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Abstract

The aim of this research was to identify the social, marketing and academic factors that effect the expectations and enrolment of students in university degrees. Of particular interest were the factors that differentiate female and male perceptions of Information Technology degrees from degrees in other discipline areas. Multi-dimensional scaling was used to analyse and compare high-school student subject dissimilarity ratings with perceptions of discipline areas at Southern Cross University. It was found that females tend to avoid information technology degrees, not because such degrees are considered difficult, but because they do not offer scope for teamwork and social interaction.

Keywords

Education, Enrolment, Gender, Information Technology Degree

INTRODUCTION

Research literature over the past decade has documented and supported evidence indicating that within the scientific and technological areas of tertiary education generally, the sex ratio discrepancy of enrolment in computer courses is very marked. Since the mid 1970s there has been anti-discrimination legislation, equal opportunity programs and other government and non-government initiatives in many countries to redress this imbalance (Wajcman, 1991; 1993). Despite this effort, the proportion of female applicants for undergraduate-level computer studies courses in many universities has actually decreased in recent times (Hoyles, 1988, p.9; Wajcman, 1991; Moffatt, 1997).

These trends are of concern because industry loses access to half of the available creative and innovative professionals if it fails to attract women. It is also economically important that university schools or departments such as the School Multimedia and Information Technology at Southern Cross University (SCU) fully utilise their potential female client-base. Added to this is the worrying scenario that, if women do not gain technological skills and fail to enrol in courses that specifically teach and train them in the use of computer and related technology, then they will be automatically excluded from the new technology based economy. Those responsible for the moulding of young women should be reminded that the majority of today's women will hold jobs outside the home, and many of these women will be the sole support of their families. This situation has far-reaching social implications that make the research described in this paper particularly significant.

Many possible reasons have been suggested for the decrease in female enrolment in computer-related courses. Females may perceive technology and computing as a “man's field” (Loyd and Gressard, 1984; Kromer and Lehman, 1990; Teague et al 1996). Both children and adults receive gender-specific messages concerning the appropriateness of computing as an occupation (Lockheed, 1985; Craig and Fisher, 1998). Differing male and female achievement patterns result from different but equally important goals (Eccles, 1987). Females are typically stereotyped as less technically competent than males; the incorporation of gender-role stereotypes could result in girls having less confidence in their general intellectual abilities than boys (Lockheed, 1985; Koohang, 1986; Chambers and Clarke 1987; Shashaani, 1994).

Evans (1996) states that barriers to technological studies are aggravated by attitudes of male teachers, male images in publicity and teaching materials, male oriented language and curriculum content, all of which ignore the social content of technology. Moffat (1997) concludes “that the greater participation of women may make computers more responsive to human needs. But, more importantly, with the technologicalisation of many types of work, it is crucial for women to keep up to date with the changes in order to retain their employability”.

In 1998 five hundred female undergraduates were surveyed at Southern Cross University (Jewell, et. al., 1998) on their attitude to technology and perception of what a career in IT would entail. Over 25% indicated that they had been misinformed and that, with better information, they might have considered an IT degree. They considered themselves behind when it came to technology. Nevertheless they were open to learn more about it.

A study of 500 female and 150 male students by the GROW (Growth and Retention of Women) project found that females were less likely to consider technology-related careers (Melymuka, 2001). The students were all equally computer literate, with 85% of females and 87% of males having taken computer courses and used the Internet. The top choices for males for a college major and career path were computer science and engineering, but females were less likely to consider such technology-related careers. The females did not see corporate IT as providing what they were looking for in life; instead they perceived it as a money-grabbing industry with little opportunity for work with others, with little room for understanding people's needs and helping others to do their best. But this is a mistaken perception: the role for computer technology has moved from number-crunching towards an understanding of computing as an interactive process, where the computer becomes a facilitator of individual and mass communication (Kramer and Lehman, 1990). Creative computing now relies at least as much upon language, visual design, problem definition, and organisational skills as it does upon quantitative analysis.

Steve Dorman (1998) maintains that computers are not inherently gender biased but that use can often reinforce gender bias. Parents and teachers should be sensitive to these cultural biases and strive to expose both girls and boys to the advantages of technology and computing. Teachers should expose students to successful women in technology. After a nine-month poll of 1200 families Dorman found that even though boys in junior school used computers a third more than girls, by middle school the usage was the same by both sexes. The gender gap in computer use became more evident in advanced classes as girls gradually lost confidence in their use of computers and both boys and girls perceived computers as being in the domain of males. Dorman (1998) states "Girls and boys interact with technology differently. Girls use technology as a way to connect with people and solve real-life problems, whereas boys view technology as a way to extend their power, preferring computerised games and entertainment."

