Internet access as a structural factor in career choice: a comparison between computing and non-computing major students

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Abstract

The career choice model of Adya and Kaiser posits the availability of technology resources as a structural element impacting on career choice. The model distinguishes between accessibility at school and at home. Based on this theoretical point of departure and by arguing a link between choice of major and choice of field of career, this paper explores specifically the influence of the access of internet at school and at home on perceptions and values pertaining to the career South African students are preparing for. This exploratory study investigates whether any differences can be found between students who selected computing majors at tertiary level and students who selected non-computing majors. Internet availability in South Africa is potentially interesting, as it constitutes not simply an 'available technology', but may be an indicator of aspects such as technology skills, information resources, educational quality and socio-economic conditions.

A quantitative study was conducted with 1741 students as participants from three different departments in the School of IT at a university in South Africa. Students participated in a survey early in the academic year.

The findings show that lack of internet access homogenises students' career perceptions across the groups of majors. However, where students have internet access the views on career choices differ considerably between computing-majors and non-computing majors particularly in terms of views on the nature of work opportunities and of personal qualities of IT people. Also, a pronounced difference emerges in the perceptions of non-computing majors with and without internet access centering around views about the importance of sources of career information and around self-efficacy in the chosen career. Most importantly, the computing majors group is fairly homogeneous in terms of their perceptions regarding computer-related careers regardless of internet access.

Since similarities shared by these students evidently cannot be ascribed to internet access or even to the socio-economic and educational factors that make internet access possible, this research indicates that the influence of the internet on perceptions of career and consequently on career choice is complex with more diverse linkages to psychosocial factors than posited by the model of Adya and Kaiser.

Keywords: Computing major, IT career choice, self-efficacy, IT self-efficacy, internet access

Introduction

Declining student numbers after the dot-com disaster and gender discrepancy when young people choose IT careers are major concerns for tertiary institutions worldwide (for instance, Akbulut & Looney, 2009; Benokraitis, Shelton, Bizot, Brown & Martens, 2009; Beyer, 2008;

Slonim, Scully & McAllister, 2008). These enrolment-related crises have spawned a significant body of research related to selection of careers in information technology (IT) (these include Agosto, Gasson & Atwood, 2008; Alexander et al., 2011; Johnson, Stone & Phillips, 2008; Trauth, Quesenberry & Huang, 2009).

Internet connectivity as an available technology has also been shown to be a structural factor on career decisions in other studies (Bright, Pryor, Wilkenfeld & Earl, 2005). Its availability, in turn, increases students' experience with using computers, computer self-efficacy and confidence in their ability to succeed in an IT career, but for some South African students internet availability impacts negatively on their expectations of careers in IT and thus on decisions to study IT-related courses (Seymour, Hart, Haralambous, Natha & Weng, 2005).

This study builds on these earlier research findings by exploring the influence of first year students' internet access on values and perceptions pertaining to career including their IT self-efficacy and career expectations. These students have recently enrolled for various majors at tertiary level at a South African university. Because the authors are active in teaching computing courses at tertiary level, the research focused very specifically on a comparison of perceptions of students who have selected computing majors with those of non-computing majors. South Africa is in an interesting position as it is simultaneously a first world and a third world country and this is reflected in the unequal access to the internet that students entering university have had at school and at home. Exploring the influence of internet access on making informed career choices is of importance for various role players, such as South African educators who have to market computing degrees, technology providers and those responsible for governmental programmes focused on the provision of information infrastructure in support of an information society.

Theoretical point of departure

Our point of departure is primarily psychosocial – this means that we explicitly assume that career choice behaviour of an individual, results from the interaction between the individual ('self') and the individual's environment. The model of Adya and Kaiser (2005) is considered appropriate as it recognises these constructs and has as its focus specifically career choice in Information Technology. In this model, access to technology is explicitly specified as one of the structural factors influencing career choice and its relationship to other factors are specified.

Since we explore the influence of internet access on values and perceptions of careers, we use aspects of *individuality* and some *structural* factors as proposed by Adya and Kaiser. According to them "individuality" is the least mature construct and therefore the most malleable (Adya & Kaiser, 2005, p. 248). We use this opportunity to incorporate the major social cognitive concepts of self-efficacy and career expectations and perceptions as proposed by Bandura (Lent, Brown & Hackett, 1994). Lent et al. (1994) note that the focus of social cognitive theory, namely the role of self-referent thinking in guiding human motivation and behaviour, facilitates its application to a wide array of psychosocial domains. It addresses the limitations of the psychosocial view by providing insight into personal agency and dynamic aspects of the self-system (Lent et al., 1994).

The model of Adya and Kaiser

Numerous factors jointly influence the decisions made by young persons in selecting university courses and careers. These include social, structural, cultural/ethnic and individual factors (Adya

& Kaiser, 2005). The interactions between these are complex and an adaptation of the model by Adya and Kaiser is shown in Figure 1.

