2009

Girls from Low Socio-Economic Backgrounds: Factors Influencing their Interest in ICT Study and Career

Iwona Miliszewska
Victoria University, iwona.miliszewska@vu.edu.au

Ewa M. Sztendur
Victoria University, ewa.sztendur@vu.edu.au

Girls from Low Socio-Economic Backgrounds: Factors Influencing their Interest in ICT Study and Career

Iwona Miliszewska
Victoria University
Iwona.Miliszewska@vu.edu.au

Ewa M. Sztendur
Victoria University
Ewa.Sztendur@vu.edu.au

ABSTRACT

The under-representation of women in information and communication technology (ICT) fields of study and occupations has attracted considerable attention of researchers in higher education. This paper discusses findings of a preliminary investigation aimed to investigate further study and career preferences of female students in one of Melbourne's all-female secondary schools and determine factors that might influence their decisions. The investigation focused on female students from schools in the Western suburbs of Melbourne, Australia, home to families with low socio-economic status and students exposed to "educational disadvantage".

Keywords

Female students, parental influence, information technology, ICT study, careers, attitudes, perceptions, cultural differences, low socioeconomic status.

INTRODUCTION

ICT is a critical tool for living and learning in the 21st century, yet females are largely under-represented in ICT courses (10% to 30%) and ICT-based careers (under 20%). The key motivation for the current study is the evidence that the low participation rates have not improved significantly in the past decade (Miliszewska, 2006). This issue and the particular shortage of female ICT professionals received considerable attention at the 2005 *PartICipaTion Summit* (PartICipaTion Summit, 2005). Also, a 2006 government report on Building Australian ICT Skills recommended a number of areas to be addressed by government, industry, and education and training providers. One of the recommendations was a call for research on ICT skills in schools so as to identify the factors that contribute to deterring students from considering ICT as an option for further study at university or technical college and as a career choice (DCITA, 2006).

According to Margolis and Fisher (2002) low participation of women among the designers and creators of information technology has serious consequences, not only for women who are "missing the educational and economic opportunities that are falling into the laps of computer-savvy young men (p. 2)", but also for a society increasingly influenced by technology. Margolis and Fisher also point out that, "women must be part of the design teams who are reshaping the world, if the reshaped world is to fit women as well as men" (Margolis and Fisher, 2002, p. 3). In the literature pertaining to women's under-representation in ICT sector, a number of possible factors that may influence girls' ICT career decisions have been discussed. In general, girls tend to report lower levels of interest in computers and lower levels of confidence in their abilities (Hargittai and Shafer, 2006; Volman and van Eck, 2001). Some authors suggested that girls perceive ICT careers as boring, very technical, "nerdy", and "geeky" (Babin, Grant and Sawal, 2008; Courtney, Timms and Anderson, 2006; Margolis and Fisher, 2002). Others also reported that female's choice of ICT courses or careers may be influenced by their intrinsic interest in computing as a field of study (Courtney et al., 2006), early exposure to computers, gender stereotypes (Adya and Kaiser, 2005; Trauth, 2002; Volman and van Eck, 2001; von Hellens, Nielsen and Trauth, 2001), early exposure to advanced computing subjects (Craig, Fisher and Lang's, 2007), and girls' abilities in math and science (Margolis and Fisher, 2002; Volman and van Eck, 2001).

The choice of career is an important process in young people's life - a process that is often guided by a complex interplay of pressures, influences and perceptions (IFAC, 2008). It has been recognized that factors such as family background, parenting style, parental education and occupation, socio-economic status affect young girls' occupational aspirations and career choices (Adya and Kaiser, 2005; Babin et al., 2008; Gates, 2002; von Hellens et al., 2001). For example, Babin et al. (2008) reported that twice as many female students (34%) than male students (17%) indicated that parents had influenced their career choices. In addition, girls' career choices have been found to be strongly influenced by their fathers (Gates, 2002; Trauth, 2002), as well as working and educated mothers (Smith, 2000).

Traditionally, young girls choose careers in "health, wellbeing, care, applied arts, such as clothing, graphic design … contrary to young boys who select sectors that are related to mechanical engineering, electrical engineering, computers and finance…" (IFAC, 2008, p. 10). These views were confirmed by Symonds (2007), who examined students' patterns of future career choices in an English Midlands' city. In this study, male students were more likely to choose careers in engineering, followed by ICT, whereas female students' career interests were in education and health. Symonds (2007) pointed out that, although the two careers were popular choices for all girls, they were particularly common for female students from low SES. Further, this study revealed that the range of career choices became more limited with lower level of student achievement and socio-economic status. According to Klein (2007):

> In an inequitable environment, students will make career choices based on limited factors, including family and personal demographic characteristics. Parent education and occupation, social class, and such factors as acculturation and discrimination all affect how students develop their career expectations (p. 430).