An area of research that appears to have been neglected relates to the perceptions of high school students in their final year, prior to entry into a university degree. It is this gap in knowledge that is addressed by this paper.

RESEARCH QUESTIONS

Several studies suggest that just as many women as men reach maturity with a bent for calculation, problem-solving, design and construction (Mackenzie & Wajcman, 1999). There is no suggestion that women cannot master computer technology. This study examines female perception of Information Technology degrees and the result of that perception on enrolment and expectation. To achieve these objectives the following questions were addressed:

(a) Does female perception of Information Technology degrees differ from male perception by identifiable factors?

(b) Does female perception of Information Technology degrees significantly influence their decision to enrol in that degree?

RESEARCH DESIGN

This study examines the way in which potential students view courses offered by twelve schools at Southern Cross University. How do prospective students evaluate and describe the various attributes and course requirements associated with each school? What adjectives do they use to describe the personal attributes perceived as necessary for successful completion? How do they define the type of person who would enrol in a particular school to do a particular degree? What are the job opportunities? Under investigation is the outcome of the process by which an individual transforms a multiplicity of observation and hearsay into a set of attitudes and perceptions. To achieve this end data in the form of dissimilarity ratings, and the outcome of student interviews, was submitted to multivariate analysis using multi-dimensional scaling (MDS). MDS is a data analysis technique that displays the structure of distance-like data as a geometrical picture. It is ideally suited to the comparison of data that are characterised by pairwise proximity values, as here. The design allows analysis to be undertaken and conclusions drawn for any one of the 12 discipline areas with regard to different perceptions across gender; in this paper, however, our interest lies in the issues associated with female perceptions of Information Technology degrees.

Data was obtained by interviewing a convenience sample of 20 year-twelve students enrolled at the Coffs Harbour Senior College (part of the Coffs Harbour Education Centre (CHEC). The campus is shared by the Senior College (a Senior High School), Department of Technical and Further Education (a College of TAFE) and Southern Cross University. The gender split for the sample was 9 female and 11 male.

The twelve schools under analysis are listed in Table 1. The number of possible pair-wise comparisons for n schools is $\frac{1}{2}n(n - 1)$, 66 in this case. 66 index cards were prepared upon each of which was printed a different school pair. During a one-hour interview session, students were given the cards one by one and asked to rank the pairings on each by placing each card on a table against a number from 1 to 10, where 1 represented low dissimilarity and 10 high dissimilarity. Total anonymity was guaranteed and each student was assured that were no judgmental connotations, i.e. no answer was right or wrong. During the dissimilarity judgement process the subjects were encouraged to verbalise their thoughts. As the subject's own opinion of similarity/dissimilarity between the members of pairs was being surveyed, no basis for similarity was provided. The subjects were, in fact, asked many times during the interview what basis they used to make particular pair-wise judgments and their spontaneous comments were recorded and subsequently transcribed. This procedure produced 66 x 20 = 1,320 school dissimilarity judgements plus 1,700 associated comments as to how these judgements were derived.

School	**ID**
School of Business	BUS
School of Contemporary Arts	ART
School of Education	EDU
School of Exercise Science and Sport Management	ESM
School of Humanities, Media and Cultural Studies	HMC
School of Law and Justice	LAJ
School of Multimedia and Information Technology	MIT
School of Natural and Complementary Medicine	NCM
School of Nursing and Health Care Practices	NHP
School of Resource Science and Management	RSM
School of Social and Workplace Development	SWD
School of Tourism and Hospitality Management	THM

Table 1: 12 Schools at Southern Cross University

STUDENT COMMENTS

All verbal judgement-comments were recorded, transcribed and entered into a relational database. The database was used to classify the comments in five ways: by gender, by subject (one of the 20 students), by object (one of 66 pairs of schools), by attribute (one of 8) and by status (one of 7). The eight attributes were selected from an analysis of the comments and are listed in Table 2. In addition, seven object comparison relationships, referred to as status's, were identified in order to attribute meaning to the dissimilarity ratings; these are defined in Table 3.