The Adya and Kaiser model postulates that both social and structural factors impact on career choice. Social factors (gender, media and significant role models) are mainly related to the people that influence a young person's perceptions. Structural factors relate mainly to institutional support related to career choice – these are largely linked to school-based support (e.g. teachers, availability of career counselling, type of school). Access to technology is considered a structural factor, and the model distinguishes between school and private access.

The model recognises the impact of individual differences and personality traits on career choice. Adya and Kaiser admit that individuality is a complex construct and that more work is needed to provide insight into its role in the choice of career. One of the intentions of this paper is to address this issue.

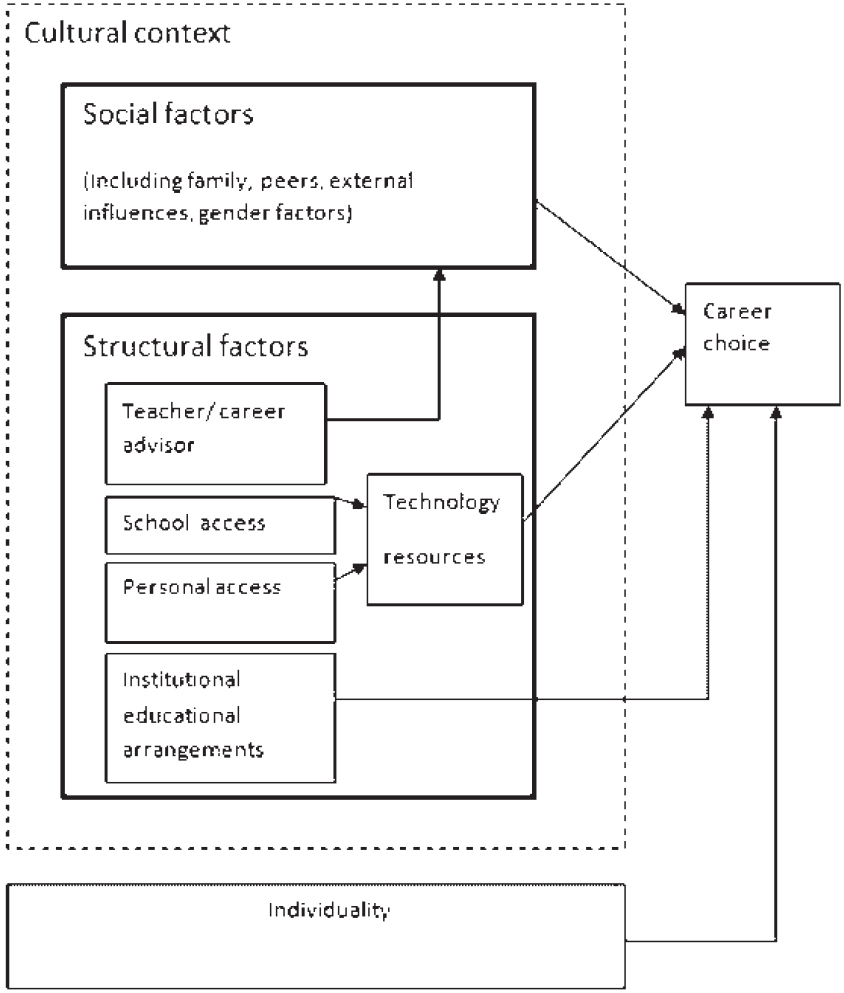

Figure 1: Career Choice model for computing students (Adapted from Adya and Kaiser, 2005)

Major social cognitive constructs

Expectations related to personal interest, potential remuneration and employment opportunities are significant in the selections of careers (Walstrom et al., 2008) even if the perceptions of the attributes of professions, such as job content and skills and qualifications required, may not be very realistic (Papastergiou, 2008).

Bandura, Barbaranelli, Caprara, and Pastorelli (2001) argue that the career choices and expectations of adolescents relate strongly to *self-efficacy*. Johnson, Stone and Phillips (2008) indicate a link between what they define as IT self-efficacy (a person's beliefs in his/her capacity to pursue a successful career in IT) and the intention to follow a career in IT. IT self-efficacy should be distinguished from computer self-efficacy (confidence in using IT). The distinction becomes meaningful in the South African context where it has been seen that students who have had limited exposure to computers nevertheless have *an interest in* computer-related careers (Bovée, Voogt & Meelissen, 2007). Some research indicates that ultimately high computer self-efficacy results in higher IT self-efficacy (Johnson et al., 2008; Papastergiou, 2008). Other research findings suggest that computer self-efficacy does not match actual computer skills, with most male students being over-optimistic about their own abilities (Hilberg & Meiselwitz, 2008). One would expect similar gendered tendencies related to IT self-efficacy.

Choice of major vs choice of career

There is a tendency to assume that the choice of major reflects the intended career at that time, in the words of Adya and Kaiser: "their course selections reflect their career orientation" (p. 231). However, Lent et al. (1994) argue quite clearly that career choices may change over time as self-efficacy changes since there are "dynamic interactions that occur between developing individuals and their changing contexts" (p. 82). The process of development and self-reflection is very likely to happen in the period between choosing university majors and graduating.