In Australia, recent research from University of Melbourne Professor Richard Teese identified students from the Western region of Melbourne as suffering from "entrenched educational disadvantage" (Teese, 2006). In response to the above issues, a research investigation was launched to examine the perceptions towards ICT, ICT studies and careers of "educationally disadvantaged" female students from secondary schools in the Western Metropolitan Region of Melbourne; the research aimed to:

- Gain a better understanding of attitudes, perceptions, and biases of high school female students towards information technology careers and the skills perceived to be necessary to succeed in such careers;
- Investigate attitude differences related to ethnic background, socio-economic status, year level, participation in ICT subjects, and coeducational versus all-girls schools with respect to computer usage and computer careers; and,
- Identify factors that clearly influence female student attitudes towards technology and technology careers.

It is now generally acknowledged by the government, business, employers, and the education and training sectors that there is an urgent need for improved targeting of information and advice on ICT studies and careers to students including high school students, with a particular goal to capturing girls' interest. To develop effective strategies to improve the advice, research is needed to first identify and debate key issues including female students' perception about the nature and scope of ICT work and occupations; the results of this research may inform this identification and debate.

METHODS

A survey questionnaire was used to obtain students' opinions or preferences. It included both structured (or closed) questions with pre-determined responses, and several open-ended questions to give respondents the opportunity to express their feelings and motives spontaneously. Open-ended questions tend to generate more self-revelations by participants and give them the ability to express their thoughts and opinions without inhibition. This was intended to allow researchers in this study to capture and study nuances of perceptions and attitudes that tend to go undetected in multiple-choice questions.

Participants

This pilot study involved female students from an all-female government secondary school in a Western suburb of Melbourne; the complete study will include female participants from several secondary schools of various profiles – all-female, coeducational, government, private, independent. Of the 250 questionnaires that were distributed to students in this pilot study, 113 were returned, representing a return rate of 45%. Over a third (32%) of the respondents studied in Year 7, 13% in Year 8, 16% in Year 9, 9% in Year 10, 16% in Year 11, and 13% in Year 12. One respondent (1%) did not indicate her school year. The majority of the respondents (84%) were born overseas in 26 different countries. Table 1 presents a summary of the ethnic background of the participants grouped by broad geographical regions.

Ethnic background	N (%)
Australia and New Zealand	21 (17)
Africa	23 (21)
Asia	57 (47)
Europe	7 (9)
Pacific	5 (6)

Table 1. Ethnic background grouped by geographical region.

Survey

Questions in the survey were grouped in four sections. The first section aimed to determine students' demographic characteristics and provide information regarding students' family circumstances. The students were also asked if they had a computer and access to the Internet at home, and how much time they spent using those. In the next section questions pertaining to the students' ICT interests and skills were asked. The participants were required to indicate what kind of career they would like to pursue after finishing school and, more specifically, whether they would be interested in an ICT career; and, what kind of computing experience and level of skills they had and whether they found computing interesting. Suggested choice of career options provided to students included: Architecture and Building, Agriculture and Environment, Creative Arts, Education, Engineering and Technologies, Health, Hospitality and Personal Services, Information Technology or ICT, Management and Commerce, Natural and Physical Sciences, and Society and Culture. Students were invited to select as many of these career options as they wished. To obtain information on other potential career interests, an open-ended question was also included in the survey. In addition to nominating future career choices, students were also asked to rate their ability to use computers. The next part of the survey aimed to determine students' perceptions and attitudes with respect to computer use in a classroom, for example, questions were asked to draw out if girls enjoyed classes in which computers were used, and whether they found computers useful in their learning. Finally, the last section was designed to seek information regarding the participants' perceptions of gender differences with respect to computer use and interests.

Data Analysis

Descriptive statistics were used to summarize the data from the student surveys. In addition, a statistical model was developed to relate the response variable, *student self-reported interest in ICT career*, to a number of potential factors. The response variable was measured on an ordinal scale, with possible levels: *not interested at all, only somewhat interested, interested, and very interested*. Considering the ordinal nature of the response variable, ordinal logistic regression (Venables and Ripley, 2002, pp. 204-205) was used to determine what factors were associated with female students' level of interest in an ICT career. The model fitted to the student data was summarized by diagrams, so that the effect of each variable could be easily seen and understood. Statistical analyses were performed using the statistical computing environment *R* (R Development Core Team, 2009).

FINDINGS AND DISCUSSION

Family Situation

Over half (53%) of the respondents lived with both parents, 39% lived with mother only, 6% lived with father only and 2% reported living with their uncle. A summary of family-related demographic information is presented in Table 2.

Family-related factor	N (%)	Family-related factor	N (%)
Living arrangements		Mother's education	
Living with both parents	60 (53)	0-6 years	20 (18)
Living with mother	44 (39)	7-10 years	29 (26)
Living with father	7 (6)	11-12 years	35 (31)
Living with uncle	2 (2)	Post-secondary	22 (19)
		Missing data	7 (6)
Parents employment		Father's education	
Both employed	32 (28)	0-6 years	14 (12)
Only mother employed	12 (11)	7-10 years	21 (19)
Only father employed	34 (30)	11-12 years	33 (29)
Unemployed	27 (24)	Post-secondary	27 (24)
		Missing data	18 (16)

Table 2. Family-related demographic information.

