Student Attitudes and Perceptions Regarding Computing and Its Related Disciplines

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Abstract

Declining enrollments in the computer-related disciplines continues to be problem. To help determine the reasons for this continued decline, first-year students were surveyed. The survey collected data about: 1) the factors that were used to select a college major, 2) why or why not the student picked a major in a computer-related field, 3) the student's high school guidance counseling experience both in general and in regard to computer-related fields, and 4) perceptions regarding the computing field in general.

Keywords: computer careers**,** declining enrollment in computer careers, student perceptions of computer careers

1.0 INTRODUCTION AND BACKGROUND

Articles appear weekly regarding the continued declining enrollments in computer programs in the United States. These programs include all of the computer related sub-disciplines CS, IS, IT. A March 2007 report from the Computer Research Association (CRA) based on a survey from the Higher Education Research Institute at University of California at Los Angeles (HERI/UCLA) confirms what has been reported by institutions and businesses alike: the number of new undergraduate majors who indicated that they would be entering computing programs declined nationally by 70% from 2000 to 2005 (Vegso, 2007).   Vegso (2007) also reports that "after six years of declines, the number of new CS majors in Fall 2006 was half of what it was in Fall 2000."

The Bureau of Labor Statistics sees the need for growth in all computer science occupations by 2010, especially those requiring strategic and business knowledge, such as computer software engineers (95% projected growth), systems analysts (62% projected growth) and computer and information systems managers (48% projected growth) (U.S. Department of Labor Statistics, 2004).

In 2004, Kessler reported that despite outsourcing of some computer-related jobs, a decrease in the pool of trained technology workers could become a problem in about four years if CS majors continue to decline while the U.S. technology industry grows. Also in 2004, Chabrow warned that the "declining computer science enrollments should worry anyone interested in the future of the U.S. IT industry." He continued to state that

if companies were not able to secure enough people in the U.S. who were trained in the skills they needed, it would provide another reason to outsource work to other places such as India. Microsoft Chairman Bill Gates testified before the Senate Committee on Health, Education, Labor and Pensions on U.S. competitiveness in March 2007. He expressed his concern about the declining enrollment in computer science saying that if the U.S. did not have enough workers in technology it "cannot possible sustain an economy founded on technology preeminence" (Thibodeau, 2007).

High-technology jobs are in demand and plentiful. Professor Eric Roberts of Stanford University says that "…the biggest problem in computing today is not a lack of jobs but a shortage of qualified workers to fill those jobs" (Jia, 2007). In April, 2007, AeA, a Washington-based trade group formerly known as the American Electronics Association, released a report stating that high-technology jobs were up 3% in 2006 (Thibodeau, 2007). Robert Half Technology, an IT staffing company headquartered in Menlo Park, CA, conducted a quarterly survey in December, 2006 of more than 1,400 CIOs. The results indicated that during the first quarter of 2007, 16% of the CIOs planned to hire additional IT staffers (Thibodeau, 2007). Katherine Spencer Lee, executive director of Robert Half Technology, stated that "there's plenty of domestic demand for a host of IT jobs…..it is taking 56 days to fill full-time IT positions…Firms that want IT managers are looking at an even longer search – about 87 days. And the wait is only getting longer" (Holahan, 2007).

"Despite the fact that high paying technology jobs are plentiful, students have been shying away from the profession and leaving a talent gap across the country" (Dionne, 2007). "We have more jobs than students" reports Hal Records chairman of the Computer Information Systems department at Bryant University. "In 2001, with the dot-com crash, a lot of parents lost their jobs, and everybody said technology is not a good way to go…..In spite of the outsourcing, the number of technology jobs is increasing. So what we have now is a massive gap between the demand for technology graduates and the supply of technology graduates" (Dionne, 2007).