Many papers refer to the theory by Lent et al. (1994) as simultaneously and equally being applicable to choice of major and choice of career (the monograph itself in the abstract links these as "selection of academic and career choice options" and "performance and persistence in educational and occupational pursuits") but, whereas the theory is be applicable to both, this does not imply that the academic choices determine the career choice.

However there is some evidence that there is a link between choice of computing major and choice of career. For instance, Cohen and Parsotam (2010), working at a similar research university in South Africa, find that there is a "significant relationship between career intention and educational aspiration" (p. 61).

Recent large surveys among the ICT workforce give mixed results. Computing careers may be a special case with an unusually high intake of non-computing majors into the careerbut this certainly confirms the point that choice of major does not imply final career choice.E-Skills UK (2008) report that 55% of new management and senior professionals entering the ICT sector in the UK come from other occupations. However, there is conflicting evidence about the percentage of Computing Majors who do not take up computing careers. In the UK in 2004/2005, only 52% of those who had studied IT had entered the IT & Telecoms workforce within 6 months of graduating (e-Skills UK, 2008, p. 71). An extensive survey of graduates with ICT qualifications from a number of US universities in the period 1988 to 2001givesthe much lower figure of 16% for those who left the ICT sector (Wardell, Sawyer, Mitory & Reagor, 2006).

Johnson et al. (2008) make an explicit differentiation between IT self-efficacy as the belief in one's ability to succeed in an IT career, and computing self-efficacy as the belief in one's ability to use computers effectively. These authors then report unusually high IT self-efficacy amongst disadvantaged youth (African-Americans) but no translation into high employment in the IT sector. There have been similar findings among black South African school learners in South Africa (Jacobs & Sewry, 2009; Seymour et al., 2005).

There are, as illustrated above, flaws in the simple logical sequence demonstrated by the pipeline rationale, namely that there is a shortage of skilled people entering the ICT industry and thus issues regarding the recruitment of students into computing disciplines become a priority. Despite the fact that many students may review their career choices over time, it is not unreasonable to investigate choice of majors as a way of understanding students' current attitudes regarding future careers and the underlying influences on these attitudes.

Potential impact of Internet access in the South African context

In the South African context, we consider 'being connected' as having relevance in four main ways, namely, connectivity as a source of technology skills development; the internet as an information source regarding potential careers; the internet as an indicator of quality of schooling; the internet as an indicator of socio-economic conditions. Each of these is discussed briefly.

Skills development

Internet use and technological 'familiarity' are not necessarily similar (Lang, 2007). However, the development of skills in 'playing with' the technology has been found to lead to increased self-efficacy and positive attitudes towards technology and the manner in which technology is used at home is significant in terms of influencing perceptions, attitudes and expectations related to careers in technology (Adya & Kaiser, 2005).

Internet as an information source

Lomerson and Pollacia (2006) suggest that one of the main influences on adolescents' choice of IT careers relates to the accessibility, or lack thereof, to information about these careers. Clearly, access to information on the internet has the potential to address this challenge.

Internet as an indicator of education quality

The infrastructure in South African schools, including the availability of computers and telecommunications, plays a role in the quality of educational outcomes achieved (Bhorat & Oosthuyzen, 2008). As the availability of the internet presupposes access to both computers and telecommunications, the presence or absence of the internet could indicate the quality of education which a school provides and may potentially be an indication of the quality of other structural resources at the school.

Internet and socio-economic conditions

Research has shown a link between socio-economic conditions and the likelihood of internet use with students from households with low family incomes being less likely to use the internet

(Debell, 2006). In a country like South Africa where large parts of the population (especially in rural areas) are socio-economically disadvantaged this potential low use of the internet is a considerable concern. We are therefore aware that absence of the internet at both school and home may indicate underlying poor socio-economic conditions.

Research objective

The two main components of the theoretical basis for this paper are firstly the model of Adya and Kaiser (investigating the proposed link between internet access and career choice by looking at sources of advice as structural factor and perceptions of personal qualities of IT people as individual factor) and secondly the major social cognitive concepts of self-efficacy and expected outcomes of careers. The latter intends to expand the individuality construct of the Adya and Kaiser model.

Our research objective is therefore to investigate the relationship between access to the internet, the major chosen (the two groups referred to above) and (1) Perceptions regarding the importance of sources of advice; (2) Self-efficacy in terms of the chosen major and by assumption career choice; (3) computer self-efficacy; (4) expected outcomes and rewards in a proposed career; (5) perceptions of personal qualities of people working in IT.

Research method

Questionnaires

A survey for data collection and statistical analysis was considered appropriate in answering the research questions as a large sample of students could be accessed early in 2009. The research was conducted in the first two weeks of the first semester. Research on career choice predominantly uses quantitative data obtained from questionnaires that is analysed statistically (Akbulut & Looney, 2009; Beyer, 2008; Seymour et al., 2005) and this study follows the same approach.

