Into the New Millennium: Why do Students Decide to Study IT?

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Abstract

The shortage of Information Technology (IT) professionals is a recognised world wide problem. During the last ten to fifteen years we have seen the introduction of computers into high school and also primary school. These computers are now being used, not only as an adjunct to school subjects, but for the study of IT as a subject in its own right. As we begin this new millennium, this study aims to discover if these changes in curriculum are affecting students' decisions to become IT professionals. A survey was administered to a group of students, undertaking an IT programme of study, to examine the IT subjects they completed in high school and the effect these subjects had on their decision to study IT. The literature suggests that gender is an important constructs in students' decision to study IT and so this variables were examined also.

Keywords: curriculum, gender, high school, IT career.

Introduction

During the last ten to fifteen years we have seen a dramatic increase in the usage of computers in high schools. At first computers were used as an adjunct to classes, but now many high schools offer units in IT, varying from personal use of a computer, through business use of a computer, to programming type units, and computers are common within primary schools. In the UK the government reports that in primary schools, in 1999, on average, there was one computer for every 13 pupils. The average expenditure on ICT (Information and Communication Technology) was £5,700 per school and £27 per pupil and 62% of schools reported that they were connected to the Internet. In secondary schools, on average, in 1999, there was one computer for every 8 pupils. The average expenditure on ICT for teaching and learning was £38,200 per school, and £45 per pupil, and 93% of schools reported that they were connected to the Internet (UK Government 1999).

There is a world wide shortage of Information Technology (IT) professionals and this situation will continue to be a problem as our usage of computers increases (Brotherton 2001) (Jay and Cantelo 2000). At the same time women are underrepresented in most IT university courses and, in general, their numbers are declining. For example Newmarch found that overall student enrolments in Australian IT courses increased by 30% from 1994 to 1998, but females accounted for only 10% of that increase (Newmarch, Taylor-Steele et al. 2000). Phillips reports that women are not entering the IT industry at the same rate as men (Phillips 1999). Gender stereotypes about careers still limit girls' interest and participation in career options. Stitt-Gohdes reported that children begin to eliminate careers because they are the wrong "sextype" between the ages of 6 and 8 (Stitt-Gohdes 1997).

Role models can be a powerful influence in peoples' decision making. For students at high school a particularly important role model can be a teacher. Eccles reports that educational and vocational decisions are influenced by differential past experience and gender-role socialization, especially "the behaviors and goals of one's parents, teachers, role models, and peers" (Eccles 1987).

This study investigates the reasons students choose IT as a career. Aman, in his study of high school students in USA found that the most important effect on positive attitude to computers is previous or current experience, not necessarily structured (Aman 1992). Levine also reports that positive computer experiences are a predictor of positive attitudes, and positive attitudes are the best predictor of future behaviour for computer-related activities (Levine and Donitsa-Schmidt 1997). In another study of university business students, Al-Jabri found that the number of computer-using courses affects computer anxiety and liking (Al-Jabri and Al-Khaldi 1997).

Research Questions

This study is part of a larger study investigating the effect of attitude toward computers and the high school curriculum on the decision of students to study IT.

The current study examines the content of the high school units completed by a cohort of students studying for an IT degree at Murdoch University. It also examines the reasons this cohort of students gave, for deciding to study IT.

Hence the following questions were considered:

- What is the content of the high school IT units completed by students studying IT?
- What were the factors influencing IT students' decision to study IT?

This study also examines the attitudes toward computers of IT students. The literature suggests that there are differences between male and females' participation and performance in IT and so this paper looks at the attitude of these two groups to find out if this difference can be explained by attitude to computers. The literature also stresses the importance of role models on students, and so this study investigates gender of the teacher of a high school unit and the students' decision to study IT.

Thus, this paper further examines the questions:

- Is the attitude toward computers of male and female studying IT the same?
- Are the students with male or female teachers of IT units equally likely to report that the unit positively affected their decision to study IT?

The hypotheses that will be tested are:

H_0: The attitude toward computers of male and female students studying IT is the same.

H_1: Students with male or female teachers of IT units at high school are equally likely to report that the unit positively affected their decision to study IT.

Research Instrument

The survey consisted of two parts. The first section asked the students questions about their gender, the course they were taking and their participation in any IT units at high school. Where students had completed an IT unit at high school they were asked to indicate the gender of the teacher taking the IT unit and whether or not taking this unit influenced their decision to study IT at university. This last question was open-ended, and students answered with Yes, No or "I had already made up my mind to study IT". They were also asked to indicate the subject areas included in the unit. Students could select

one or more subject areas from the following list: Hardware, Word Processing, Spreadsheet, Database, Multimedia, Programming, email, Networks, Operating Systems and Other. Only one student ticked Other; he had done some Desk Top Programming. This list was compiled from an examination of the Tertiary Entrance Examination (TEE) Curriculum and from informal talks with three teachers of IT in high school.