Attribute	**Number of Comments**
SOCIAL	373
DIFFICULT	356
REQUIRES INNATE APTITUDE	202
EMPLOYMENT	193
PEOPLE ORIENTED	187
MANAGERIAL	175
PRACTICAL	173
TECHNICAL	126

Table 2: Number of comments associated with each attribute

Relationship between objects A and B	**Statement status in terms of objects A and B**
A = B	Statement equally attributed to A and B
A > B	Statement referred to A more than B
B > A	Statement referred to B more than A
A ~ B	Statement referred to A without clear reference to B
B ~ A	Statement referred to B without clear reference to A
A_	Statement referred to A without any reference to B
B_	Statement referred to B without any reference to A

Table 3: Statement status relationships

Once the comments were entered into the database for all the subjects it was possible to methodically retrieve all relevant sets of comments that conform to any specified set of criteria. For example: *find comments made by all subjects when comparing the School of Nursing and Health Care Practices with the School of Natural and Complimentary Medicine in which the two Schools were perceived as equally possessing any or all of the attributes represented by the 8 attribute categories*. The subsequent report from that database query shows the comments made by all those students who perceived these two schools as equally possessing certain attributes. In this example the attributes in common were difficulty (mentioned twice), people oriented (mentioned once) and social (mentioned five times).

ANALYSIS OF RANKINGS

For the MDS analysis, the SPSS model INDSCAL was employed. INDSCAL expresses the dissimilarity between pairs of objects as distances between points in multi-dimensional space. The greater the distance the greater the dissimilarity. The purpose of the basic multi-dimensional procedure is to produce a configuration of points whose distances reflect as closely as possible the rank order of the data. The analysis was non-metric with ties untied. The 2-dimensional model was estimated (2D Stress = .28, RSQ = .48). The results are shown in Figure 1.

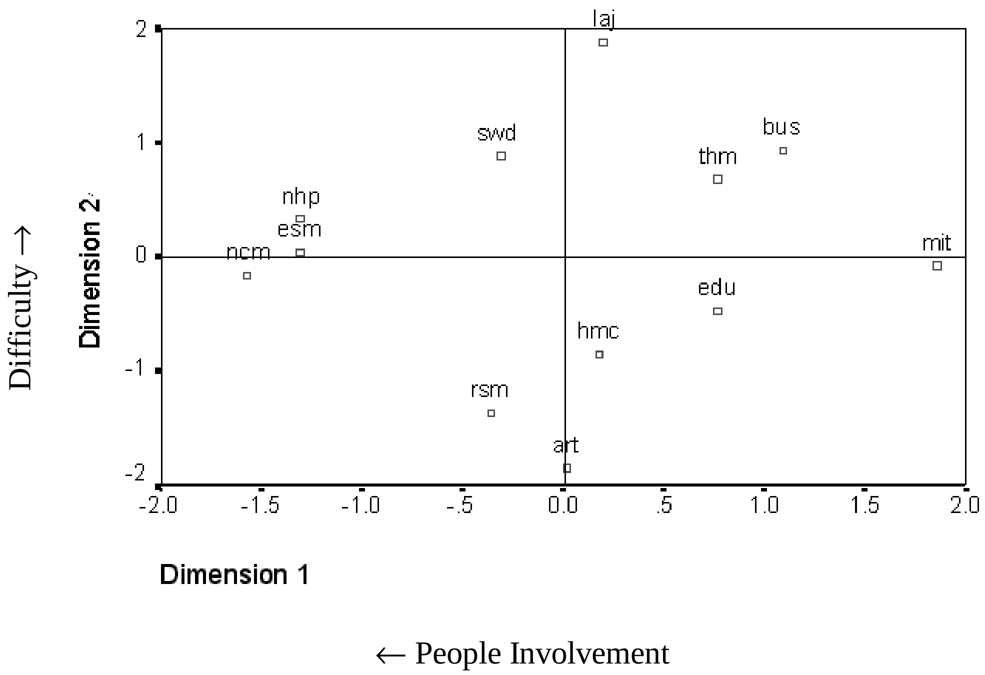

Figure 1: INDSCAL stimulus configuration chart: dimension-2 (difficulty) by dimension-1 (people involvement)

The spatial positioning of the schools on the on the chart in Figure 1 is more meaningful when the dimensions are named. This can be facilitated by considering the comments associated with strategically placed pairs of schools. For this purpose, pairs of schools that are close on the dimension under consideration and far apart on the other dimension are referred to as class-A pairs; these pairs are useful in naming the dimension at the point that the class-A pair occurs. Conversely, schools that are far apart on the dimension under consideration but close on the other dimension are referred to as class-B pairs; such pairs are useful in naming the dimension overall. An example of a class-A pair for dimension-1 is LAJ-ART and an example of a class-B pair for the same dimension is MIT-NCM. Similarly, an example of a class-A pair for dimension-2 is MIT-NCM and an example of a class-B pair for the same dimension is LAJ_ART.