Sample

The 1741 students in the sample were taking introductory IT courses in three different departments in the School of IT at a research-based university in South Africa, namely the Computer Science, Information Science, Information Systems departments and students in an extended programme who did not meet the full entry requirements but would like to take Computer Science (Table 1). We distinguish between those who study computing-majors (CM) and those studying other majors (O). The latter group are required to enrol for one or two computing courses as a compulsory component of their degree programme.

This research is considered exploratory and does not claim to be generalizable to all South African universities. However the diversity of academic backgrounds (different computing degrees being studied) is believed to be valuable as it gives the broad picture regarding students intending to take up careers in the ICT sector. Different lecturers used different strategies for eliciting responses as circumstances differed. This resulted in return percentages varying from 13% in one class to 100% in another with an overall response rate of 60% (Table 1). This variation in response rate is acknowledged as a limitation.

Table 1: Demographic information per class surveyed

Department	Number of responses by gender		Number of responses by major At home and school Neither		Internet access		Registered students	Response rate (%)
	M	F	CM	O				
Information Systems	567	701	106	1162	49%	18%	1642	77.2
Information Science	136	133	146	123	29%	24%	269	100.0
Extended Programme	57	21	78	0	28%	38%	85	91.8
Computer Science	80	39	75	44	32%	34%	886	13.4
Total	840	894	405	1329	44%	21%		60.2

The full set of questions was based on previously published sets in research on factors affecting career choice (Beyer, 2008; Seymour et al., 2005; Walstrom et al., 2008). Questions were asked about sources of career advice, self-efficacy and perceptions of working life. Students were asked to indicate either how important a factor was in selecting a career and the related university course, or a level of agreement with a statement. The scales had six as 'most important' or 'in complete agreement'; one as 'least important' or 'in total disagreement' and zero for "Do not know or have not really thought about it". These were subsequently reduced to three categories (low, medium and high). Option zero was ignored in the analyses.

Analysis method

For the purposes of this exploratory study we have grouped together reported access to the internet at school and at home, recognising that the nature of interaction with the internet may differ considerably in both environments.

The data was analysed using SPSS under the guidance of a senior statistics consultant.

The interpretation of results was based on two analyses for each question looking at the competing influences between access to the internet, the major chosen and a number of sets of questions. In the first Pearson Chi-Square analysis the data was split according to major and then analysed as a Crosstab of individual questions versus internet Access. The second Pearson Chi-Square analysis reversed this by splitting the data according to internet access and then analysing the groups in terms of major. For example, CM(A) vs. CM(D) means that 'advantaged' CM students were compared with 'disadvantaged' CM students. Few cells had low cell occupancy values meaning that the analysis method is acceptable.

Cramer's V was also calculated for every analysis as a measure of association and in order to check effect size. The relatively large number of students in the sample that are categorised as O(A) (other major with internet access) means that relying on significant difference alone is unwise. In the results, * shows a significant difference with $p < 0.05$; LM indicates size effect with Cramers' $V > 0.15$ but less than 0.2; M indicates size effect with Cramers' $V > 0.2$.

Cronbach's Alpha was calculated for the grouped questions (questions were grouped according to content) and was in all cases greater than 0.6 showing that these data sets were all reliable and consistent. The further analysis was done by looking at the number of significant differences in sets of data (for the group of questions).

The results are analysed by looking at the number of significant differences and number of moderate size effects for each of the four comparisons undertaken within groups of questions. Our intention is to identify a pattern which would indicate how similar or different the groups are. This is not a form of analysis that has been found in the literature but is being proposed as an intuitive way of identifying group similarity.

Degree of acquiescence

Table 2 shows the degree of acquiescence of the groups using a 'positivity score' which was calculated[1] across all the questions asked during the survey by weighting the positive responses more heavily than the relatively negative responses. The students with no access to internet at school, which we consider to be 'disadvantaged', can be seen to have been inclined to agree more strongly with statements than either of the advantaged groups indicating the eagerness of the 'disadvantaged' group. This is an important finding and will undoubtedly be reflected in the results but we have not adjusted the results to correct for this. The analysis compares the number of significant differences for different sets of questions rather than for individual questions and seeks to identify reasons for the differences between question sets rather than claiming to find reasons for the responses to individual questions.

Table 2: Positivity score by Internet access

Positivity Score	
Internet (at either home or school)	191
Internet (at both home & school)	187
Internet (at neither home nor school)	238

Results of the survey

General

As reflected in Table 3, 757 students reported that they had internet access at both home and school and 358 that they did not have access at either of these locations. We refer to these as A (indicating advantaged) and D (disadvantaged) students. Students, who had access at one or the other of the locations, have been excluded in order to sharpen the divide. As can be seen in Table 3, a smaller percentage of other (O) students (19%) had no access to the internet during their final year at school than CM students (26%).