This section also asked the students to indicate the year they completed high school. This was used to distinguish those students who would not have had access to computers in school because they would not have been available. The personal computer (PC) has only been available since 1981 and was not common in schools for several years after that. There was also some open-ended questions to allow students to elaborate on the reasons for their thoughts and actions.

The second section of the survey was a series of questions designed to measure the students' attitude toward computers. The items for the instrument were chosen to measure the following constructs of computer attitude: stereotype, perceived control, perceived usefulness, computer anxiety, self-confidence, computer liking, behavioural and computer interest. The items for the instrument were drawn from several available scales: The Computer Attitude Scale by Selwyn (Selwyn 1997), the Attitude Scale by Collis (Collis and Williams 1987), and the Computer Attitude Scale by Nash (Nash and Moroz 1997). Each of these scales has been validated with various populations in different cultural settings.

The forty items, accompanied by a five-point Likert response scale (labelled Strongly Agree, Agree, Neutral, Disagree and Strongly Disagree) were used to assess the students' attitude toward computers. The items from each construct were alternated to prevent any clustering effect and seventeen of the items were negatively worded to provide a check against respondents giving positive or negative response sets. For the purpose of the analysis, the scoring of these items was reversed.

The responses to the questions in the second part of the survey were coded so that a higher score indicated a lower degree of anxiety and a higher degree of liking, confidence, perceived control, perceived usefulness and interest. The eight subscale scores were obtained by summing the coded items on the respective subscales, and the total score was the total of the eight subscale scores. A high score on any of the subscales or total score indicated a more positive attitude toward using computers.

The reliability of this instrument was checked and is reported below.

Research Method

Participants in this study were drawn from the undergraduate students at Murdoch University who were currently enrolled in an Information Technology degree course. During lectures students were asked to volunteer to complete the survey, after the purpose of the survey had been explained to them. Students from many different units completed the surveys. The resulting sample consisted of students from a range of age groups and cultural backgrounds.

141 students completed the survey. Some of the surveys were incomplete and were discarded, leaving a sample of 122 students.

A reliability analysis was performed on the attitude survey and, as a result, some of the questions were excluded. Discussion of these is included below.

H_0: The attitude toward computers of male and female students studying IT is the same.

The scores for the various subscales on the attitude survey and the overall attitude score were examined for differences between males and females. A One way ANOVA analysis was performed on the data,

Construct	Items	Mean	SD	α
Stereotype	6	21.52	2.55	.2503
Perceived Control	7	26.08	3.76	.6909
Perceived Usefulness	6	23.76	2.82	.5948
Computer Anxiety	3	11.98	2.18	.6383
Self-Confidence	3	11.76	1.94	.5089
Computer Interest	8	33.05	4.52	.8170
Behaviour	4	17.77	2.14	.6994
Computer Liking	3	11.26	2.11	.5228

Table 1: Initial Means, Standard Deviation and α for Attitude Sub-scales.

using SPSS, to compare males and females attitude for each of the subscales and for the overall attitude score.

H_1: Students with male or female teachers of IT units at high school are equally likely to report that the unit positively affected their decision to study IT.

The data was analysed using chi-squared tests for independence to determine whether the observed distribution of students with female and male teachers reported that the unit affected them positively, was significantly different from that expected. The alpha statistic or probability of a significant deviation from the expected distribution was calculated using a χ^2.

Reliability Analysis

A Cronbach's coefficient α was calculated for each of the eight subscales. The initial results are shown in Table 1.

As can be seen from the table, the internal reliability for some of the subscales is questionable. Of particular concern is the Stereotype subscale. Students responses to several of the statements concerning stereotype were not as would be expected from previous studies. The most significant of these were the statements: "I would not expect a good athlete to like computers", "People who like computers are the types who like science", "People who like computers are often not very sociable" and "You have to be intelligent to like computers". It appears that perceptions of the students in this study, with regard to the stereotypical IT person, are not the same as those in previous studies.

For subscales that had α values less than 0.7, questions were deleted until the results shown in Table 2 were obtained.