1.1 REASONS FOR ENROLLMENT DECLINE

A myriad of reasons have been hypothesized for the decline in computer-related disciplines enrollment in the early 1990s and again since the year 2000. The majority of these arguments focused on the reported decline in the number of "good tech jobs" (Hoganson, 2004). The media definitely had and continues to have a major influence with the continual reporting of the outsourcing of American IT jobs to foreign countries where labor costs are lower and skilled workers are plentiful. Holahan (2007) reports that companies have relocated call centers and software development jobs to India, Prague, and Russia, but there is great 'global demand for employees proficient in programming languages, engineering, and other skills demanding higher level technology knowledge that outsourcing can't meet all U.S. needs." Additionally, the debate in Congress whether to increase the numbers of foreign skilled workers allowed into the country under the H-1B visa program has caused a focus on American workers first. The dot com bust of the 2001, the terrorist attacks of September 11, 2001 and their effect on the U.S. economy, and the budget cuts of many companies in the IT area during the early 2000s certainly did not paint a positive image of the IT field.

Another reason cited for declining enrollment in CS involves the image of a computer scientist. Edward D. Lazowska, a computer-science professor at the University of Washington, states "If you ask a kid to draw a caricature of what a computer scientist does, it's some overweight, greasy male, hunched down in front of a terminal, in front of a workstation, in a little cubby-hole" (Foster, 2005, p. A-32). Students are turned off by the common image of a computer scientist as an antisocial nerd (Foster, 2005). Samuel Bright, an Analyst for Forrester Research believes that one factor which has lowered an interest in IT careers is the student "perception of the IT career as confined to back-office programming and populated by geeks. Some students do not perceive IT as a socially conscious career choice that will enable them to contribute to the greater societal good" (Locher, 2007).

The problem of image is seen differently by Peter Denning, professor at the Naval Post-

graduate School in Monterey, California and former president of the ACM who recently was interviewed about the Great Principles of Computing. During this interview he stated, "We are still not communicating well with prospective new computer science majors. I think our problems with enrollments in the last few years are connected with our self-image. I believe that our self- proclamations about programming have mixed combustibly with the external reputation that programming is a low-grade, easily-outsourced job, exploding the incentive for somebody to identify computing as a career to enter. Trying to continue to defend our beliefs that computing is programming and technology is taking too much energy; it is unproductive in that people outside are not buying or are not joining. To inspire interest in a career, we need to show our field as constantly engaging in big, important ideas. We want people to react: 'I want to be part of that!'" (Ubiquity, 2007).

Recently, K-12 curricula have come under fire regarding their role in fostering computer science as an important part of an overall education. In the state of Pennsylvania, for example, teachers cannot be certified in a computer related discipline. Lots of examples abound of former English majors with no training teaching CS K-12 courses. "Talent is what drives this industry" says Eric Roberts Stanford Professor and co-chair of the education board of the ACM (Jia, 2007). "The lack of adequate computer science education in high schools is another major factor contributing to the dire state of computer science enrollment in colleges….Almost no place is looking at computer science on par with learning physics or mathematics, which it should be…Consequently, few students leave high school looking at computer science as a serious career option" (Jia, 2007).

Chris Stephenson, Executive Director of Computer Science Teachers Association believes that students are not particularly interested in technology partly because of the lack of time to study computer science in high school. He states, "The problem with the K-12 curriculum is that there is no consistency in how technology and computer science subjects are taught. One thing our research shows is that having a national curriculum for computer science in place not only improves consistency but goes a long way toward ensuring that courses are rigorous and teachers are properly prepared to teach the material" (Locher, 2007).

1.2 ATTITUDES TOWARD COMPUTING

What factors influence students to choose a major in computing? O'Lander (1996) collected data from 4,127 high school students who were enrolled in a computer course in New York State concerning the factors that influenced their attitude towards computing. He found that these factors included: 1) enthusiasm towards computing; 2) perceptions of computing ability; 3) apprehension about majoring in CS; 4) perceptions of degree of positive instructional influence towards computing received; and 5) perceptions of career and employment opportunities in computing.

