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In this issue:

Identifying Influencers in High School Student ICT Career Choice

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The Key Influencers in High School Student ICT Career Choice

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Abstract

This paper examines the role of influencers in Canadian high school student decisions to pursue Information and Communications Technology (ICT) careers and education. With growing rates of retirements of ICT workers expected over the next 10-15 years and continued projections of staff or skills shortages, industry representatives are concerned that the shortfall in replacement workers will have a significant detrimental impact on business. Various authors and panels have cited the need to attract more high school students to enroll in ICT post secondary programs. However, what is not clear is how or why students make decisions to pursue ICT in university and as a career. This paper examines the various influencers that affect students' decisions to choose an ICT education and career. As part of an ongoing program this paper presents the results of three surveys -- with responses from 111 Canadian guidance counsellors, 141 ICT university students and 1335 first year business and IT management students. The survey findings suggest that parents are the strongest influencers and guidance counsellors are the weakest influencers. To achieve any significant improvement in the numbers of students choosing ICT careers, it is recommended that ICT industry representatives must speak directly with students and their parents. The survey results do suggest that students are attracted by the relatively high income potential of ICT careers and the entry to a business environment that ICT skills provide. Further, guidance counsellors see math and science subjects as much more important for success in an ICT career than do students.

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1. INTRODUCTION

Over the last 20 years, the Information and Communications Technology (ICT) industry and related academic programs have seen both a dramatic increase and then a dramatic decrease in new entrants. From the early 1990s into the start of the new millennium, students flocked to ICT programs and to opportunities within the industry. This rush of interest peaked in approximately 2001. With the economic downturn of 2002, exacerbated by 9/11 and the growing offshore outsourcing of ICT, the technology bubble burst. The fall-off in ICT enrollments and career interests has been more dramatic than the earlier growth. In addition, a long-established trend of declining female participation continues. This roller-coaster of interest has been well documented in both academic and trade journals. What is less clear is how to re-encourage the young students of today to consider a career in ICT.

The fall-off in ICT post-secondary program enrollments has become an important societal issue. In Canada and the USA, the ICT working population will soon face a sig-

nificant decline as Baby-Boom generation workers begin to retire over the next 10 to 15 years. Both industry and government have recognized the impact of this impending departure. Businesses that rely on ICT skills to build, maintain and operate information systems and technology will need to replace these knowledge workers. At the same time, the usage of ICT continues to grow in commercial and personal use, as technology continues to become more affordable and reliable. ICT jobs, especially those related to the business application of ICT (such as business analyst and project manager) are predicted to be in high demand in the US and in Canada for the next decade and beyond (Ticoll, 2007).

The Canadian government's Information Communications and Technology Council (ICTC) has frequently cited the need to encourage students to enter the ICT careers, especially given the expected 'Boomer' retirements. David Ticoll (2007, p. 1) points out that "the [ICT] labour market is tightening, and employers are having trouble finding people they need", as he describes the ongoing talent shortage and the global war for talent as ICT "innovation, persuasiveness and cost-performance continue to accelerate, becoming even more integral to life and work". Ticoll (2008, p. 3) further reports that "unemployment among those in ICT occupations is 2%, which signifies a labour market under pressure." Slonim (2008) comments that the Canadian ICT workforce will grow from 600,000 positions in 2007, by another 60,000 by 2010. Combined with retirements, and other exits, this growth will generate a need for 89,000 new ICT professionals. Given that the number of Canadian university computer science enrollments was 22,000 in 2006, and the combined number of graduate and undergraduate degrees conferred annually is about 3,500, clearly there will continue to be a significant gap between supply and demand for newly educated ICT resources. As the Ticoll (2008, p. 3) reports, "Many organizations can't find the ICT professionals they need and say this is hurting their ability to deliver projects and provide services."

The ICT industry is taking steps to highlight and resolve this growing gap. In Canada, a recently formed ICT industry coalition has focused on the issue of declining numbers of skilled workers. Members of the coalition represent over 40 major employers of ICT resources. In a recent speech to an industry audience, coalition chair Stephane Boisvert described the gap of 89,000 positions, and stated: "this IT talent gap represents Canada's greatest human capital challenge" and in the next three to five years "the total cost of not filling those positions would surpass $10 billion." (Boisvert, 2008) In a recent advocacy paper the CIO Association of Canada has also recognized this talent gap calling for a multi-pronged program to "communicate information about IT's changing role and about IT's emerging career and education opportunities". Similarly, the US based Society for Information Management (SIM) conducted a study of Information Technology Workforce Trends and Implications, concluding that more organizations are increasing their IT staffs, with a shift from technical to project management and business skills (Zweig, 2006, p. 48). And as McInerney et al. (2006, p. 51) suggest: "The shortage of IT workers presents a dire need of the U.S. in an era when technology is ubiquitous" yet students are "misinformed about the opportunities available in IT fields, about salaries and about certain business practices, such as outsourcing."