Construct	Items	Mean	SD	α
Stereotype	2	8.56	1.45	.7471
Perceived Control	5	19.67	2.94	.7618
Perceived Usefulness	5	20.21	2.56	.6341
Computer Anxiety	3	11.98	2.18	.6383
Self-Confidence	3	11.76	1.94	.5089
Computer Interest	8	33.05	4.52	.8170
Behaviour	4	17.77	2.14	.6994
Computer Liking	2	7.73	1.68	.6850

Table 2: Final Means, Standard Deviation and α for Attitude Sub-scales.

Results

The final sample of 122 students was made up of 86 males (70%) and 36 females (30%). 49 students (40%) were taking an Information Systems (IS) major, 39 (32%) were taking a Computer Science (CS) major, 10 (8%) were taking a IS/CS major and 24 (20%) were taking an E Commerce major. 13% of the students completed high school before 1991, 76% completed high school between 1991 and 1999, and 11% completed high school in 2000 or 2001.

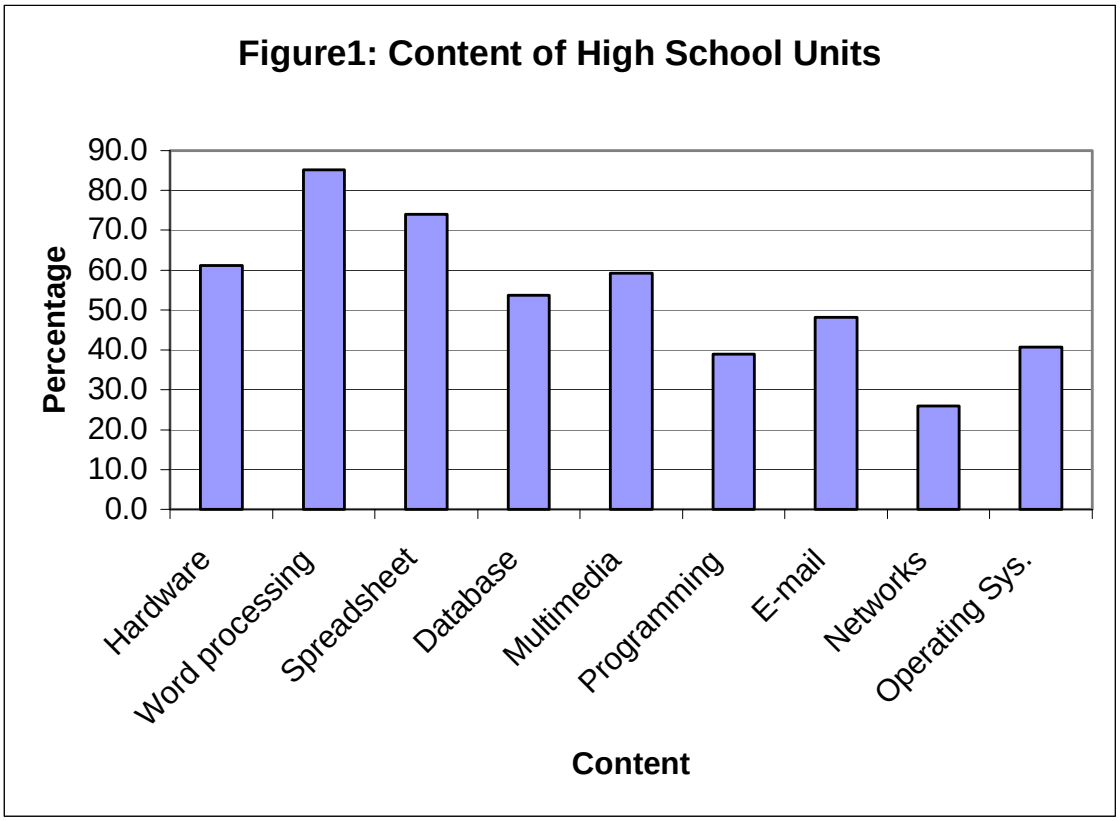
When asked the question: "Did using computers at school motivate you to study computing at university?", 40% replied positively. However, it should be noted that 15% of those who replied negatively, did so because computers were not available when they were at school.

From the sample of all students 54 (44%) had completed one or more IT units at high school. When these students were asked the question: "Did taking this unit influence your decision to do IT at university?", 48% replied that the unit had positively affected their decision, 42% said that the unit had not affected their decision and 10% said that they had already made up their minds to study IT.

What is the content of the high school units completed by students studying IT?

The graph below (Figure 1) shows, for each of the areas of study in the high IT units undertaken, the percentage of students who studied that area. (WP is word processing, SS is spreadsheets, DB is databases and MM is multimedia.)