Recently, Pollacia & Lomerson (2006) conducted research to determine the factors that influence a student's decision regarding a CIS major. They surveyed students enrolled in a first-year introductory computer courses. The results of their survey found: 1) students have limited knowledge of the career opportunities of CIS. Their knowledge seems to be inadequate or inaccurate; 2) many of the respondents indicated they choose their major using only self-developed information and did not rely on family, peers, the media or high school counselors; and 3) there are a wide variety of causes for disinterest in a computer career (Pollacia & Lomerson, 2006).

2.0. PROBLEM AND PURPOSE

The continued decrease in computer-related majors, the continuing retirement of baby-boomers, and the increasing use of computers in all fields is expected to create a substantial number of IT jobs in the U.S. As already has been stated by a number of authors, the shortage of qualified graduates in the computer-related profession will be a significant problem.

The purpose of the research described here was to determine: 1) the factors that influence a student's decision to major in a computer-related discipline, 2) attitudes towards computers and computer related majors, and 3) the role, if any, that a high school

computer class and/or guidance counselor had in influencing the student's decision regarding their major. The research was designed to replicate and enhance the Pollacia & Lomerson study.

3.0   METHODOLOGY

A survey was designed and administered to all first-year students at XXX University during the Spring, 2007 semester. XXX University is located in Southwestern Pennsylvania and offers bachelors, masters, and a few doctoral degrees. Currently, XXX University enrolls some 5000 students. Because all first-year students are required to partake in a two semester first-year studies seminar at XXX College, the completion of the survey was integrated as a seminar requirement. The survey was administered by hand by each seminar instructor during the 13th week of the semester. XXX University had 441 first-year students enrolled in the Spring, 2007 semester. Of those, 439 completed the survey.

4.0   RESULTS

Please refer to Appendix A for all tables.

Table 1 describes the 439 participants of the survey. The majority of both the male and female respondents are 18 years old.

Table 2 describes whether or not the respondents are graduates of Pennsylvania High schools. The vast majority of both the female and male respondents are graduates of Pennsylvania High Schools.

Table 3 describes the size of the graduating high school class of the survey participants. A wide variety of class sizes are seen.

Tables 4 and 5 describe the number of survey respondents that took a computer class in high school and what that class was. The vast majority of both female (78.5) and male (91.4%) took a high school computer class. For the 'Other" category in Table 5, the majority of the female respondents indicated that they took a high school class in Keyboarding, Typing, Word Processing, Web Design, and Yearbook Creation Software. For the male respondents, Keyboarding and Web Design were also popular high school

classes. Additionally, some of the male respondents indicated they completed high school computer classes in Corel Draw, Video Production Software, Macromedia, Music Making Software, Quick BASIC, Auto CAD/CAD, Python, and Robotics.

The respondents were asked if they completed a collegiate computer class. Very few of the respondents did so. Only 21 (7.9%) of the male respondents completed such as class, and of the female respondents a mere 6 (3.5%) reported that they completed such a class. The results are shown in Table 6. The collegiate classes completed by the male respondents included MSWord, Java, Desktop Software, Programming I & II, Visual BASIC, C++, and QBASIC. The female respondents reported that they completed classes in Computer Science, Multimedia, Visual BASIC, Introduction to Computers, and Math & Computer Science I. One of the female respondents stated that she could not remember the name of the collegiate computer class she completed.

Respondents were asked if any professors from nearby colleges/universities visited their high schools. If there was such a visit, the respondent was asked about the professors' gender, if the professors talked about a major they were interested in, and if the professors talked about majors in computer-related fields. The majority of the female respondents (67%) and the male respondents (60%) indicated that both male and female professors visited their high school. Forty-six percent of both the female and male respondents also report that the professor(s) spoke about majors in computer-related fields. Tables 7, 8, and 9 detail the results.

Table 10 describes the results of the question that asked the respondents if they had a family member who works in a computer-related field. The female respondents reported that 75 (43.6%) did have a family member who works in a computer-related field and 96 (40%) of the male respondents indicated such. The majority of both the male and female respondents do not have (a) family member(s) who work(s) in a computer-related field.