The authors' university has seen a steady decline in the number of IS students--about 25% over three years--while the interest in business programs and the university enrollment in general has grown by 20-30% in the same time frame. Others have reported similar drops, such as Hirschheim (2008) who cites enrollment declines of 18%, 23%, and Granger, et al. (2007, p. 304) who suggest that current enrollments are lower than the mid-90s prior to the internet and the dot-com build-up. Similarly, McInerney et al. (2006, p. 35) cite declining IT student enrollments and a drop in computer science doctorates to the lowest levels in 12 years. Writing for the Conference Board of Canada, Gagnon (2005, p. 2) cited three-year declines, on average, of 50% in post-secondary ICT programs.

It is particularly ironic that the projected shortfalls are greatest in those jobs that require good interpersonal and business skills as well as solid ICT skills (such as business analysts and project managers) since, as will be discussed below, one of the reasons cited for reduced interest in ICT careers is the

perceived "nerdiness" and solitary nature of ICT work.

In summary, the issue of declining enrollment in ICT programs and the current and forecasted shortfall in employable resources is a serious challenge to industry and society in this information age.

2. REVIEW OF RELATED LITERATURE

Declining IS Enrollment and Potential Solutions

Much has been written in the last few years in both academic journals and the trade press, about how "a generation has been dissuaded from pursuing what is in reality a very promising career choice." (Mitchell, 2006, p. 32)

Many researchers and industry observers have postulated and examined reasons why students have avoided programs and careers in ICT. At the AMCIS 2007 conference, a panel discussed reasons why "Suddenly, within a year or two, enrollments decreased by as much as 70-80 percent throughout the world." (Granger, 2007b, p. 649) Panel members suggested that students and their parents perceive that there are no jobs in IS, and perhaps that the IS major is too difficult. The IS workers are often cited as "geeky" and "nerdy" or as a Fortune article unflatteringly described as "Dilbertesque drones writing code in cubicles and Third World masses working for pennies an hour." (Colvin, 2007)

Another area often criticized is the traditional IS curriculum with an emphasis on technical issues and software coding. Young entrants to IS university programs have a lifelong history of information technology usage and tend to view technology as well understood devices to be used rather than programmed. Indeed, Nicholas Carr's Harvard Business Review article "IT Doesn't Matter" (2003) has given some support to the students' reluctance to learn the detailed technical issues of the traditional curriculum. Add to that a view from employers that "interpersonal communications, integration, management and project management skills" are more valued than programming skills; "programming is not in the top 15 skills industry is seeking from IS graduates." (Granger, 2007b, p. 655), and the SIM research finding that there is "a shift in the mission of the information systems function from delivering technology-based solutions to *managing the process* of delivering solutions." (Zweig, 2006, p. 48)

Several authors have suggested a breadth of solutions to reverse the declining enrollment. Some, such as Granger et al. (2007, p. 308) have suggested marketing and outreach programs working with industry and professional associations. For example, "Society of Information Management (SIM), IBM and Microsoft have programs targeted at creating a more positive image of IS positions and opportunities." The University of Georgia IS Program has put advertising on buses with smiling IS students, distributed IS T-shirts printed with "5 Reasons to be an IS Major" and has published articles in the student newspaper. Brookshire (2006) advocates using a multimedia dynamic website with an easy to remember domain name as the hub of the outreach efforts, rather than the traditional two-color tri-fold text based flyer. In Canada, the CIO Association of Canada sponsors a program where industry representatives visit high schools and speak to interested students about careers in ICT.

A number of authors have suggested curriculum revisions and support as key components to retaining IS students. Brookshire (2006) and Granger et al. (2007) recommend putting the excellent teachers into the introductory classes to attract and retain the incoming students, using engaging hands-on technology. Akbulut et al. (2008, p. 85) have suggested instrumental assistance (i.e. informal pedagogical support to help students outside of the classroom).

Influencing Students on Career Directions and Programs

Given the precipitous decline of students in the last five years the conundrum of IS enrollments has initiated a spate of research and recent articles. However, the broader topic of how high school students choose a post-secondary program and a career direction rests on a much longer history of research. Paa and McWhirter (2000, p. 30) for example cite Farmer's research program in the 1980s and 1990s which proposed a model demonstrating how background, personal and environmental variables establish

adolescent career motivation. Paa and McWhirter further cite a concept well developed by theorists of "(r)ole models or key figures in the immediate environment of young people [who are viewed as] important influencers on young people's career development." Regarding these role model influencers, Alexitch at al. (2004, p. 142) found that "parents and friends were rated as more important influencers on student decisions than either high school teachers or guidance counsellors." In the Alexitch et al. sample, only 45% of students reported that they had met with a guidance counsellor to discuss post-secondary options.

3. RESEARCH TOPIC AND METHODOLOGY

With a clearly defined societal problem and a marshalling of government and industry resources, a new research question begins to emerge: how should ICT representatives from industry and academia influence high school students to pursue education and a career in ICT? While other avenues for fulfilling the ICT resource demand deficit are available (e.g. immigration, temporary visas and outsourcing/offshoring), this research focuses on the factors that influence the supply of students and potential employees through the high school and post-secondary education system.