As can be seen from the graph, word processing and spreadsheets are the most common included subject areas. Of interest is the high percentage of students who have studied multimedia. This is a relatively new subject area and yet almost 60% of students reported studying some multimedia. Programming and networks have the lowest percentage of students having studied them. Since these are the most technical of the subject areas likely to be covered at high school this is to be expected.



What were the factors influencing IT students' decision to study IT?

Students were asked the question: "What were the things that influenced your decision to study IT?" Since not all students answered this question, it is only sensible to report the general findings from this question. The most common answer was because the student enjoyed using computers and/or was good at using computers. As one female student said "I just loved anything to do with computers". The second most common reason was because of the good job prospects and good money available in a career in IT. Of interest here is the fact that these two reasons were the same for males and females. Twelve male students mentioned playing computer games and owning a computer as a reason, but no females gave either of these as a reason.

Four male students mentioned doing a course at high school or a particular teacher as the reason they chose to study IT. It appears that there are very few and simple reasons why students chose IT, as in this sample there were no other reasons mentioned.

H_0: The attitude toward computers of male and female students studying IT is the same.

For each of the subscales the means and standard deviations were compared for male and female students. Table 3 below shows the means and standard deviations for each of the subscales and the attitude survey as a whole. The means for the male and female are very similar for all the subscales except stereotype. For the subscale stereotype they are very different. The remaining stereotype statements were about the ability of males and females in using a computer ("Females have as much ability as males when learning to use a computer" and "Girls and boys are equally competent at using a computer"). The differences in means indicate that females are more likely to agree with these statements than males. In other words, they are more confident that females and males are equally competent using computers than males.

Source		N	Mean	Standard Deviation
Perceived Control	Male	86	19.84	2.966
	Female	36	19.56	2.944
Perceived Usefulness	Male	86	20.17	2.595
	Female	36	20.28	2.679
Computer Anxiety	Male	86	12.16	2.080
	Female	36	11.78	2.439
Self-confidence	Male	86	11.79	2.070
	Female	36	11.89	1.864
Computer Interest	Male	86	33.22	4.856
	Female	36	33.00	4.099
Behaviour	Male	86	17.86	2.070
	Female	36	17.89	2.122
Computer Liking	Male	86	7.81	1.712
	Female	36	7.86	1.533
Stereotype	Male	86	8.3	1.511
	Female	36	9.33	1.069

Table 3: Means and Standard Deviations of the Computer Attitude Subscales by Gender (N=122)

A oneway ANOVA was performed to compare the attitude of male and female IT students for each of the subscales and for the instrument as a whole. The results are listed in Table 4 below. The tests for each of the subscales shows that only Stereotype shows a significant difference for male and female (Sig.=.000), all other subscales show no significant difference between male and female. For the instrument as a whole, no significant difference was found (Sig. = .873). Therefore the null hypothesis was accepted, that there is no difference in the attitude toward computers of male and female students studying IT.

H_1: Students with male or female teachers of IT units at high school are equally likely to report that the unit positively affected their decision to study IT.

The data analysis using chi-squared tests for independence indicated that students with male or female teachers were equally likely to report that the unit positively affected their decision to study IT (p=.063). Thus the null hypothesis was accepted.

Source	Sum of Squares	Df	Mean Square	F	Significance of F
Perceived Control					
Between Groups	2.013	1	2.013	.231	.632
Within Groups	1046.610	120	8.722		
Total	1048.623	121			
Perceived Usefulness					
Between Groups	.271	1	.271	.040	.843
Within Groups	823.606	120	6.863		
Total	823.877	121			
Computer Anxiety					
Between Groups	3.762	1	3.762	.784	.378
Within Groups	575.943	120	4.8		
Total	579.705	121			
Self-Confidence					
Between Groups	.245	1	.245	.060	.806
Within Groups	485.788	120	4.048		
Total	486.033	121			
Computer Interest					
Between Groups	1.264	1	1.264	.059	.809
Within Groups	2568.753	119	21.586		
Total	2570.017	120			
Behaviour					
Between Groups	.021	1	.021	.005	.945
Within Groups	521.881	120	4.349		
Total	521.902	121			
Liking					
Between Groups	.056	1	.056	.020	.887
Within Groups	331.329	120	2.761		
Total	121				
Stereotype					
Between Groups	26.975	1	26.975	13.825	.000
Within Groups	234.140	120	1.951		
Total	261.115	121			

Table 4: Analysis of Variance of the Computer Attitude Subscales by Gender (N=122)

Discussion

Reliability of the Attitude to Computers Instrument

The reliability of the attitude instrument was of concern because of the low α scores for some of the subscales. These low scores are not consistent with the scores reported by the authors of the original survey instruments. For example, Selwyn reported an α of .88 for the subscale of Perceived Control, whereas this study initially found an α of .6909 initially and .7618 for the final set of questions in the subscale. Similarly, Nash reported an α of .91 for the subscale of Computer Liking, whereas this study found an α of .5228 initially and .6850 for the final set of questions in the subscale. The Nash and Selwyn studies are quite recent (1997) and so this discrepancy needs to be further investigated.