Computer and Internet Access and Use

Overall, 103 (93%) participants reported having access to a computer and 90 (84%) had access to the Internet at home. All students who had both parents in employment reported having a computer and an Internet connection. Of those who had a computer at home, almost 31% reported using it, on average, for 1-5 hours per week, and further 28%, 6-10 hours per week. Almost 20% of students reported spending more than 25 hours a week on a computer. Similarly, Table 3 shows that of those who had access to the Internet at home, almost 30% used it for 1-5 hours per week, 36% 6-10 hours per week, and almost 16% of students indicated that they spent more than 40 hours a week on the Internet. In fact, 3 students reported spending 80 hours and more hours per week, including one girl reporting 97 hours.

Hours per week	N (%)
1-5	27 (30)
6-10	32 (36)
11-20	9 (10)
21-39	7 (8)
40-79	12 (13)
80 and more	3 (3)

Table 3. Weekly Internet usage at home.

In terms of computer use, all students indicated that they used a computer for homework; 106 students used Word, 50 of them used Excel, and 84 used Power Point; students also reported using Publisher (N=13) and the Internet (N=10). Other software mentioned by the students included Front Page (N=1), Photoshop (N=1), and Word Pad (N=1). Students also responded to questions about computing skills or topics that they had learned or discussed at school so far. As presented in Table 4, the majority of girls indicated that they had used multimedia presentations (79%), and word-processing (77%). Half of the respondents used spreadsheets (50%) and learned how to set up web pages (45%). Interestingly, final-year students

reported a much lower level of exposure to the more advanced computing skills such as database skills, programming, and Web data retrieval; a finding supported by the literature (Craig et al., 2007). However, a recent change in the curriculum of final year ICT subjects introduced in 2007 may improve the poor participation rates. The redesigned curriculum aligns better with female students' preferences for collaborative and situated learning. It considers how individuals use, and can be affected by, ICT in their daily lives; it incorporates problem-solving tasks for real-life clients; and it links ICT studies with future career pathways (VCAA, 2009).

Technology/Software	**Year Level**						
	7 (%)	**8 (%)**	**9 (%)**	**10 (%)**	**11 (%)**	**12 (%)**	**Total N (%)**
Multimedia presentations (e.g. PowerPoint).	82	73	64	100	71	92	71 (79)
Word processing	70	73	86	88	88	69	70 (77)
Spreadsheets	33	67	44	64	72	40	56 (50)
Setting up Web sites	11	40	89	46	78	40	51 (45)
Web surfing	36	20	39	36	56	53	45 (40)
Database skills (e.g. MS Access)	6	28	6	46	61	7	24 (21)
Programming.	8	40	11	36	39	13	24 (21)
E-mail exchange	11	13	28	9	39	27	23 (20)
Web data retrieval	17	20	11	9	33	13	20 (18)

Table 4. Software use at school.

Perceptions of Computers and Self-efficacy

The majority of female students in this study felt confident with their ability to use computers; 18% of them rated their skills as excellent; 50% as very good; 28% as good; and only 4% reported poor computer skills. Students' perceptions regarding computer usefulness in their learning environment were very positive. All students thought computers help them find new information; 97% of girls indicated that they enjoyed classes in which computers were used; 89% thought that students should learn about computers at school; 87% would like to use computers more often in school; and, 86% thought computers helped them learn more easily.

Overall, students recognized the importance of ICT education. When asked if ICT education would help them in pursuing their future career, 97% of students responded "yes"; 72% of students felt that their knowledge would be enhanced, and 65% agreed that ICT education would help them function in modern society. Only 37 % of participants felt that ICT would increase their social interests, and 34% thought that it would improve their communication ability. The majority of girls (87%) indicated that girls knew how to use computers as well as boys; yet, 41% of them thought that boys were more interested in computers than girls.

The above findings indicate a positive attitude towards computers and ICT among the participating girls; they indicated a relatively high level of interest in ICT, and reported rather high levels of self-efficacy in computing skills. These findings seem somewhat "optimistic" in comparison to those reported in the literature (Hargittai and Shafer, 2006; Jewell and Maltby, 2002; Volman and van Eck, 2001; von Hellens and Nielsen, 2005).

Career Plans

A future career in Health appeared to be most popular with the participating girls (Table 5). Thirty-five students (31%) expressed interest in this area; of those, 11 girls chose Health as the only career option. Education emerged as the second most attractive career option: 27 girls (24%) selected it, and 14 of those selected this area as the only career option. While 27

girls also nominated ICT as their career of choice, only 7 of those selected ICT as the only career option. Similar findings have been reported in Symonds (2007), where female students' career interests were mainly in education and health.