Table 3: Internet access by major

Internet Access At	Both (Advantaged)		Neither (Disadvantaged)		One		Total
	n	%	n	%	n	%	
CM	142 CM(A)	35.1%	105 CM(D)	25.9%	158	39.0%	405
O	615 O(A)	46.0%	253 O(D)	18.9%	468	35.0%	1336
All	757	43.5%	358	20.6%	626	36.0%	1741

Importance of sources of career advice

Table 4 summarises students' perceptions of the importance of several sources of career advice. For each item, the table present measures of association (p-values) between the perceptions of two groups of students, together with statistically significant differences (p< 0.05) and size effect. As will be seen in Table 4 (and subsequent tables), moderate and even lower moderate size effect was not always evident even when a significant difference is reported. The analysis that follows relies heavily on significant difference rather than size effect.

Table 4: Perceptions of importance of sources of career advice compared by student group

Source of career advice	p-values for:			
	CM(A) vs. CM(D)	O(A) vs. O(D)	CM(A) vs. O(A)	CM(D) vs. O(D)
Advice of University Student Advisors	0.011* M	0.000* LM	0.000* LM	0.000* M
Advice at Open Day at university	0.234	0.001*	0.758	0.205
A counselling centre, career tests or assessment not attached to school or university	0.655	0.743	0.015*	0.095
Career guidance teacher at school	0.001* M	0.000* M	0.053	0.335
Other teachers at school	0.008* M	0.000* LM	0.464	0.604
Professor(s) at university	0.244	0.264	0.114	0.429
Advertisements or articles in newspapers, magazines or the Internet	0.128	0.000* M	0.279	0.118
Parents	0.169	0.006*	0.019*	0.463
Older brother or sister	0.135	0.265	0.093	0.788
Friend or family member who works in a similar career	0.409	0.198	0.001*	0.022*LM
Number of questions with a significant different p < 0.05	3	6	4	2

There were few significant differences in terms of major for the D students (shown in Table 4 as CM(D) vs. O(D)) as p > 0.05 in all but two questions. This is interpreted to mean that disadvantage is a binding factor. In contrast, there was a greater variety in responses to these questions between CM(A) and O(A) students with p<0.05 for four questions.

The largest number of sources of advice that were valued significantly differently was seen between the O(A) and O(D) subgroups (six). This shows that advantage influences the way that this diverse group (O) values sources of advice.

In comparison with the O group, the CM group was in greater agreement regarding sources of advice. However, in the case of sources at school (both career guidance and other teachers) differences between the two CM subgroups were significant. The responses showed that the 'disadvantaged' CM students valued input from their teachers more[2] than the 'advantaged' CM students did which is in line with the general positivity score in Table 3.

Self-efficacy for chosen career

Table 5: Perceptions of importance of self-efficacy compared by student group

Aspects of self-efficacy in deciding on a career and choice of degree courses.	p-values for:			
	CM(A) vs. CM(D)	O(A) vs. O(D)	CM(A) vs. O(A)	CM(D) vs. O(D)
Difficulty of subject matter – difficult for most people	0.192	0.046*	0.035*	0.397
Ease of subject matter – easy for me	0.078 LM	0.010*	0.065	0.437
Performance in High School subject matter courses	0.274	0.021*	0.005*	0.037*
Performance in university subject matter courses	0.156	0.002*	0.151	0.120
No of questions with a significant different $p < 0.05$	0	4	2	1

Table 5 shows p-values for the set of questions on self-efficacy (related to the chosen career and not to Information Technology) which had the most marked differences between the analyses, with O(A) vs. O(D) giving p values < 0.05 for **all** four questions and CM(A) vs. CM(D) significantly different for **no** questions. Size effect was less than 0.15 in all cases.

'O' students varied greatly in terms self-efficacy depending on whether they were 'advantaged' or 'disadvantaged'. This is similar to the finding in the earlier career advice analysis. In contrast, the A and D subgroups within the CM group varied very little. This could mean that CM students have surmounted issues of advantage or that only those who can surmount advantage will consider computing. This similarity between the subgroups corresponds with the finding reported for the career advice analysis above. For this set of questions, the D students were similar regardless of major selected, again confirming the results reported in the career advice analysis above.

Computer self-efficacy

Student perceptions on their computer self-efficacy are presented in Table 6.

Table 6: Perceptions of importance of computer self-efficacy compared by student group

Aspects of computer self-efficacy	p-values for:			
	CM(A) vs. CM(D)	O(A) vs. O(D)	CM(A) vs. O(A)	CM(D) vs. O(D)
I have lots of self-confidence in working with computers	0.30	0.00*	0.00* LM	0.00* M
Confident I could teach someone to use a software package	0.00* M	0.00*	0.00* M	0.00* M
No of questions with a significant different $p < 0.05$	1	2	2	2

Significant differences were obtained in all the comparisons **except** for the more general question regarding the computer self-efficacy of CMs, where both CM(A) and CM(D) were confident of their abilities (Table 6).This gives some evidence that disadvantage in terms of Internet access does not affect CM students when they assess their basic ability to use and study computers. In contrast O(D) students are more unsure of computer self-efficacy than O(A) students although there is low size effect. Since this finding is based on a single question it needs to be treated cautiously.