Participants were asked if they had ever considered a college major dealing with computers? The overwhelming answer was "No." Table 11 details the results.

Those participant responded "No," were asked why. The respondents were able to select multiple reasons for their decision and the overwhelming majority of both female (87.7%) and male (69.7%) respondents selected that they were not interested in a technical career. The second highest response (12.3%) given by the female participants was "I don't like using computers." This same response ranked number three for the male respondents. The male respondents choose "Other" as their second highest response (13.4%). "Other" ranked as the third highest female response. Table 12 illustrates the results. For the "Other" option, the female participants included the following reasons:
  1) it seems really boring,
  2) I don't know much about computers,
  3) I already knew what I wanted to major in,
  4) it wasn't my dream job, plus I associ ate computer related jobs as lazy,
  5) I didn't really give it a thought, it is a boring stressful career with no self-expression, and
  6) I don't think they make a lot of money and it's too much work, and 5) I didn't want a desk job.

The majority of the 13 female respondents' reasons involved one of the first three reasons.

The male respondents included the following reasons for the 'Other" option:
  1) it never appealed to me,
  2) I would rather do something else,
  3) overall computers interest me, but I'm leaning more toward something else,
  4) I have other interests,
  5) it's not the career for me, and
  6) I am not good with computers.

The majority of the 19 male respondents' reasons involved one of the first five reasons.

Those respondents who indicated that they had considered a college computer-related major, but did not pursue it were asked why. The respondents were able to select

multiple reasons for their decisions. Almost half of the male respondents, 47%, and 10 (38.5%) of the female respondents choose the option "I didn't think I would like the work." The option "I didn't think the employment prospects were good" ranked as the second highest response from the female respondents. This option was the third highest response from the male participants tied with "Other." The option "I thought it would be too technical" ranked as the second highest response from the male participants. Table 13 illustrates the results. For the "Other" option, the female respondents included the following reasons:
  1) I have no major yet,
  2) I'm not sure what I want to do, and
  3) I decided to pursue another field that interested me more.

The first two reasons were the most popular responses of the six female participants.

The male respondents included the following reasons for the "Other" option:
  1) I'm undecided as to what I want to do,
  2) I simply chose something better,
  3) I wasn't as interested in computers as I thought I was,
  4) I'm still undecided,
  5) I just didn't do it, and
  6) I'm more of a hardware person and not into programming.

The first three reasons were the most popular cited by the 14 male respondents.

All respondents, regardless of their major, were asked as to how they picked their major. The respondents were able to pick multiple responses. Table 14 details the results. Sixty-seven percent of the female and sixty-six percent of the male respondents stated that they choose their major through self-collected inputs. The next option with the highest percentages was "input from family." This option was chosen by 33.7% of the female respondents and 28.5% of the male respondents. For the "Other" option, the female respondents stated some of the following reasons:
  1) it has always been one of my main interests,
  2) teacher recommendation,
  3) mentor recommendation,
  4) career shadowing day got me interested,

5) High School speakers got me inter
   ested,
6) Career Aptitude Test,
7) I want to make a lot of money,
8) Classes I took in High School, and
9) Knowing, seeing, and talking to adults
   in the field.

The first three reasons were stated by the majority of the 24 female respondents.

The male respondents stated some of the following reasons for the "Other" option:
1) I already work in the field,
2) It just interests me,
3) I made my own decision,
4) I am studying business because we have a family business,
5) My field has a high placement rate,
6) Teachers,
7) I already work in the field,
8) It just interests me,
9) I worked with technology in High School and had a job involving it,
10) I love sports and wanted to do some thing in that field, and
11) The University contacted me and said I would be suited to this particular major, and
12) A personal experience helped me to decide.

The first two reasons were stated by the majority of the 27 male respondents.