Several authors (McInerney et al., 2006, p. 50; Granger et al., 2007, p. 654) have suggested working with high school counsellors and teachers. Based on the literature review and on discussions with industry representatives, two research questions were developed, each with a focus on the role of the guidance counsellor:

1) Several groups, including guidance counsellors, teachers, peers and parents will influence students to pursue ICT studies. What role will guidance counsellors play in influencing students to pursue ICT careers?

2) What are the expectations of guidance counsellors regarding math and sciences as pre-requisites for ICT programs and careers, and are these expectations reasonable?

Zhang (2007, p. 448) has suggested that the Theory of Reasoned Action (TRA) can be used to understand how students choose an IS major. Student "attitudes are based on their evaluations of all possible outcomes resulting from choosing an IS major, and the social pressures resulting from the salient referents' opinions on whether they should major in IS." Zhang concludes that students prefer majors that have more job opportunities, that are easier to learn and that they are genuinely interested in. Zhang also concludes that students were influenced in their selection of major by families and professors.

Using the concepts from the TRA and from Zhang's research, the model shown in Exhibit 1 (see appendix) was developed to provide a structure for assessing student decisions to pursue an ICT program.

Two surveys (the *ICT Surveys*) were conducted to compare the perceptions of counsellors and students regarding ICT programs and careers. The first survey collected responses from counsellors at the annual Ontario Provincial Dialogue Conference, a three-day event which brings together university representatives and high-school counsellors, and through an online survey distributed by the Ontario School Counsellors' Association (OSCA). From these two sources, 111 usable counsellor surveys were collected, of which 50 were electronic responses and 61 were paper responses. The second survey was conducted in the same time period at the authors' university. This electronic survey of IT Management (ITM) students resulted in 141 usable surveys, representing an 11% sample. Aside from the demographic questions, the surveys asked identical questions regarding perceptions of math and science requirements and the role of influencers on student ICT career directions.

A third survey (the *General Survey*) was administered to all first year Business Management and IT Management students in the Bachelor of Commerce program at the authors' university. The purpose of the survey was to evaluate student character attributes and their preparedness for university studies and eventual career directions. In total 1335 students, a 95% sample, voluntarily responded to an electronic survey as part of their in-class program. Fourteen questions focused on the student career orientation and over 50 questions focused on student character assessment. Each student who

participated in the survey received a detailed personal evaluation.

4. RESULTS

The ICT Survey

Exhibit 3 in the appendix compares the student and counsellor responses from the two ICT surveys. Four key areas of interest were identified.

Differing views on the importance of math

The survey asked about perceptions related to student abilities in math and science as an indicator of interest in post-secondary ICT programs. About 77% of guidance counsellors agreed or strongly agreed with the statement: "For post-secondary ICT programs, students should have strong interests and capabilities in math and sciences." In contrast, only 52% of ITM students agreed or strongly agreed that they had a strong interest in math and science. The top four subjects that these students studied in the final two years of high school were English (95%) and Math- Functions and Calculus (76%), both being mandatory final year courses, followed by Physics (64%) and Business (57%). Note that one high school math course is required for entrance to the Bachelor of Commerce program, although students may have taken more than one. Student response in the survey identified three math courses taken as Functions & Calculus at 76.4%, Geometry & Discrete Math at 47.9%, and Data Management at 39.6%.

Exhibit 2 in the appendix depicts the gap in student and guidance counsellor perceptions on math and science capabilities.

It is important to note that the respondent students are not in the computer science or computer engineering programs, which are also offered at the university. As described by McInerney et al. (2006, p. 42), computer science and engineering students typically place a higher emphasis on physics and math while Information Technology Informatics students, similar to the ITM students in this study, emphasized a "people centered view of computers" with an emphasis on business and interpersonal skills.

Student choices are strongly influenced by potential income, as well as personal and career interests

When asked about major influencers that attract students to post-secondary ICT programs, all respondents in the counsellor and student surveys agreed that the "opportunity to earn above average income" was the top influencer at 4.05 on a 5-point Likert scale for students and at 4.15 for counsellors. However, students see "the foundation in a core business discipline that could be used in any large organization" as the next most important influencer at 4.0, while counsellors saw this factor as lower at 3.82, slightly behind influencers "entrepreneurial business opportunities" at 3.9 and "well defined and secure career opportunities" at 3.83. The most interesting gap is the perceived impact of "an influential authority figure, such as a parent or community member"; students rated this factor as the lowest influencer at 2.7 and guidance counsellors rated this factor as middle to high on their list of influencers at 3.6.

When the survey probed further on the factors that influence the decision to pursue an ICT career, both students and counsellors agreed that personal and career interests were the top two factors at 4.0 and 4.0 for students, and 4.4 and 4.2 for counsellors. This agrees with findings from McInerney et al. (2006, p. 49) that students generally enter ICT programs and careers because of an inherent personal interest in computers and information technology. Other researchers (Malgwi et al., 2005; Kim et al., 2002; Akbulut et al., 2008; Zhang, 2007) have come to similar conclusions, that the primary influence for a student program and career direction will be their personal interests.