As might be expected, both subgroups of CM students were more confident than the corresponding O subgroups.

Perception of work opportunities in selected career

Table 7 presents the p-values for students' views on their chosen careers (not necessarily careers in computing) comparing two groups each time. In general the students' opinions were similar depending on major and internet access did not seem to have much influence. This table had few meaningful size effects compared with the reported number of significant differences.

Table 7: Perceptions of importance of work opportunities compared by student group

Aspects of future work	p-values for:			
	CM(A) vs. CM(D)	O(A) vs. O(D)	CM(A) vs. O(A)	CM(D) vs. O(D)
A flexible work schedule	0.179	0.000*	0.04*	0.491
Job security	0.945	0.785	0.000*	0.035*
Good prospects for a better than average starting salary	0.950	0.587	0.010*	0.143
Good prospects in obtaining a first job without any prior experience	0.098	0.232	0.085	0.091
A good image / status in the chosen profession	0.490	0.236	0.086	0.080
Opportunities to work overseas	0.290	0.604	0.006*	0.064
Opportunities to work in different kinds of businesses	0.044*	0.175	0.001*	0.037*
Good prospects for promotion and professional development	0.298	0.167	0.000* M	0.001* M
Different tasks at different times (variety)	0.710	0.000*	0.061	0.142
Good long-term salary prospects	0.778	0.271	0.000*	0.023*
A stable career with fairly guaranteed employment no matter what the general economic climate	0.869	0.064	0.000*	0.017*
No of questions with a significant different p < 0.05	1	2	8	5

Once again there were very few significant differences between the advantaged and disadvantaged CMs i.e. CM(A) vs. CM(D). The two subgroups in the non-computing majors O(A) and O(D) are also generally in agreement. However, among the advantaged students i.e. CM(A) vs. O(A), those taking a CM have significantly different views about their proposed careers from the rest of the students.

This table had few meaningful size effects compared with the reported number of significant differences. Table 8 presents the p-values for students' views on the qualities of IT people comparing two groups each time for each question.

Table 8: Perceptions of personal qualities of IT people compared by student group

	p-values for:			
Aspects of personal qualities of IT workers	**CM(A) vs. CM(D)**	**O(A) vs. O(D)**	**CM(A) vs. O(A)**	**CM(D) vs. O(D)**
Considering a job where they work with people as important	0.000* M	0.083	0.000* M	0.542
Considering Information Systems / Informatics careers as allowing one to help people	0.046*	0.003*	0.002*	0.424
IT workers are hard working	0.006* M	0.026*	0.767	0.002* M
IT workers are interesting	0.024*	0.000*	0.000*	0.004*
IT workers enjoying socialising	0.098	0.000*	0.014*	0.137
IT workers enjoy being around other people	0.018*	0.091	0.003*	0.044*
No of questions with a significant different p < 0.05	5	4	5	3

There is more inconsistency in all columns of the question set shown in Table 8 than in previous sets. An anomaly can be noted for the question regarding how hard working IT students are: The CM(A) and O(A) students are in agreement whereas the other three analyses show disparate views. In all other analyses these two subgroups were most likely to *disagree*.

All four analyses show disagreement between the groups being compared regarding how interesting computer people are.

Discussion

Table 9: Number of significant differences reported in each set of questions with number of size effects (phi > 0.15) in brackets

	CM(A) vs. CM(D)	**O(A) vs. O(D)**	**CM(A) vs. O(A)**	**CM(D) vs. O(D)**
Importance of source of career advice (max=10)	3 (3)	6 (4)	4 (1)	2 (2)
Self-efficacy for chosen career (max=4)	0 (1)	4 (0)	2 (0)	1(0)
Computer Self-efficacy (max=2)	1 (1)	2 (0)	2 (2)	2 (2)
Work opportunities in selected career (max=11)	1 (0)	2 (0)	8 (1)	5 (1)
Personal qualities for IT people (max=6)	5 (2)	4 (0)	5 (1)	3 (1)
TOTAL (max=33)	10 (7)	18 (4)	21 (5)	13 (6)

Table 9 has been compiled from the last row from each of Tables 4 to 8. As can be seen a pattern emerges when we look at the number of significant differences resulting from the individual CrossTabs Pearson Chi-Square analyses.

According to column 1, Table 9, the CMs have the lowest number of significant differences, namely 10 but mainly moderate size effects for those same questions indicating that where there are differences they are meaningful.