Career field	One of many selections N (%)	Only selection N
Health	35 (31)	11
Education	27 (24)	14
Information Technology or ICT	27 (24)	7
Creative Arts	22 (19)	3
Hospitality and Personal Services	12 (13)	2
Engineering and Technology	16 (14)	3
Natural and Physical Sciences	16 (14)	3
Management and Commerce	13 (12)	2
Society and Culture	10 (9)	3
Architecture and Building	10 (9)	1
Agriculture and Environment	3 (3)	0

Table 5. Future career interest.

Statistical Modeling of Student Interest in ICT Career

Due to the format of the response variable, the ordinal regression method (using *R*) was performed to determine the relationship between the response variable, self-reported level of interest in ICT career, and a number of explanatory variables concerning student environmental factors, as well as student perceptions regarding computers. The variables in the model were as follows:

- The response variable was obtained from the question "How interested would you be in an ICT career?" The responses were ordered as: not interested at all, only somewhat interested, interested, and very interested.
- Explanatory variables included:
    - Student school level (Year 7 – Year 12); computer access at home (Yes/No); ethnic background (Australia and New Zealand, Asia, Europe, Pacific); mother's education (0-6, 7-10, 11-12, postsecondary) and father's education (0-6, 7-10, 11-12, postsecondary); whether mother uses a computer at home (Yes/No); whether father uses a computer at home (Yes/No); whether mother helps with computer questions (Yes/No); and whether father helps with computer questions (Yes/No);
    - Number of different software packages/tools used/discussed at school; number of different software used for leisure; hours spent using a computer;
    - Level of interest in computers (boring, only somewhat interesting, interesting, very interesting); self-efficacy (poor, good, very good, excellent); willingness to develop computer skills (Yes/No);
    - Indication of whether girls know how to use computers as well as boys (Yes/No); whether boys are more interested than girls in computers (Yes/No);
    - Level of commitment to career choice - this variable was created to control for the fact that students might indicate that they are interested in an ICT career, but at the same time select entirely different careers in another section of the survey. The score was constructed by examining students' choices of career. Options that emerged included: a student did not select ICT as a potential career (No ICT), a student selected ICT, but also 3 other careers (ICT+3); ICT and 2 other careers (ICT+2); ICT and 1 other career (ICT+1); and ICT only.

A forward stepwise method for variables selection, using Akaike's Information Criterion (AIC), was applied. AIC is a measure computed separately for each model under consideration. AIC chooses models that fit well with a penalty for models that have too many variables (Venables and Ripley, 2002, pp. 173-176). The "best" model, based on the minimum value of AIC, is selected. Estimated coefficients and their standard errors, as well as *t*-values from a final model are shown in Table 6.

Variable	Coefficient Value	Standard Error	*T*
Computers are very interesting	3.65	0.97	3.75
Computers are interesting	2.07	0.93	2.24
Willingness to develop computer skills	1.36	0.64	2.12
ICT and 3 other areas selected	2.44	1.20	2.03
ICT and 2other areas selected	1.81	0.71	2.54
ICT and 1 other areas selected	2.86	1.13	2.53
Only ICT selected	4.39	1.25	3.52
Asia	1.30	0.62	2.11
Europe	1.44	0.89	1.63
Africa	2.33	0.77	3.03
Pacific	3.29	1.01	3.25
Mother's education (7-10)	0.78	0.62	1.25
Mother's education (11-12)	1.45	0.61	2.38
Mother's education (University)	0.36	0.65	0.55
Father helps with computer questions	1.17	0.55	2.12
At least one parent in employment	-1.59	0.55	-2.90

Table 6. Coefficient for ordinal regression model regressing students' self-reported interest in ICT career on attitudes toward computers and socio-cultural factors.

Figure 1 – Figure 7 convey the results of this model in a more clear and informative way, showing the relationship between the response variable and significant explanatory variables. The pattern in Figure 1 is quite straightforward. It can be seen that as interest in computers increases, so does the interest in ICT career. For example, students who thought that computers are very interesting were more likely to report interest in an ICT career. None of the students in this group felt that computers are boring. Figure 2 shows that students who indicated that they are willing to develop computer skills were also more likely to be interested in ICT career. Similarly, Figure 3 indicates that students who selected ICT as their only potential career were also more likely to select "very interested in an ICT career".

The pattern in Figure 4 reveals quite an interesting finding. Girls of an immigrant background were more likely to be interested in an ICT career than those who were born in Australia or New Zealand. Moreover, students who had immigrated from Africa showed the highest interest in an ICT career, followed by students who immigrated from Pacific Islands; however, it needs to be noted that the number of respondents of Pacific Islands background was quite small. The literature acknowledges that, in different cultures, people may have different perceptions and uses of ICT; however, it refers to ICT as 'racially white' and Western (Li and Kirkup, 2007). The findings of this study seem to indicate the opposite; the immigrant girls showed more interest in ICT than their Australian born counterparts and showed no signs of being 'culturally dominated' by technology.