Differing views as to the importance of advice from guidance counsellors

Interestingly, for students the next three influencers were clustered close together -- location of the institution, career focus and reputation of the program. The biggest differences in student and counsellor views were the relative importance of other influencers on a student's decision for an ICT career, with students rating counsellors as least influential, while counsellors felt that parents and teachers were about equal on the influence scale as themselves. In decreasing levels of influence, students ranked

their 1) parents, 2) friends, 3) teachers and 4) counsellors. The student scores were substantially below the counsellor scores for these four influencers, for example counsellors rated themselves at 3.61 while students rated counsellors at 1.99. These findings agree with Malgwi et al. (2005, p. 278) where students rated 1) parents at 2.4 on a 5.0 scale, 2) teachers at 2.0 and then 3) counsellors at 1.7. An interesting finding is that students rated their parents as slightly more influential than their friends with regards to career direction. Counsellors believe that friends have a slightly higher influence than students themselves perceive. In support of the findings in this research, Paa and McWhirter (2000) also found that high school students were influenced very strongly by their parents regarding career expectations, with girls being more influenced than boys by their parents. Alexitch et al. (2004, p. 149) surveyed 816 high school students and found the same ranking for these four influencers, and that the ratings for the influencers did not differ by high school grade. The authors state: "parents and friends were more influential than high school counsellors and teachers… Parents were very important in students' decisions to attend university or college and even more in their decision to attend a particular institution."

Young women entering the ITM field have made different high school course choices in than young men

The survey distributed to ITM students resulted in some contrast between the responses of males and females. Of the 141 ITM students that responded, 25% were females. The small number of female respondents in the program reflects the low number of female entrants into the ICT industry and related post-secondary education programs. In comparison to their male counterparts, female ITM students had much higher levels of high school courses such as French (39% for females, 6% for males), Biology (44% for females, 20% for males), and Fine Arts (28% for females, 9% for males). Inversely, male ITM students had higher enrollment in Physical Education (36% for males, 17% for females) and Technical Arts (30% for males, 11% for females). This difference in subjects studied provides a vivid contrast between female and male educational and potential career interests. However, when asked about what attracted them to their current program and what factors most affected their choice "to pursue IT as a program and a career", there was a general consistency between the female and male responses. A major difference was that in response to question 4, approximately 34% of females versus 17% of males claimed to be influenced by their parents; suggesting that young females are twice as likely to be influenced by their parents as are young males. Again, this agrees with research findings from Paa and McWhirter (2000).

The General Survey

The third survey, administered to students in the authors' Faculty of Business Management addressed student career orientation and character assessment, and found similar results regarding influences on student educational directions. The survey asked first-year business management and IT management students about the assistance they received while deciding on post-secondary education. 1248 Business students and 87 ITM students responded to this question. Both sets of students frequently identified their parents as influencers, at 27% for business students and 32% for ITM students. Similar to the findings in the first two surveys, all students identified their guidance counsellors as the lowest influencers; 9% of business students and 8% of ITM students identified counsellors as influencers.

In this third survey ITM students rated 'No one' as the highest level of influence at 38%. A possible interpretation for this may be that they relied on their own understanding and interests. ITM students also put a low value on the influence of friends, at 12% compared to business students who rated their friends' influence much higher at 26%. The results from this third survey agree with the second survey, which indicates that ITM students rely more on their own interests and guidance than others, even that of friends. If anything, students look to parents for direction for post-secondary education and potential careers. Exhibit 4 in the appendix summarizes student responses.

5. DISCUSSION AND ANALYSIS

The research team drew the following four broad interpretations from the data.

1. Students who have chosen an ICT program do see these careers as well paying and providing a secure path into a business career.
2. Math and science, at least for ITM students, are less important than guidance counsellors believe. High school business courses may be more relevant for the students who pursue education in information systems. A background in social studies, especially for young women, is not seen as a barrier by the students (but may be by guidance counsellors).
3. Students make their own decisions on career directions in ICT based on their own perceptions and interests. They are least likely to listen to guidance counsellors or teachers on ICT career directions. They are more likely to listen to parents. Although they rate friends as having some influence, that influence is not as strong as other student groups would acknowledge. ITM students are somewhat more likely to listen to parents than to anyone else.
4. Female students exhibit higher interests and capabilities in communication and working with other people. They are also most influenced by their parents.

These findings suggest at least six considerations to attract young students to ICT careers and post-secondary programs.

1. Speak and work directly with students.

As industry and academic representatives attempt to reach out to high-school students, it is very important to be directly in front of and communicating with students. Obviously, teachers and guidance counsellors will introduce industry speakers and provide access to students, but clearly the students will put more credence in messages and presentations that come directly from the primary source and are not interpreted by others. This suggests that literature and multimedia communication campaigns that are delivered through the schools may be less successful because students will derogate messages delivered by teachers and counsellors.