According to column 3, Table 9, the 'advantaged' students are by no means a homogeneous group in terms of the values and perceptions discussed in this paper. There were 21 questions where the two A groups were significantly different. However, these differences are not often reflected in the size effect. The different understandings about careers emerged particularly with respect to perception of work opportunities in their own selected career and of the personal qualities of IT workers. Thus, even when their backgrounds are similar (as measured in terms of Internet access but with the implications of better secondary school education and more privileged homes) 'advantaged' students from different disciplines differ regarding their expectations of future careers. Hence, although the structural factor of Internet access may be relevant it is not of such great importance that it can negate all the other differences. And since A and D computing majors are apparently similar, all computing majors differ from advantaged others in this respect.

According to column 4, Table 9, however, if we look at only D students the number of differences is smaller than between the A students – only 13 versus 21.

Lastly, according to column 2, Table 9, the two subgroups of non-CMs (O(A) vs. O(D)) differ significantly on 18 questions. As noted above, this is a contrast with the CM subgroups that are rather similar. Hence, the two subgroups of students who register for 'O' degrees do not 'fit' into a particular profile. Note, the group covers a wide choice of degrees but this variety is present in both the O(A) and O(D) subgroups. There is a noticeable difference between the way 'advantaged' non-CMs look at future careers and the way their 'disadvantaged' classmates look at these issues. In two of the sets of questions, 'Importance of source of career advice' and 'Career chosen self-efficacy' the results of the analyses were most varied.

The findings show that the views on computing-related careers vary least between computing-major students with or without previous internet access. This important finding may be explained in several ways. Firstly, the D students registering for CM may have found ways of compensating for the lack of Internet access (and other associated factors like under-resourced schooling and less favourable socio-economic conditions at home) and are in fact better at doing so than the O(D) students. Furthermore, once they have overcome these practical barriers, their values and perceptions (i.e. perception about the importance of source of career advice, self-efficacy for chosen career and computer skills, and perceptions of work opportunities in envisaged career) align quite closely with the students who have a better resourced background. Alternatively, only those students who can overcome these obstacles register for CMs. Thirdly, the values of CMs do not appear to be influenced by issues of advantage or disadvantage, but may be inherent, or be dependent on other, non-structural factors.

Beyer (2008) found more intra-gender differences (that is, more differences between female students taking computing majors and non-computing majors) than inter-gender differences (differences between male and females taking computing majors). Our results confirm those of Beyer in that they also show relatively few differences within the group of CM students where the other factor is Internet access and not gender.

Limitations in the research are acknowledged. The technology access at home vs. at school as defined by the Adya and Kaiser model should preferably be expanded in the South African context to include other potential sources of Internet access, such as a telecentre, or via mobile phone. Also, the study did not attempt to relate access to internet to the availability of other technologies, nor did it probe the extent of usage of internet or computers by respondents.

Conclusions and recommendations

This research has highlighted the possibility that students electing to take computer-majors are a fairly homogeneous group in terms of psycho-social and social cognitive factors related to the values and perceptions about careers which we examined. This is in contrast with the other students taking the first year course introducing computer concepts who are not majoring in computer-related courses. As discussed above, the underlying reasons for the similarities do not appear to have to do with internet access or even with the socio-economic and educational factors that make internet access possible.

Our findings highlight some shortcomings in the model of Adya and Kaiser. Firstly the relationship between internet access and other structural and individual factors as well as the socio-cultural context of the student needs to be more carefully understood. Secondly, the 'individuality' construct and the 'structural' construct are clearly not independent as currently proposed by Adya and Kaiser and its relationship needs to be investigated. In addition, with the advent of mobile technologies, the distinction made by Adya and Kaiser in terms of availability of internet at school and at home needs to be reconsidered in terms of the potential ubiquitous availability of internet, which is relevant especially in Africa.

We would therefore argue for viewing internet access as a complex socio-technical phenomenon rather than simply as a factor; and that developing an explanation of its linkages to psychosocial factors in career choice may offer more promising avenues in understanding its influence on career choice of students. Unravelling this complex set of relationships becomes relevant to the way that tertiary institutions use the internet to market computing courses to school learners, and government programmes to provide internet connectivity to especially disadvantaged communities. Given the high costs involved in such initiatives, it is quite important to maximise the potential impact of information provided via internet.

The research leads to another set of questions. How do students who select computer courses overcome their structural and socio-economic challenges as is evident in the fact that about 25% of computing majors had no internet access in their final year at school. Secondly, are others excluded by these challenges? An unknown number of students, who might turn out to be successful computing majors, may not be attempting the courses because of the barriers. This is an important issue that needs to be investigated. An in-depth exploration of the potential explanations offered as part of the discussion section holds potential provide valuable insights into the dynamics involved in selecting CM, especially in environments where O(A) vs. O(D) is a significant distinction (e.g. in developing countries in Africa and elsewhere).

End notes

1. A positivity score is calculated for each of the three groups. The positivity score = $\sum in_i$ where i represents the Likert scale options (values from 1 to 6) and n_I is the number of responses selecting option i across all questions in the survey per group. Choice of option zero was not taken into account as these are ignored in the analyses.