Figure 5 shows that mother's education had a positive influence on students' interest in ICT career, that is, students whose mothers had a higher level of education were more likely to be interested in this kind of career. However, this effect was largest for students whose mothers had 11 or 12 years of education; the effect decreased for students whose mothers had university degree. It appears that fathers' involvement in helping their daughters with computer related issues also had a positive effect on the students' interest in an ICT career (Figure 6). The literature reports on the key influence that parents, particularly fathers, have on girls' interest in ICT careers (Adya and Kaiser, 2005; Babin et al., 2008). Interestingly, Figure 7 shows that students who indicated that their parents were unemployed were more likely to be interested in an ICT career. This is an encouraging finding as it indicates that the students' low socio-economic background does not seem to be a prohibitive factor; moreover, it might indicate that the girls appreciate the opportunities that a career in ICT is likely to provide. According to the literature, the male-dominated careers tended to appeal to girls whose parents were educated and in employment (Adya and Kaiser, 2005).

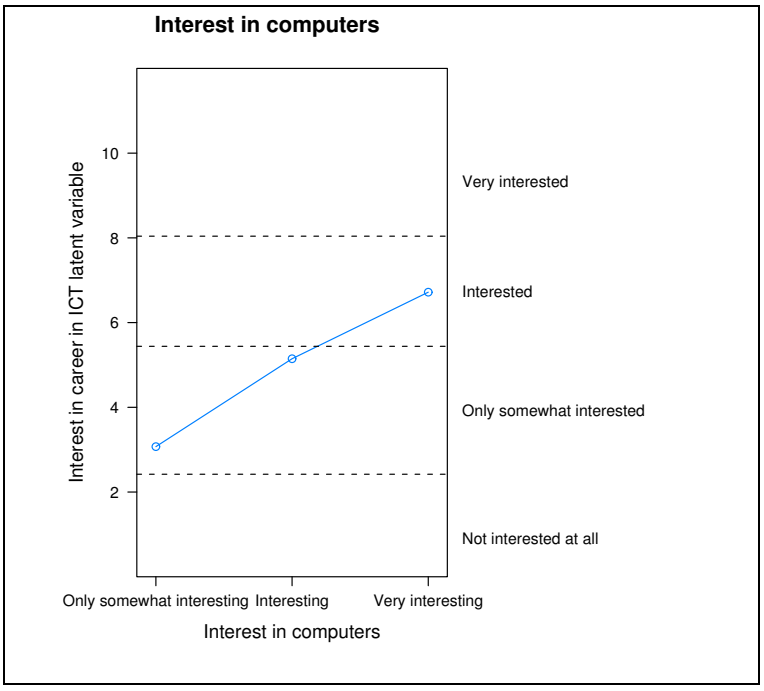

Figure 1. Display of the relationship between perception of computers and interest in ICT career.

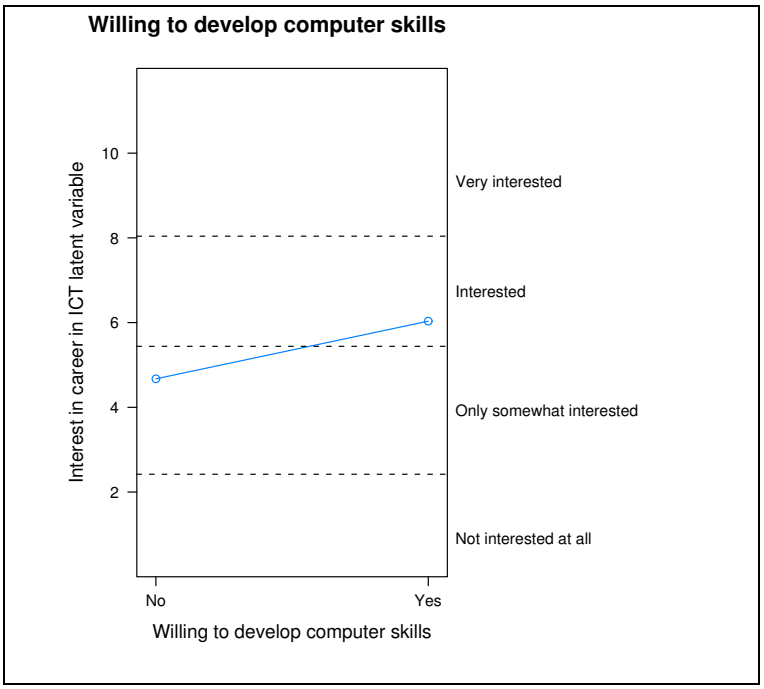

Figure 2. Display of the relationship between willingness to develop computer skills and interest in ICT career.