Clearly, schools closely adjacent on this diagram in a particular dimension have many attributes in common, whereas schools widely spaced have few. Schools widely spaced in one dimension but closely spaced in the other dimension, therefore, have few attributes in common when viewed from the widely spaced dimension but do have attributes in common when viewed from the closely spaced dimension. Those few attributes that are common to a pair of schools are the attributes of interest.

In order to extrapolate from the similarities and dissimilarities between schools it is necessary to identify each dimension in terms of one or more specific attributes. This is achieved by considering class-A pairs for that dimension. First identify all perceived attributes for each of the two schools and then eliminate all perceived attributes not echoed in the partner. The remaining attributes identify the actual location along of the dimension. Pairs at either extremity identify the full extent of the attribute that the dimension is expressing. Identification of pairs more toward the middle should be a logical intermediate between the two extremes.

Interpretation of the database reports indicate that the core attributes towards the negative end of dimension-1 (NCM, NHP-ESM) are social skills, people oriented, hands-on, difficult, practical physical involvement. With these are associated social responsibility in the care and service toward people. Attributes at the positive end (MIT) are technical, academic with good employment opportunities. MIT was the only school where Social (caring and serving) and People Orientation (people contact, people's cultures) are never mentioned except with negative connotations. Accordingly dimension-1 is seen to progress from *high people involvement* at the negative end through moderate people involvement to *low people involvement*; it is therefore named *people involvement*.

The least separated pairs on dimension-2, while being well separated on dimension-1, are MIT and NCM. They represent a class-A pair on dimension-2. ESM is also close to MIT on dimension-2. Both pairs are placed too close to the centre to be ideal. The third close pair on dimension-2 is BUS-SWD, which has little separation on dimension-2 but is reasonably well spaced on dimension-1. Similarly, SWD-THM are reasonably close on dimension-2 but separated on dimension-1. ART and LAJ are the two extremes on dimension-2 and represent an opportunity to name this dimension.

Database reports indicate the core attributes towards the negative ART end of dimension-2 is predominantly *innate aptitude*. This includes creative, gifted and having talent. ART is 'fun', not difficult, something undertaken by people not particularly intellectual. This contrasts with the positive end of dimension-2 where LAJ stands alone, associated with the core attributes of high *difficulty*, high *employment* and high *social* standing, requiring a certain degree of social skills. Dimension-2 runs from low difficulty at the negative (ART) end to high difficulty at the positive (LAJ) end to and is therefore named *difficulty*.

COMMENTS RELATING TO INFORMATION TECHNOLOGY

Relational database reports were generated to examine perception relating to MIT and other schools. A summary is presented in Figure 2.