2. The table does not indicate the direction of the association as only p-values are presented but the data supports this claim.

References

Adya, M., & Kaiser, K. M. (2005). Early determinants of women in the IT workforce: a model of girls' career choices. *Information Technology & People, 18*(3), 230–259.

Agosto, D. E., Gasson, S., & Atwood, M. (2008). Changing mental models of the IT professions: A theoretical framework. *Journal of Information Technology Education, 7*, 205–221.

Akbulut, A. Y., & Looney, C. A. (2009). Improving IS student enrolments: Understanding the effects of IT sophistication in introductory IS courses. *Journal of Information Technology Education, 8*, 87–100.

Alexander, P., Holmner, M., Lotriet, H., Matthee, M., Pieterse, V., Naidoo, S., Twinomurinzi, H., & Jordaan, D. (2011). Factors affecting career choice: Comparison between students from computer and other disciplines. *Journal of Science Education and Technology, 20(3)*, 300–315.

Bandura, A., Barbaranelli, C., Caprara, G. V., & Pastorelli, C. (2001). Self-Efficacy beliefs as shapers of children's aspirations and career trajectories. *Child Development, 72*(1), 187–206.

Benokraitis, V. J., Shelton, R. D., Bizot, B., Brown, R., & Martens, J. (2009). Reasons for CS decline: Preliminary evidence. *Journal of Computing Sciences in Colleges, 24*(3), 161–162.

Beyer, S. (2008). Gender differences and intra-gender differences amongst Management Information Systems students. *Journal of Information Systems Education, 19*(3), 301–310.

Bhorat, H., & Oosthuyzen, M. (2008). Determinants of Grade 12 pass rates in the post-Apartheid South African schooling system. *Journal of African Economies, 18*(4), 634–666.

Bovée, C., Voogt, J., & Meelissen, M. (2007). Computer attitudes of primary and secondary students in South Africa. *Computers in Human Behaviour, 23*, 1762–1776.

Bright, J. E. H., Pryor, R. E. G., Wilkenfeld, S., & Earl, J. (2005). The role of social context and serendipitous events in career decision making. *International Journal for Educational and Vocational Guidance, 5*, 19–36.

Cohen, J. F., & Parsotam, P. (2010). *Intentions to Pursue a Career in Information Systems and Technology: An Empirical Study of South African Students*. Paper presented at the KCKS 2010, IFIP AICT. 56–66.

Debell, M. A. C. C. (2006). *Computer and Internet use by students in 2003.* US Department of Education: Institute of Education Sciences.

e-Skills UK. (2008). Technology counts: IT & telecoms insights 2008. Retrieved 2011/07/18, from http://www nwua.ac.uk/HLSP/docs/eskillsUK_TechnologyCounts.pdf

Hilberg, J. S., & Meiselwitz, G. (2008). *Undergraduate fluency with Information and Communication Technology: Perceptions and Reality.* Paper presented at the SIGITE '08, Cincinnati, Ohio, USA. 5–9.

Jacobs, C., & Sewry, D. A. (2009). Learner Inclinations to Study Computer Science or Information Systems at Tertiary Level. *South African Computer Journal, 44*, 85–91.

Johnson, R. D., Stone, D. L., & Phillips, T. N. (2008). Relations among ethnicity, gender, beliefs, attitudes, and intention to pursue a career in Information Technology. *Journal of Applied Social Psychology, 38*(4), 999–1022.

Lang, C. (2007). Twenty-first century Australian women and IT: Exercising the power of choice. *Computer Science Education, 17*(3), 215–226.

Lent, R. W., Brown, S. D., & Hackett, G. (1994). Towards a unifying Social Cognitive Theory of career and academic interest, choice, and performance. *Journal of Vocational Behavior, 45*, 79–122.

Lomerson, W. L., & Pollacia, L. F. (2006). Declining CIS enrolment: An examination of pre-college factors. *Information Systems Education Journal, 4*, 3–13.

Papastergiou, M. (2008). Are computer science and information technology still masculine fields? High school students' perceptions and career choices. *Computers & Education, 51* 594–608.

Seymour, L., Hart, M., Haralambous, P., Natha, T., & Weng, C.-W. (2005). Inclination of scholars to major in Information Systems or Computer Science. *South African Computer Journal, 35*, 97–106.

Slonim, J., Scully, S., & McAllister, M. (2008). Crossroads for Canadian CS enrolment. *Communications of the ACM, 51*(10), 66–70.

Trauth, E. M., Quesenberry, J. L., & Huang, H. (2009). Retaining women in the U.S. IT workforce: theorizing the influence of organizational factors. *European Journal of Information Systems, 18*, 476–497.

Wardell, M., Sawyer, S., Mitory, J., & Reagor, S. (2006). Gender and IT professionals in the United States: A survey of college graduates. *Labour & Industry, 16*(3), 39–58.