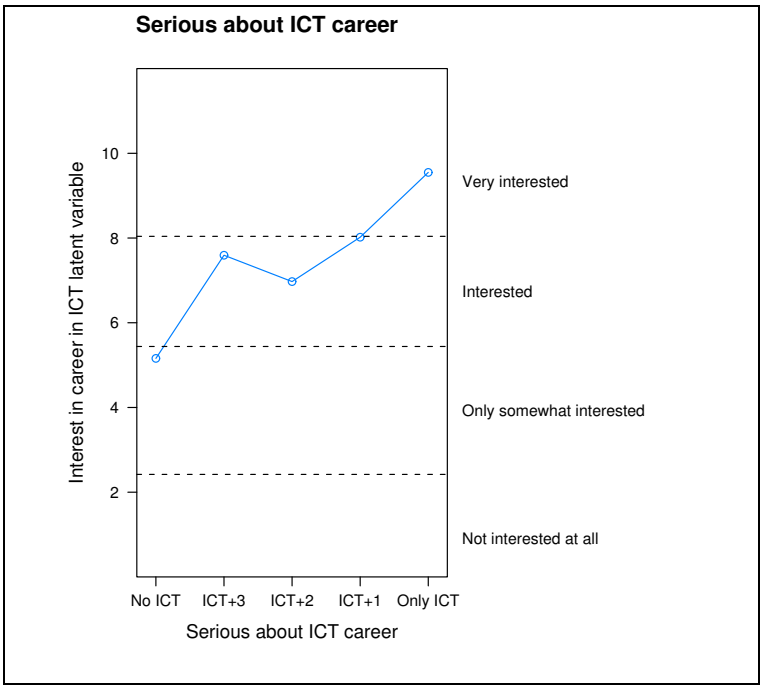

Figure 3. Display of the relationship between career seriousness score and interest in ICT career.

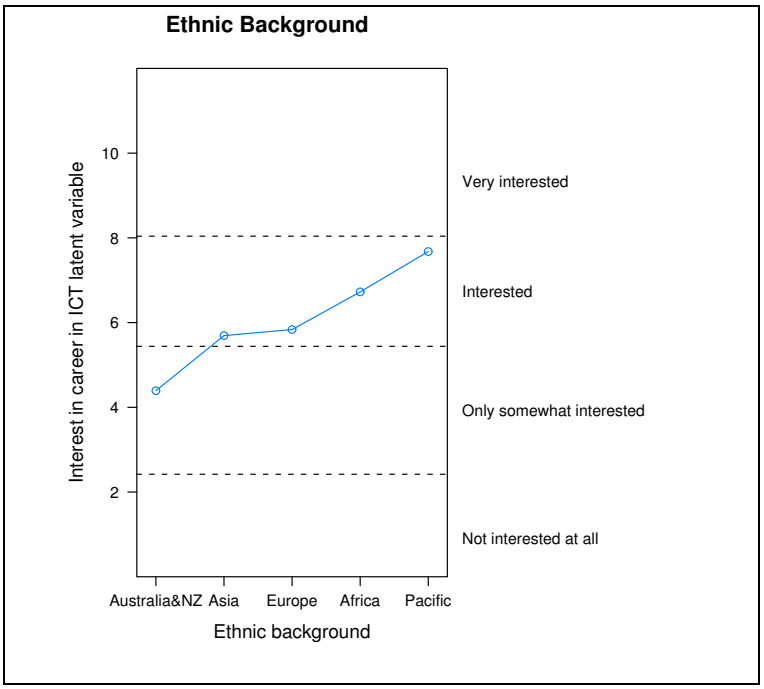

Figure 4. Display of the relationship between ethnic background and interest in ICT career.

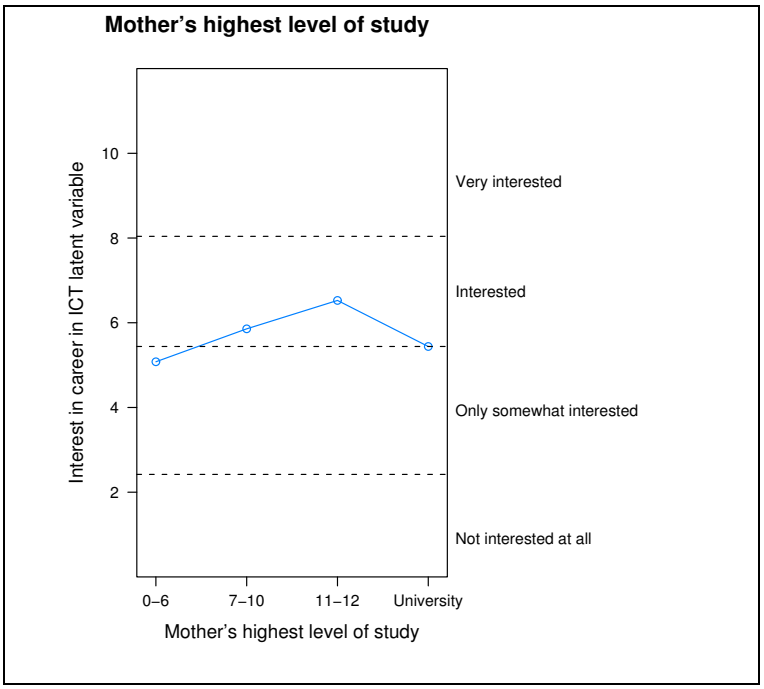

Figure 5. Display of the relationship between mother's education and student interest in ICT career.