2. Emphasize to students the earning potential and the opportunities to pursue other business careers from an ICT foundation.

Students, and possibly their parents, see ICT as a career that can pay well. As industry and academia reaches out to students with information sessions, the compensation potential of an ICT career should be discussed. Trends such as supply and demand in local markets should be addressed. The issues regarding offshore outsourcing should be addressed honestly and openly, citing factual statistics and responding to the one-off stories and fear-mongering about job-loss. McInerney et al. (2006, p. 50) suggest that there is "an information gap among students and, no doubt, among potential IT students about outsourcing and how it affects the job market."

The income potential for ICT should be compared to other relevant careers such as engineering, business, etc. Some of the messages may focus on how ICT is being used in specific industries such as health-care, transportation, financial services, law enforcement and other areas that may be of interest to the students. Students may value seeing the end-use of ICT in business and society, not just the technology components.

As the survey has suggested, students may envision themselves using ICT skills as a stepping-stone to further careers in business or other fields. Examples of professionals who have made the transition would be useful to demonstrate to students how they could follow a similar path.

3. Encourage math studies, but de-emphasize the need for strong math skills as a pre-requisite for ICT careers.

Adequate math skills are required, but best–in-class skills are not necessary, for business oriented ICT careers. Math skill requirements are no different than those expected for other business students. The students in this survey are not computer scientists or computer engineers, so this interpretation will be more relevant to information systems students. However, there is some concern suggested by the gap between student experience and counsellor perceptions that

strong math and science capabilities are required to be successful in all ICT-related programs.

With an acknowledgment that computer science and computer engineering still require strong math and science skills, there is a growing recognition in business that an equal or perhaps more important capability is the student's understanding of how technology supports business or organizational processes. This capability requires a high degree of emotional intelligence, interpersonal and communication skills, and an understanding of how business and organizations operate. As the SIM study found (Zweig, 2006, p.48) found that industry requirements are shifting to a need for client communication and project management skills, with declining emphasis on technology solution development. An over-emphasis on strong math and science skills may dissuade students, and perhaps many female students, from following an ICT career where their skills will be very valuable.

What may be important here is the need to recognize the distinction between business oriented ICT careers, which will have a greater emphasis on communication and inter-personal skills, and the more traditional computer science and engineering careers which will continue to require strong math and science skills.

4. Female students should be reassured of their ability to succeed in ICT programs and careers.

They should be made aware of the presence of ICT career opportunities and of the societal issues surrounding women in ICT and how to diminish those stereotypes. Singh et al (2007) states that in their research, "women rate their abilities lower and report lower confidence than do men in computer-related tasks, despite objective evidence of equal or superior academic performance". Correspondingly, both male and female ITM students reported having almost equal levels of interest and capabilities in math and sciences, with the female students reporting a 10% advantage over males although the male students had a better understanding of the distinctions between computer science and IT management.

With regards to professional abilities, Cathy Gulli (2008) points out that "men prefer working with tools or machines, so more of them choose IT jobs, while women prefer working with people". The results of the survey distributed to ITM students complemented this observation; the variances in the courses that males versus females took in grades 11 and 12 displays the tendency of females to take courses that involve more communication and human interaction, while males showed a preference for courses that were more physical and/or technical. Also, after observing the performance of females and males in high-school computer science classes, Crombie et al. (2001) comment that female students showed more enthusiasm in collaborative environments and in perfecting the end-products of their work. In contrast, "male students tended to work alone, as quickly as possible, to obtain a piece of software that 'worked'". This is a strong indication that in order to reach out to potential female ICT students, they must understand how to successfully capitalize on their higher level of communication and interpersonal abilities in order to determine what careers they are best-suited for in the ICT industry and that there are many career choices in ICT that will fulfill their interests in the more social and community aspects of work.

5. Encourage students to take business and social studies courses in high school.

In recognition of the fact that the overwhelming use of ICT and the resulting ICT careers are in business-oriented organizations, students should have an understanding of how their skills will work within the larger organization. The students may follow a career path that begins with ICT and moves into different business disciplines or organizational functions. Female students in particular may find this helpful in realizing the management opportunities in the ICT industry. Again, this interpretation may be appropriate for those students who will not follow the computer science or computer engineering paths.

6. Communicate directly with parents and students emphasizing the career potential and earning prospects in ICT.

Students have told us that parents have the strongest external influence on their post-secondary and career directions. Representatives from industry and academia may be challenged to reach busy parents to speak about ICT careers for their children. Community efforts, perhaps through chambers of commerce or industry councils, may be appropriate. Many professional organizations have already taken steps to reach out to students through the school systems, but we know of no such out-reach programs to parents. Parents may have been over-influenced by the negative stories of recent years such as offshoring and dramatic boom-and-bust employment in ICT. Again, thoughtful and fact-based discussions targeted at parents may influence students to consider ICT programs and careers. The survey results indicate that females are most influenced by their parents, suggesting that communicating directly with parents would also aid in effectively attracting more female students to the ICT industry.