Of particular interest is the difference in the α scores for the subscale of Stereotype from the Collis instrument. The fact that students rejected the typical stereotypes of IT people being non-athletic and anti-social could indicate that changes in people's perceptions of IT are changing. Collis reported α values between .602 and .797 for the subscales in her study, which was completed in 1987. The fact that this study was considerably older than the other two could also indicate a change in the stereotypical attitudes to IT people.

The differences between males and females for the stereotype subscale being significant indicates that males and females perceive the stereotypical IT person differently. Females are more confident that males and females are equal in their ability with computers. This may indicate that attempts to change these stereotypes are affecting males and females differently.

The students were also asked the open-ended question: "What do you think are the main reasons women do not enter IT as a career?" The responses to this question showed that many of the students still believe that the old stereotypes of the male nerd are still prevalent. The words 'nerd' and 'geek' were mentioned many times. One female student wrote: "It is not seen as a career where much interpersonal interaction will occur, which may be an issue for women." And a male student wrote: "Technical is associated with masculinity" Statements such as these belie the assumption that stereotype images are changing.

What is the content of the high school units completed by students studying IT?

The content of high school IT units is predominantly the traditional areas of word processing and spreadsheets. These simple applications are relatively simple to learn and can be of immediate use to the students, for example in preparation of assignments in other subjects, and hence are obvious candidates for inclusion in high school IT units.

The high proportion of students undertaking multimedia as part of a high school IT unit reflects the commitment of schools to teaching IT that is relevant and of interest to the students. Hardware and software for teaching multimedia subjects can be expensive but anecdotal evidence suggests that students find multimedia more interesting than other aspects of IT.

What were the factors influencing IT students' decision to study IT?

The samples of students in this study have all decided to study IT at university. The two main motivating reasons for this appear to be enjoying using a computer and the job/money opportunities in IT.

The literature suggests that the playing of video games by males is a factor in their enjoyment of computers and is also a discriminating factor against females, because video games are almost exclusively

designed for males (Gorritz and Medina 2000) (Mackereth 1998). The mention of video games by some males (but no females) as a factor in their decision to study IT substantiates these findings.

H_0: The attitude toward computers of male and female students studying IT is the same.

Since the sample in the study was composed of students studying IT one would expect that the attitudes of the male and female students toward computers would be similar. The results in the study are surprising, in that for all the subscales except stereotype, they are so similar as to be almost the same. This level of similarity was not expected.

Murdoch University is similar to other universities in that females make up approximately 20% of the students in IT (Downes and Hobbs 2000). Since the attitude of male and female students toward computers, in this cohort of students, is so similar, it is necessary to consider other reasons why there are so few female students studying IT.

H_1: Students with male or female teachers of IT units at high school are equally likely to report that the unit positively affected their decision to study IT.

The importance of role models has been discussed above. This study found that students with male or female teachers were equally likely to report that the unit positively affected their decision to study IT. Hence the gender of the teacher, as a role model, does not appear to be a significant factor. Four students did mention a teacher of IT as a reason for choosing to study IT, but within the entire sample this is not really significant.

Further Study

This study has shown that the issue of stereotypes in IT needs to be further investigated. This appears to be an area that is changing, which is not surprising considering how much access students have to computers and information about computers. Survey instruments containing statements about stereotypes need to be re-examined to ensure that they are still relevant.

Since enjoyment in using computers is such an important motivating factor in students' decisions to study IT, a further study needs to discover when and where students gain this liking for computers. This information could be used to devise ways to ensure that more students enjoy using computers and hence alleviate the shortage of IT professionals.

Students are informed about the job prospects in IT and the fact that there is the ability to earn lots of money as an IT professional. A study which investigates when and where they obtain this information could use these same opportunities to communicate other information about IT, for example to repudiate the stereotypes in IT.

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Biography

Sandra Downes has been a lecturer at Murdoch University in Australia for almost ten years. Her research interests include large systems development and gender issues in Information Technology. She has five teenage children who occupy all her non-working time.