Lastly, all respondents were asked to indicate their agreement with a number of statements. These statements concerned the High School guidance counselor, the career counseling the student received, and the computing field in general. Students were asked to state their agreement using a Likert scale of SA (Strongly Agree), (A) Agree, (U) Undecided, (D) Disagree, (SD) Strongly Disagree, (NA) Not Applicable, and (NR) No Response.

The female participant's responses are shown below.

Statement: I visited my high school career counselor more than once regarding my college major.

SA	33 (19.2%)
A	64 (37.2%)
U	14 (8.1%)

D	32 (18.6%)
SD	23 (13.4%)
NA	5 (2.9%)
NR	1 (0.6%)

The highest single response was for the option "agree," but that was only 37.2% of the female respondents. An almost equal percentage either "strongly agreed" or "disagreed." The combined percentage for the options of "strongly agree" and "agree" totals 56.4%. The combined percentage for the options of "disagree" and "strongly disagree" totals 32%.

Statement: My high school career counselor gave me good ideas concerning my college major.

SA	26 (15.1%)
A	57 (33.1%)
U	25 (14.5%)
D	36 (20.9%)
SD	22 (12.8%)
NA	5 (2.9%)
NR	1 (0.6%)

A mere 33.1% of the female respondents agreed with this statement. However, the combined percentage of the options for "disagree" and "strongly disagree", 34%, is almost equivalent. The combined percentage for the options of "strongly agree" and "agree" totals 48.3%.

Statement: My high school career counselor was knowledgeable about careers in the computing field.

SA	9 (5.2%)
A	36 (20.9%)
U	45 (26.1%)
D	27 (15.7%)
SD	18 (10.5%)
NA	34 (19.8%)
NR	3 (1.7%)

The highest single response for this statement was "undecided" at 26.1%. The combined percentage of the options for "disagree" and "strongly disagree" is equal is to this.

Statement: My high school career counselor gave me good counseling concerning computer–related careers.

SA	4 (2.3%)
A	20 (11.6%)
U	47 (27.3%)
D	38 (22%)
SD	27 (15.7%)
NA	33 (19.2%)
NR	3 (1.7%)

For this statement, the combination of percentages of the options for "disagree" and "strongly disagree" total 38% which is greater than the single highest response which was "undecided."

Statement: Overall, I am satisfied with the college and career counseling I received in high school.

SA	32 (18.6%)
A	60 (34.8%)
U	34 (19.8%)
D	24 (14%)
SD	15 (8.7%)
NA	4 (2.3%)
NR	3 (1.7%)

The majority of female respondents indicated that they were satisfied with the college and career counseling they received in high school. The combined percentage for the options of "strongly agree" and "agree" totals 53.4%.

Statement: Computing is mostly for men.

SA	2 (1.2%)
A	7 (4.1%)
U	22 (12.8%)
D	77 (47.8%)
SD	57 (33.1%)
NA	5 (2.9%)
NR	2 (1.2%)

The majority of female respondents either disagreed or strongly disagreed with this statement.

Statement: Computing is a field that mostly deals with programming.

SA	3 (1.7%)
A	46 (26.7%)
U	60 (34.9%)

D	39 (22.7%)
SD	17 (9.9%)
NA	3 (1.7%)
NR	4 (2.3%)

The highest number of responses was for the option of "undecided" regarding this statement, but that was only 34.9% of the female respondents. Almost an equal percentage of the respondents choose either "agree" or "disagree."

Statement: Computing is a field that mostly deals with robotics.

SA	2 (1.2%)
A	8 (4.7%)
U	40 (23.3%)
D	80 (46.5%)
SD	37 (21.5%)
NA	2 (1.2%)
NR	3 (1.7%)

A little less than half of the female respondents disagreed with this statement (46.5%).

Statement: Computing is a field that mostly deals with video games.

SA	2 (1.2%)
A	11 (6.4%)
U	34 (19.7%)
D	86 (50%)
SD	34 (19.7%)
NA	2 (1.2%)
NR	3 (1.7%)

Half of the female respondents disagreed with this statement. The combined percentage for the "disagree" and "strongly disagree" options totals 69.7%.