6. RECOMMENDATIONS FOR ACTION

These study findings provide important direction for anyone interested in reversing the current trends and increasing participation of young people in ICT-related education, especially to demonstrate to young women that there are interesting and social roles that can be played in an ICT career.

Teachers and guidance counsellors need to rethink their roles in this field and recognize that their role may be more of a conduit and less of an influencer than they might have thought in the past. To serve their students best, they need to provide students with more direct access to industry sources. They need to reduce their emphasis on the need for a strong interest and ability in math for a career in ICT and recognize that a broad background of courses including business and social studies is just as relevant.

The ICT Industry and its related Higher Education Programs must improve the ways in which they communicate information about career opportunities in ICT and make more direct contact with students and their parents to provide a realistic "sales pitch" about careers in ICT with a clearer differentiation between applied and business-focused ICT and the more technical fields of computer science and engineering. In particular, ICT advocates should conduct career information sessions specifically for parents at high-schools and at university and college career fairs.

Universities need to consider how well their ICT degree offerings match the maker needs of the industry and how well these degrees are promoted to high school students. They should consider more university/industry partnerships in both curriculum and marketing, perhaps along the lines of the successful ITMB program in the UK, which was set up in 2006 to address some of these issues (eSkills UK, 2008). These new communications must focus on realistic and clearly understandable career opportunities and earnings potential, as well as the specific program characteristics (such as placement help and co-op or field experience) that students find most attractive.

Exhibit 5 in the appendix summarizes the tactics to be considered in encouraging high school students to pursue ICT.

7. CONCLUSIONS

The paths to solving the current and future shortage of ICT resources are many. One clear approach is to encourage young people to take up education and careers in this well-paying and interesting profession. However, to get the attention of high-school students and to send messages that will be heard, ICT advocates must speak directly and factually with these young people and their parents. Teachers and guidance counsellors cannot fulfill this role alone. Hopefully with the right messages through the appropriate channels and to the right students, the interest and take-up of ICT programs and careers can increase to meet the rising societal demands.

8. LIMITATIONS AND IMPLICATIONS FOR FUTURE RESEARCH

Some limitations may restrict the application of these findings to all ICT-related programs and careers. For example, the student res-

pondents were ITM majors in a Bachelor of Commerce program (information systems oriented), not Computer Science or Engineering programs. The requirement for strong math skills would be more important in those disciplines.

A second limitation is that this study did not survey students who decided not to go into ICT careers and it also did not survey high school students directly. A follow-up research project is now being planned to survey high school students directly.

A final limitation is the fact that respondent students in this sample were enrolled at a university program, across all four years. Their limited reliance on parents, teachers and counsellors, and the fact that these students had already made a program and potential career choice may reflect their maturity relative to high school students.

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APPENDIX

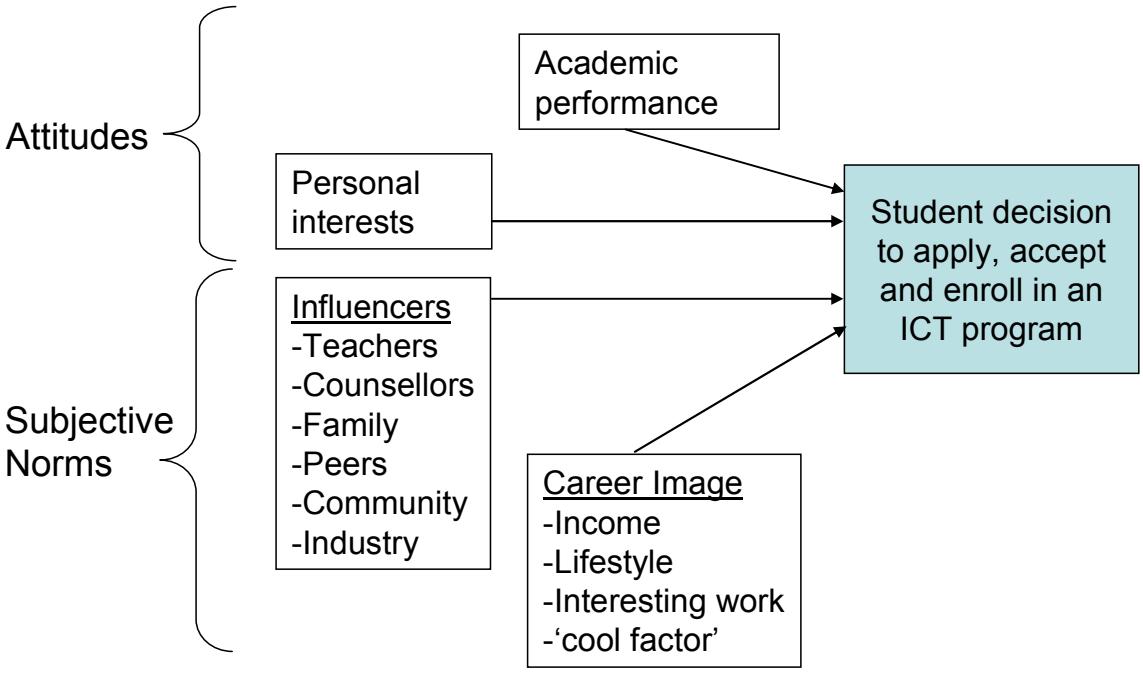

Exhibit 1: A model regarding influencers on student decisions to enter post-secondary ICT programs

