many computer-related education programmes, and in the IT industry itself, found by other researchers (von Hellens and Nielsen, 2001).

The enrolment rates for the compulsory courses at 26.3% and 23.8% are much the same as the overall rate. This is to be expected because the total number in compulsory courses is 70-75% of the overall total, and because there is continuity in enrolments from year to year but not equality.

When the optional courses' enrolment rates are compared with the overall rate, the category database and systems is clearly a much more popular choice for female students. Programming, and networks operating systems and computer architecture, are clearly unpopular choices for women. Figure 1 shows a graph of enrolment rates for all categories for both 2000 and 2001.

Figure 1: Female enrolment rates by category



The enrolment patterns shown in Figure 1 are comparable with those found by Selby (1997), and mentioned in the literature review earlier, in that the subject areas perceived as technical are less popular with female students.

5.2 PERFORMANCE PATTERNS

Pass rates were calculated as female passes divided by total females shown as a percentage, and similarly for males. Female students have a significantly higher pass rate overall (77.6% versus 69.4%), and a higher pass rate in 4 of 6 course categories in 2000, and in 5 of 6 in 2001. Notable in 2000 (see Figure 2a), was that unpopularity of course category did not affect female performance.

There is not enough data here to lead me to any one reason to explain these pass rates. Just as the reasons for low female enrolments are complex, so will be the reasons for variable performance. If women enrol less readily, then we may be hosting more able women. Whatever the reasons, it is clear that further research needs to be done that includes some measurement of the various factors suggested by the existing literature like cultural background, perceptions of computer environments, effects of teacher behaviours, expectations of students for their study, and for their work in the IT industry after graduation.

6. CONCLUSIONS

Female participation in tertiary level study, although improving in many areas, remains low in computer-related programmes, and this study shows that, of the approximately 4700 course enrolments for the NDBC programme in the years 2000 and 2001, only 26.5% and 23.6% respectively, were from female students. When these women produce results however, they secure a disproportionately larger number of the course passes. This is shown by overall female pass rates of 78.3% and 76.8% against the male rates of 70.4% and 68.4%.

Detailed consideration of the data reveals a tendency on the part of females to choose from the less technical areas of their computer curriculum. Female enrolment rates are higher for the less technical, and lower for those options seen as more technical.

When performance in these optional areas in the year 2000 is looked at, the comparatively popular (with women) database and systems courses had a pass rate for females lower than the male rate, whereas the category of courses regarded as the most technical, networks operating systems and computer architecture, shows a 19% minority of women achieving a pass rate of 77%, and an 81% majority of men with a 67% pass rate. The year 2001 does