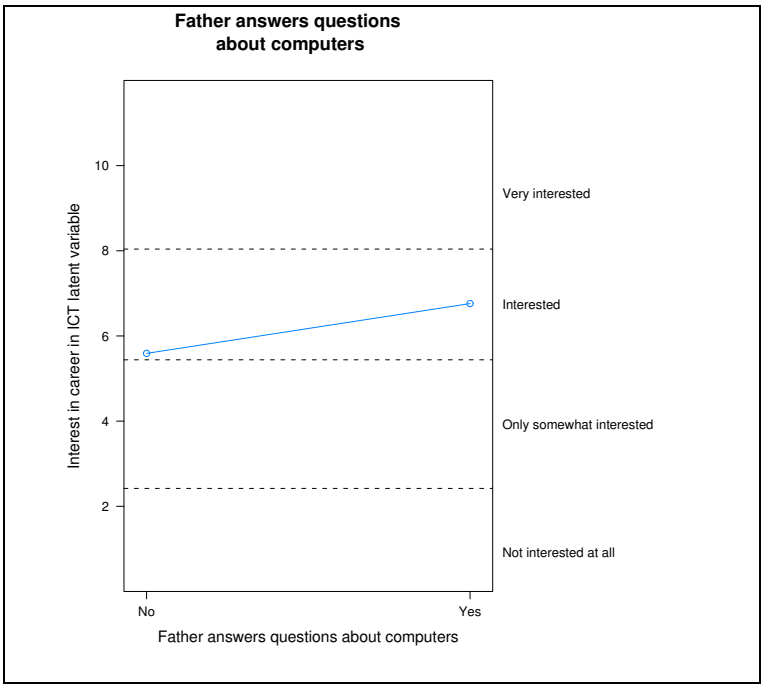

Figure 6. Display of the relationship between father's help and interest in ICT career.

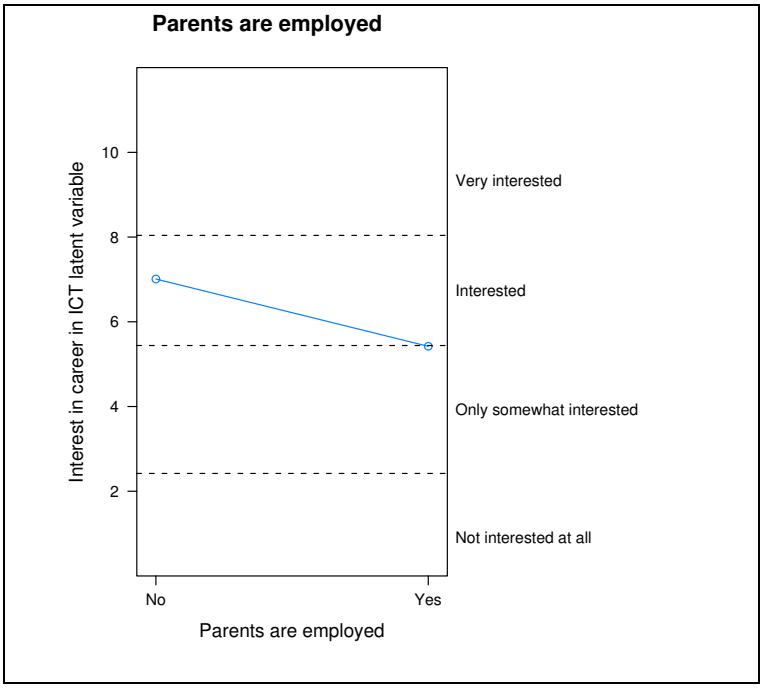

Figure 7. Display of the relationship between parents' employment status and student interest in ICT career.

CONCLUSION

The pilot study reported in this paper investigated the perceptions of ICT skills, studies and careers among female secondary school students in an educationally disadvantaged region of Melbourne. The analysis of the study findings revealed that, overall, female students had positive perceptions of ICT. Moreover, in this study, ICT was found to be among the top three popular career choices. However, not all students who expressed interest in ICT as a potential area of study and future career selected it as the only career choice. This suggests that there is a large group of female students who might be attracted to ICT studies and careers if provided with adequate encouragement and more information about the opportunities that ICT presents. The results of statistical modelling indicated that apart from factors such as interest in computers and willingness to develop skills in computers, family background played an important role in shaping female students' interest in an ICT career.

It must be noted that the presented findings come only from a pilot study. A larger study is now in progress and when completed it will allow for a more comprehensive analysis; it will also help to facilitate a stronger verification of the relationships between the response variables and explanatory variables considered in this study. When the full study has been completed in the next few months, its findings are likely to help educators, employers, and businesses effectively understand and address female student attitudes towards ICT and their interest in ICT careers; and, serve as a source of information for educators, employers, and businesses in planning, design, and implementation of targeted strategies aimed at encouraging girls from economically and socially disadvantaged backgrounds to consider a career in ICT.