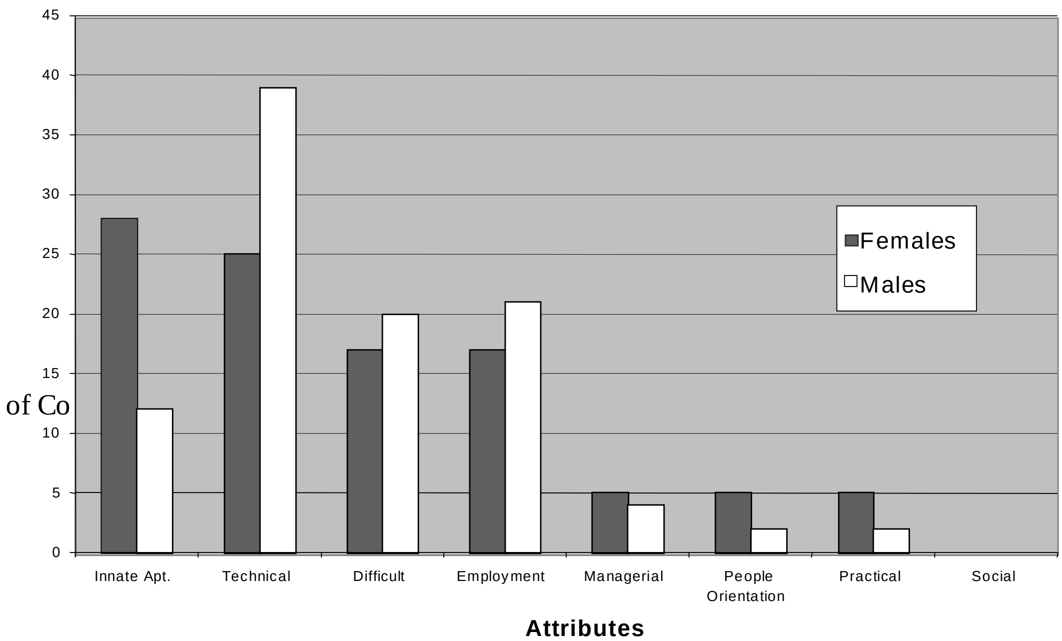

Figure 2: Number and percentage of comments for all school pairs that include MIT

It is seen that 25% of female comments and 39% of male comments described MIT as technical in nature. In addition, 28% of female comments indicated that an innate aptitude was required to study information technology. In contrast, 0% of comments from either gender saw IT as having social attributes and only small percentages (<= 5%) from both genders considered it to require managerial skills, to be people oriented or even to be a practical subject.

It is interesting to compare student perceptions with actual enrolment figures. Data was available for the 1999 intake at SCU. In that year, women represented a total of 58% of the student body. Male and female enrolment across schools in 1999 is shown in Figure 3, with the data is arranged in descending relative female preference for schools as determined by gender enrolment percentages.

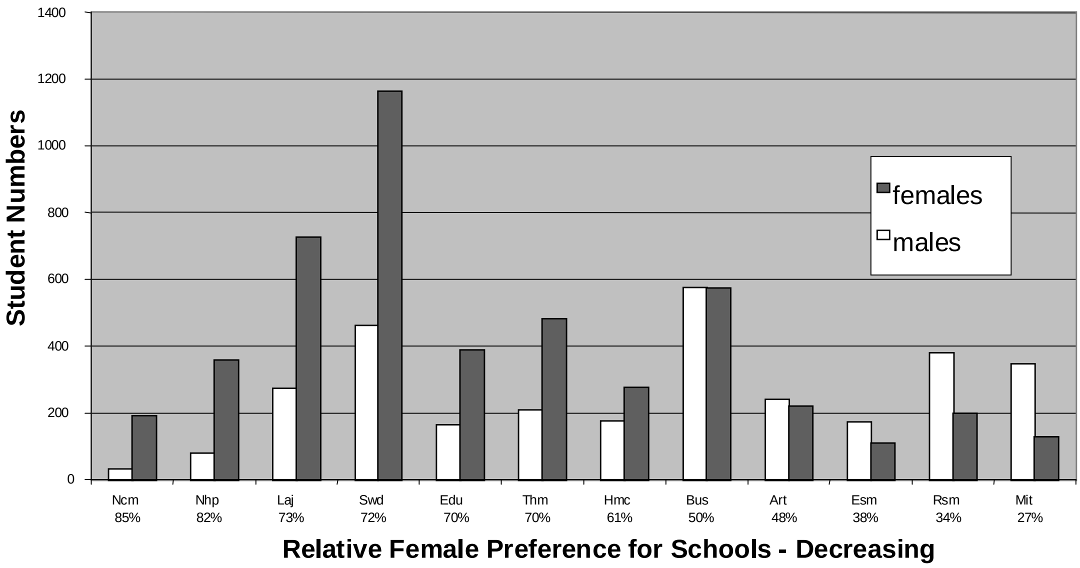

Figure 3: Enrolments by gender in 1999 (Office of Executive Director of Administration, SCU)

Although it is not possible to directly relate this enrolment data to high school student perceptions in 2000, it is both instructive and illuminating to study the student perception data for those schools which attracted the highest and lowest relative female enrolments. We will restrict the discussion to the bottom four schools (in ascending order MIT, RSM, ESM and ART) and the top four schools (in descending order NCM, NHP, LAJ and SWD).

Table 4 compares the frequency of mention by females of all attributes for the top four and bottom four female-popular schools and shows this frequency as a percentage of the total.

