# Maturity Rather than Gender is Important for Study Success

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## INTRODUCTION

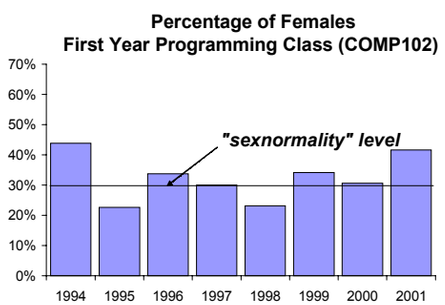
For a number of years there has been concern, particularly in the western world, about the low female participation and retention rates in computer science (Bernstein, 1994; Clarke & Chambers, 1989; Clarke & Teague, 1994; Durndell, 1991; Sturm & Moroh, 1994). Studies in New Zealand found similar trends (Brown, Andreae, Biddle, & Tempero, 1996; Ryba & Selby, 1995; Toynbee, 1993). More than ten years after these concerns were first raised, these problems largely still exist (Weston & Barker, 2004) although successful strategies are being reported (Cohoon, 2002; Fisher & Margolis, 2002; and other authors in *Women and Computing*).

To some extent at Lincoln University, New Zealand, the situation has always been different. Computing classes at all levels usually have a reasonable proportion of women (typically 25-40%). Furthermore, success in the first year programming class has been modeled for five cohorts and has been found to have no direct relationship to gender. The most consistent finding in these models is that older students are more likely to be successful than younger students. As well as summarizing the longitudinal study, key findings of interviews with some recent mature aged, female computing graduates are also included.

## BACKGROUND

Lincoln University, with only 4,500 students, is by far the smallest of New Zealand's eight universities. It has a reputation for being "small and friendly". In addition to receiving compulsory course advice there is also considerable informal mentoring of undergraduate students. There are approximately equal numbers of male and female students and about 40% of students on campus are mature aged.

*Figure 1. Female participation rate in COMP102 from 1994 to 2001*




The computing degrees and diplomas offered are in applied computing, rather than computer science, and applied disciplines are known to appeal to women (Kossuth & Leger-Hornby, 2004). The introductory programming class (COMP102) has typically had about 120 students each year. This is a medium size class by New Zealand standards. It is usually at least 30% women (Figure 1) and can therefore be considered to be "sexnormal" (Byrne, 1993). Not all students studying COMP102 intend to major in applied computing and approximately 60% continue on to advanced level programming classes.

## MODELING SUCCESS IN COMP102

For the five cohorts studied, the 120 or so students in COMP102, were surveyed to find their ages, genders, likely majors, expectations from this subject, and computing and educational backgrounds. Success in the subject as measured by final marks and grades, has been modeled using linear, logistic, and ordinal regression techniques (Agresti, 1990) for the 1994 (McLennan, Young, Johnson, & Clemes, 1999) and 1998 students (McLennan, Clemes, Young, & Kamikubo-Gould, 2000). A longitudinal study of the 1994 and 1998-2001 students, using artificial

*Figure 2. Ordinal regression model for predicting the probability of passing COMP102 for 1994 students (adapted from McLennan et al., 1999)*

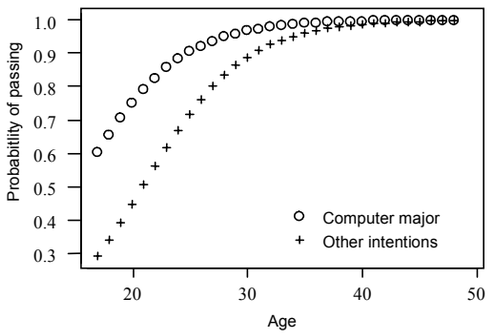
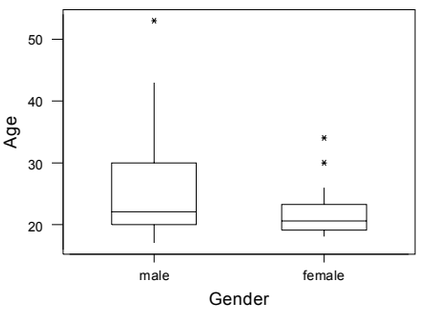



*Figure 3. Box plots showing different age distributions for male and female students in 1998 (adapted from McLennan et al., 2000)*




neural networks to model success, has also been completed (Li, Samarasinghe, & McLennan, 2002).

In the regression models the most significant factor contributing to success, was age, with older students more likely to pass than younger students. Not surprisingly, students with higher expectations and those intending to major in computing were also likely to do better. Figure 2 shows the probability of passing COMP102 for the 1994 students.

Given the prevailing view of the time, that computing was the domain of young males, it was surprising to also find in the 1994 study that gender had no direct bearing on likely success. This pleasing finding has been confirmed in all subsequent models. In the 1998 study there appeared to be a gender effect, because the average mark was 74% for men and 67% for females. This can largely be explained by the different age distributions for the sexes (Figure 3). A further factor was evidence that women had lower expectations and lower expectations were associated with lower marks.

Multi-layer perceptron artificial neural network models (Jain, Mao, & Mohiuddin, 1996) were used to model the final marks of students from 1994 and 1998-2001. Each year was modeled separately and for every year gender was not significant in predicting likely success. There were marked variations from year to year and age is the only consistently strong contributor for each model with older students always doing better. Viewed overall, a student's expectation of getting a good grade and having a strong computing background were also important. These results were not entirely consistent with the regression models where computing background was not a significant factor.

About one third of the students in the longitudinal study were of mature age. In the later years roughly 40% of the mature students were university graduates from other disciplines who were now studying for Graduate Diplomas in Applied Computing. It is not surprising that these highly motivated, older students, with a history of studying success did so well in general. However, this qualification did not exist prior to 1999, so it doesn't explain the success of older students in 1994 and 1998.

## INTERVIEWS

In 2002, 17 mature-aged women who had recently graduated with majors in applied computing were interviewed to provide further insights on studying in a non-traditional area (McLennan, 2003). They ranged in age from 26 to 48 and had studied COMP102 between 1999 and 2001. Their median age when studying COMP102 was 36 and their average mark was 81% (compared with 22 and 61%, respectively, for the entire classes).

Questions were asked about their reasons for returning to studying and their study experiences. Almost all had returned to study for employment related reasons. Some wanted to change career