REFERENCES

1. Adya, M. and Kaiser, K. M. (2005) Early determinants of women in the IT workforce: a model of girls' career choices, *Information Technology and People*, 18, 3, 230-259.
2. Babin, R., Grant, K. and Sawal, L. (2008) Identifying influencers in high school student ICT career choice, in *Proceedings of the Information Systems Educators' Conference* (ISECON 2008), Phoenix, Arizona, 1-17.
3. Courtney, L., Timms, C. and Anderson, N. (2006) I would rather spend time with a person than a machine: Qualitative findings from the girls and ICT survey, in Alison Ruth (Ed.) *Quality and impact of qualitative research*, 3rd annual QualIT Conference, Brisbane, Australia, Griffith University, 51-57.
4. Craig, A., Fisher, J. and Lang, C. (2007) ICT and girls: The need for a large scale intervention programme, in *Proceedings of the 18th Australasian Conference on Information Systems*, 5-7 December, Toowoomba, 761-769.
5. DCITA (2006) Building Australian ICT Skills. Report. Commonwealth of Australia: Canberra.
6. Gates, J. (2002) Women's career influences in traditional and non-traditional fields, poster presented at the Biennial Meeting of the Society for Research in Adolescence, April 11-14, New Orleans, LA. URL: http://www.eric.ed.gov/ERICDocs/data/ericdocs2sql/content_storage_01/0000019b/80/1a/72/5b.pdf, accessed 15 January 2009.
7. Hargittai, E. and Shafer, S. (2006) Differences in actual and perceived online skills: The role of gender, *Social Science Quarterly*, 87, 2, 432-448.
8. IFAC Project (2008) Preparing Young Girls for Science and Technology careers: Information booklet for career counsellors, Athens, Greece. URL: http://ifac-project.eu/, accessed 2 February 2009.
9. Jewell, H. and Maltby, J. (2002) Female involvement in information technology degrees: Perception, expectation and enrolment, in *Proceedings of the 12th Australasian Conference on Information Systems*, Coffs Harbour, NSW.
10. Klein, S. S. (2007) Handbook for achieving gender equity through education, 2nd Ed., Routledge.
11. Li, N. and Kirkup, G. (2007) Gender and cultural differences in Internet use: A study of China and the UK, *Computers and Education*, 48, 301-317.
12. Margolis, J. and Fisher, A. (2002) Unlocking the clubhouse: Women in computing, MIT Press, Massachusetts.
13. Miliszewska, I. (2006) Gender bias in computer courses in Australia, in Eileen M. Trauth (Ed.) *Encyclopaedia of Gender and Information Technology*, Hershey, PA: Idea Group Reference, 501-506.
14. PartICipaTion Summit (2005) DCITA. URL: http://archive.dcita.gov.au/2005/09/participation_summit, accessed 15 January 2009.

15. R Development Core Team (2009) R: *A Language and Environment for Statistical Computing*, R Foundation for Statistical Computing, Vienna, Austria. URL: http://www.R-project.org, accessed 15 January 2009.
16. Smith, L. B. (2000) The socialization of females with regard to a technology-related career: Recommendations for change, *Meridian: A Middle School Computer Technologies Journal*, 3, 2. URL: http://www.eric.ed.gov/ERICDocs/data/ericdocs2sql/content_storage_01/0000019b/80/16/d9/c2.pdf, accessed 10 December 2008.
17. Symonds, J. (2007) Choice and possible selves in the Midlands: A comparison of Year 11 pupils' education and employment aspirations to their wider world of hopes and fears, pre-GCSE examination, paper presented at the *British Educational Research Association New Researchers/Student Conference*, 5 September, University of London. URL: http://www.leeds.ac.uk/educol/documents/165911.doc, accessed 2 February 2009.
18. Teese, R. (2006) Condemned to innovate. Griffith Review, February. URL: http://www.griffith.edu.au/griffithreview, accessed 10 December 2008.
19. Trauth, E. M. (2002) Odd girl out: An individual differences perspective on women in the IT profession, *Information Technology and People*, 15, 2, 98-118.
20. Venables, W. N. and Ripley, B. D. (2002) Modern Applied Statistics with S-Plus, 4th Ed., Springer Verlag, New York.
21. Volman, M. and van Eck, E. (2001) Gender equity and information technology in education: The second decade, *Review of Educational Research*, 71, 4, 613-663.
22. von Hellens, L. A. and Nielsen, S. H. (2005) Australian women in IT, *Communications of the ACM*, 44, 7, 46-52.
23. von Hellens, L. A., Nielsen, S. H. and Trauth, E. M. 2001 Breaking and entering the male domain. Women in the IT industry, in *Proceedings of the 2001 ACM SIGCPR Conference on Computer Personnel Research,* San Diego, USA, 116-120.
24. VCAA (2009) Information Technology 2007-2010. URL: http://www.vcaa.vic.edu.au/vce/studies/infotech/changesummary.html#H2N1001C, accessed 2 February 2009.