Figure 2a: Female and Male Pass Rates vs Female Enrolment for year 2000

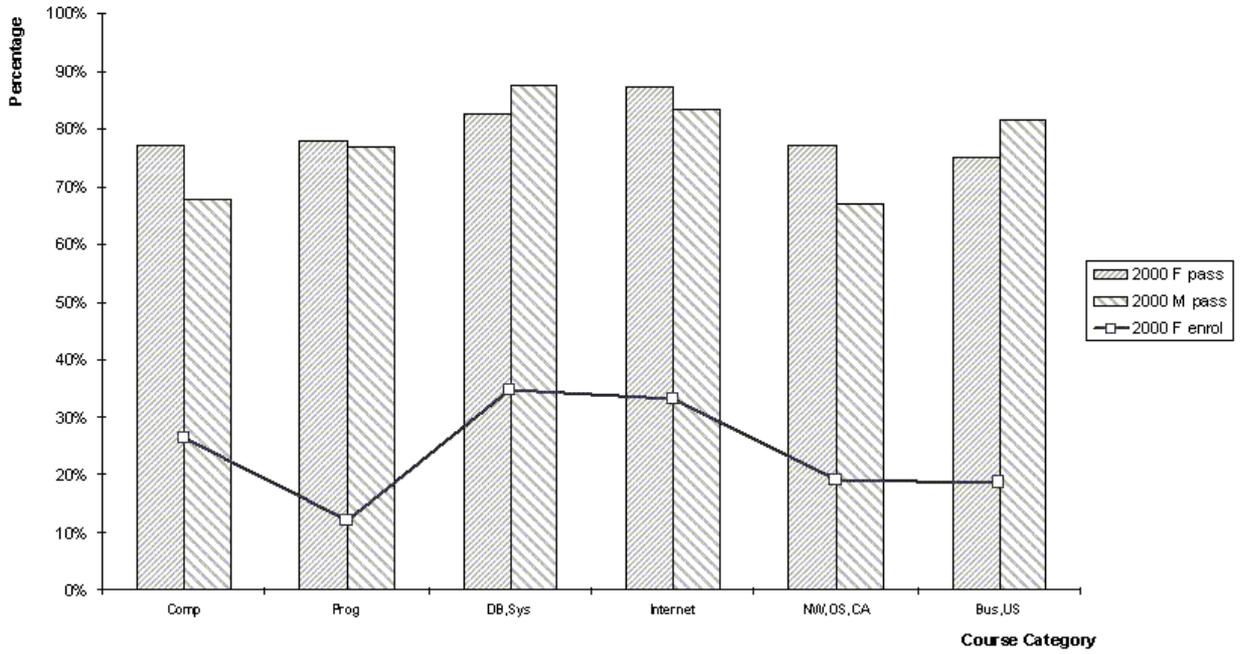
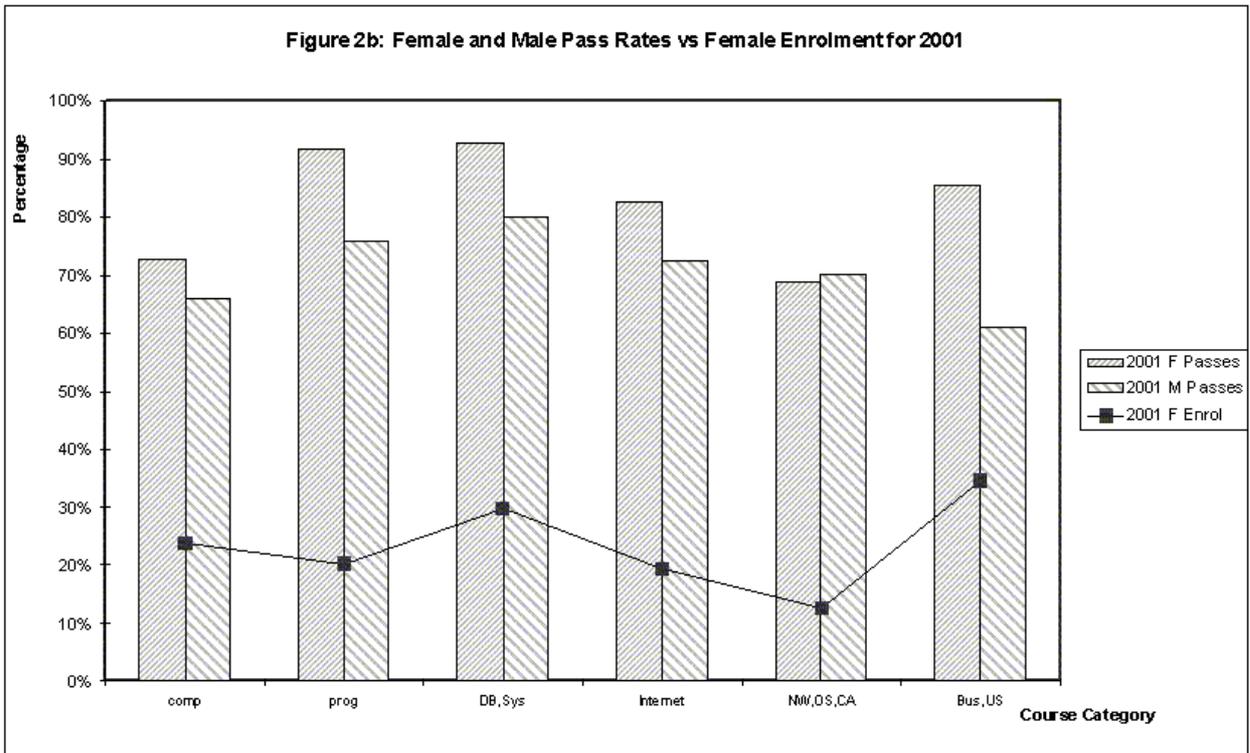


Figure 2b: Female and Male Pass Rates vs Female Enrolment for 2001



not show these patterns however - female students performing above the males in all categories except networks, operating systems and computer architecture.

It is clear that gender is a determining factor for both the enrolment and the performance of IT students, but it is not clear what the other factors are, and how they combine to explain the patterns seen in this small study. Affective factors like determination and perseverance must be involved, and also other factors like age, ethnicity and previous qualifications are suggested by this and earlier studies.

Further research is indicated in several areas. First, other MIT IS Department courses could be analysed for enrolment and performance patterns in the same way as done above for the NDBC courses. Secondly, some enrolment comparisons could be made with other study programmes offered by MIT. Thirdly some between-institutes data could be examined. Fourthly, some data could be sought from secondary school students to start trying to explain why the IT industry is missing out on the potential contributions from women who see it as 'not the place for them'.

It is certainly true that the low participation rate of women in IT is a serious problem that needs to be addressed. Not only is it inequitable for women that a situation exists giving them reason to choose to opt for other tertiary study, but the IT industry itself is disadvantaged by the absence of the more inclusive, more world-friendly point of view that women often bring.

Perhaps, though, as the Frank Hayes paper quoted earlier suggests, instant messaging may be the 'silver bullet' which finally begins to even the balance at least in early IT enrolments. The challenge of carrying forward any improvements remains.

REFERENCES

- Camp, T. (August, 2001).** "Women in computer sciences: Reversing the trend". In Syllabus Magazine. <<http://www.syllabus.com/syllabusmagazine/>>
- Hayes, F. (February, 2002).** "Girls Warm up to IT". In Computerworld News and Features. <<http://www.computerworld.com/cwi/stories/>>
- Selby, L. M. (1997).** "A critical analysis of factors affecting the participation of women in tertiary level computer science and information technology courses". Perth, Doctoral Thesis, Science and Mathematics Education Centre, Curtin University of Technology, Western Australia.
- Von Hellens, L. & Nielsen, S. (July, 2001).** "Australian women in IT". Communications of the ACM, 44(7), 46 - 52.