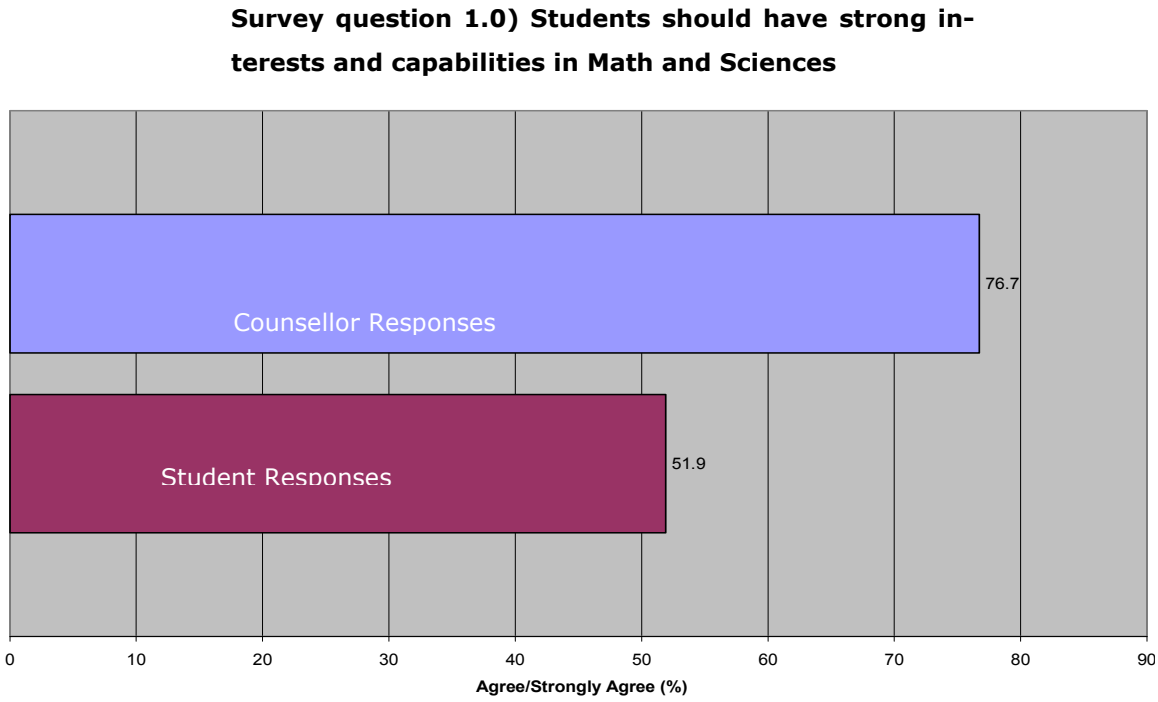

Exhibit 2: Comparison of student and guidance counsellor perceptions regarding Math and Sciences for ICT