Attribute	Popular: NCM, NHP, LAJ, SWD		Unpopular: MIT, RSM, ESM, ART	
	Frequency	Percentage	Frequency	Percentage
SOCIAL	13	30%	0	0%
DIFFICULT	9	21%	6	7%
EMPLOYMENT	6	14%	10	12%
PRACTICAL	5	12%	21	25%
INNATE APTITUDE	4	9%	30	35%
MANAGERIAL	2	5%	3	4%
PEOPLE ORIENTED	2	5%	2	2%
TECHNICAL	2	5%	13	15%
Total	42		85	

Table 4: Attributes Associated with Schools Popular and Unpopular with Females

It is seen that the schools popular with females are associated with the attribute of *social*. This attribute drew 30% of all comments, the maximum for any attribute. In contrast, the schools unpopular with females are perceived to lack the attribute of *social*. The four schools of ART, ESM, RSM and MIT together drew not one comment relating to *social*. Further inspection of Table 4 indicates that for females *difficulty* is acceptable and is not seen as a major disincentive. Perceived *employment* prospects are a consideration of moderate importance. We also see that *practical* is an attribute that is accepted in moderation but not if it is perceived as a major attribute. Similarly *innate aptitude* is acceptable in moderation but definitely not if it is seen as a major attribute. A degree of *managerial* and *people* skills are not regarded as important in enrolment decisions. The attribute *technical* is not seen as significant in female enrolment decision making.

CONCLUSIONS

This study has demonstrated that the female-specific perceptions are related to female enrolment decisions. Two key findings emerged:

1. Each of the twelve Schools at Southern Cross University is perceived as exhibiting a specific proportion of attributes that can be ranked. Each school is perceived as having distinctly different attributes.
2. Attitudes to these perceived school attributes do vary between potential female and male students.

These findings imply that each school has a perceived attribute profile. Attitudes to these school profiles are gender specific. In the context of computer-related courses, females and males do perceive the School of Multimedia and Information Technology (MIT) differently from other schools. The perceptual difference lies in the fact that females associate MIT with a requirement for a talent or gift for computing. Males view MIT as purely a technical discipline that can be mastered. Males see MIT as representing modern technology and the direction of the future whereas females see MIT as moderately technical and a discipline that could be very stressful unless they had some special gift for computing. Both groups agree that employment prospects are good. Females perceive MIT as moderately difficult while males perceive MIT as more difficult. Neither group perceives MIT as requiring practical skills. MIT is not seen as a hands-on, physical, outdoors discipline and does not require one to be fit and healthy. Both groups see MIT as a sedentary, perhaps isolated, occupation. This is a plus for the majority of males; this can be seen from their enrolment in all those degrees that are perceived to be at the lower end of the social skills, people oriented table. This is the opposite to the female pattern of enrolment where schools that are perceived as offering social involvement with expected difficulty have in excess of 70% female enrolment.

Female perception appears to be greatly influenced by their assessment of the level of person-to-person involvement and scope for personal contribution. Females perceive, as a barrier, the pre-requisite of some talent or gift for computing. Males do not see this as a consideration. Loyd and Gressard (1984), Melymuka (2001) found no marked differences in male/female attitudes towards using computers. This research agrees: any lack of confidence, computer anxiety or dislike of computers was not commented on by either males or females.

Females do not like what they perceive as the narrow and overly machine oriented focus in information technology. They appear to reject the narrow focus of computing courses and the perceived solitary, anti-social, sedentary world of computing that gives no scope for what females are known to be good at: relating to others; using their knowledge and skills to solve people's problems; being innovative and creative. Females appear to be rejecting involvement in information technology not because of their perception of what it is but because of what it is not.

Students, both male and female, need to understand that future jobs in arts, literature, law, design and the helping professions will depend on IT. Equally, careers in science and technology will draw on the humanities, social science and people skills that attract girls quite naturally. It appears that involvement with people is truly valued by females and they fail to identify it with MIT as presently offered and marketed.

Majors within MIT could be offered that would more closely correspond with female requirements. The creation of streams within MIT that maximise female strengths and aptitudes could be a key-incentive to female enrolment. Updated marketing and vocational counselling could contribute more accurate information as to the true nature of information technology degrees and their important reliance on, and valuing of, interpersonal skills.

The sample size used in this research is too small to allow generalisations. We can only state that student perceptions *appear* to be strong indicators of female enrolment. Nevertheless, the findings provide a solid basis for further investigation and a possible link to the high attrition rates of universities that may be associated with students enrolling in degrees that do not fulfil their perceptions and/or expectations.

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