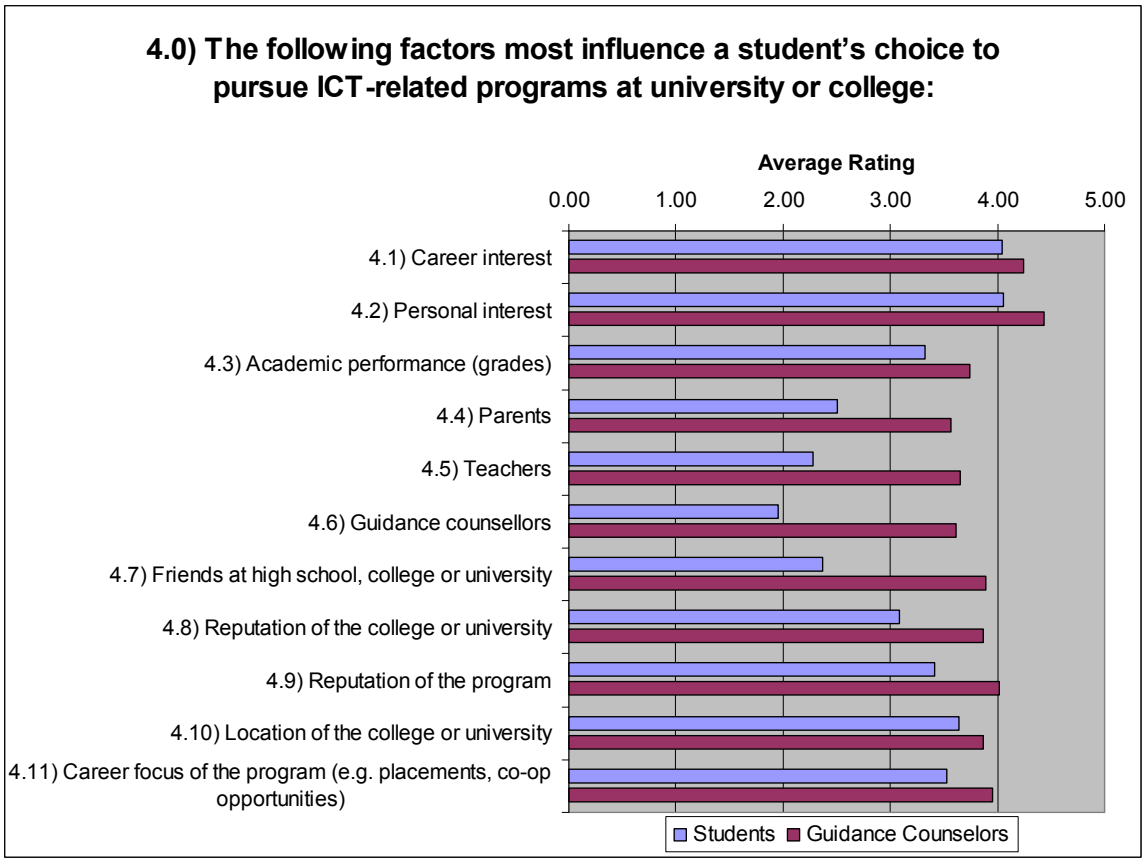

Exhibit 3: Factors that influence student's choice to pursue ICT programs

Survey Question 2) Did anyone assist you in making a decision about your post secondary education?

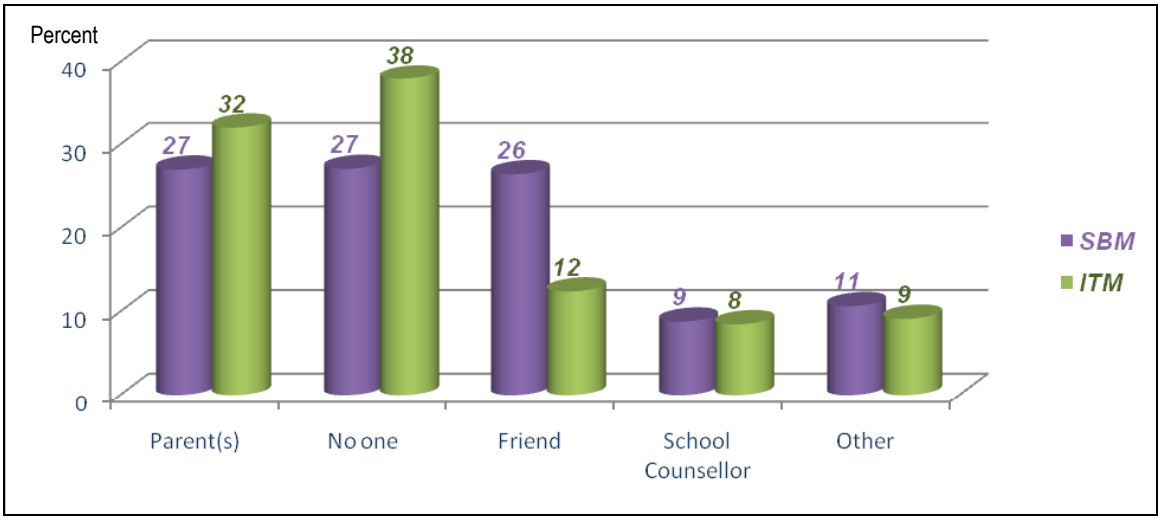

Exhibit 4: Responses from 1248 Business Management and 87 IT Management, first year students, 2007-08.

ENCOURAGEMENT TACTIC	ACTORS	CRITICAL POINTS
1) Communicate directly with students.	Industry Representatives	Students will play-down messages delivered by teachers and counsellors.
2) Emphasize facts with regards to earning potential and other business career opportunities.	Industry Representatives, Teachers, Guidance Counsellors	Important topics: • Demand and supply issues • How ICT is used in business • Outsourcing and offshoring
3) Don't over-emphasize math and science as prerequisites to pursue ICT as a program and career.	Teachers, Guidance Counsellors	Skills needed for success in ICT: • Interpersonal skills • Business and project management skills • Understanding of how technology supports business
4) Educate females on the career opportunities that require interests and abilities that they have.	Industry Representatives, Teachers, Guidance Counsellors	Non-tech skills: • Communication skills • Emotional intelligence • Interpersonal skills • Paying attention to details Possible ICT career paths: • Consultation • Project management
5) Encourage students to take business courses since ICT is used extensively in business-oriented organizations.	Teachers, Guidance Counsellors	ICT careers can be used as a means of moving into different business disciplines or organizational functions. Use real-life examples of this happening in the ICT industry.
6) Reach out to the greatest external influence on students: their parents.	Industry Representatives	Negative perceptions of parents about the ICT industry can be reflected in the career decisions of their children.

Exhibit 5: Tactics to Encourage High School Students to Consider ICT