Statement: Computing is a field that requires a lot of knowledge about mathematics.

SA	11 (6.4%)
A	63 (36.6%)
U	46 (26.7%)
D	34 (19.7%)
SD	12 (7%)
NA	3 (1.7%)
NR	3 (1.7%)

For this statement, the most popular option chosen was "agree," only 36.6% of the respondents. The combined percentage for the options of "strongly agree" and "agree" totals 41%.

Statement: I could build my own working computer if I wanted to.

SA	1 (0.6%)
A	8 (4.7%)
U	12 (7%)
D	36 (20.9%)
SD	104 (60.5%)
NA	7 (4.1%)
NR	4 (2.3%)

The majority of female respondents strongly disagreed with this statement, 60.5%.

Statement: I have built my own working computer.

SA	2 (1.2%)
A	3 (1.7%)
U	9 (5.2%)
D	32 (18.6%)
SD	92 (53.5%)
NA	30 (17.4%)
NR	4 (2.3%)

A little more than half of the female respondents (53.5%) strongly disagreed with this statement. Almost an equal percentage of respondents choose either the "disagreed" or "not applicable" option.

Statement: Most computer jobs have been outsourced to other countries.

SA	0 (0%)
A	22 (12.8%)
U	70 (40.1%)
D	43 (25%)
SD	18 (10.5%)
NA	10 (5.8%)
NR	9 (5.2%)

Forty percent of the female respondents were undecided about this statement. Almost an equal percentage of respondents choose to agree, 12.8%, or to strongly disagree, 10.5%, with this statement.

Statement: I was advised NOT to major

in a computer-related field.

SA	3 (1.7%)
A	11 (6.4%)
U	23 (13.4%)
D	52 (30.2%)
SD	62 (36%)
NA	19 (11.1%)
NR	2 (1.2%)

The highest single response for this statement was for the option "strongly disagree" followed by 'disagree." The combined percentage for these options totals 66.2%.

The male responses are detailed below.

Statement: I visited my high school career counselor more than once regarding my college major.

SA	49 (18.4%)
A	93 (34.8%)
U	21 (7.9%)
D	44 (16.5%)
SD	36 (13.5%)
NA	21 (7.9%)
NR	3 (1.1%)

The single highest response for this statement was the option "agree," representing 24.8% of the male responses. The combination of the percentage for the options of "strongly agree" and "agree" totals 53.2%, a little more than half of the total responses.

Statement: My high school career counselor gave me good ideas concerning my college major.

SA	37 (13.9%)
A	86 (32.2%)
U	36 (13.5%)
D	49 (18.4%)
SD	33 (12.4%)
NA	23 (8.6%)
NR	3 (1.1%)

The combined percentage for the options of "strongly agree" and "agree" totals 46.1%, a little less than half of the total male responses. A higher percentage of males disagreed with this statement than strongly agreed with it.

Statement: My high school career coun-

selor was knowledgeable about careers in the computing field.

SA	26 (9.7%)
A	55 (20.6%)
U	81 (30.3%)
D	35 (13.1%)
SD	22 (8.2%)
NA	45 (16.9%)
NR	3 (1.1%)

The single highest response for this statement was undecided. The combined percentage for the options of "strongly agree" and "agree" is almost equivalent.

Statement: My high school career counselor gave me good counseling concerning computer-related careers.

SA	15 (5.6%)
A	52 (19.5%)
U	56 (21%)
D	52 (19.5%)
SD	31 (11.6%)
NA	56 (21%)
NR	3 (1.1%)

The highest number of responses from the male participants was a tie between the options of "undecided" and "not applicable." The second highest response was also tied, this time between the options of "agree" and "disagree." The combined percentage for the 'strongly agree" and "agree" options is 25.1%. The combined percentage for the options of "disagree" and "strongly disagree" is higher at 31.1%.

Statement: Overall, I am satisfied with the college and career counseling I received in high school.

SA	47 (17.6%)
A	96 (36%)
U	46 (17.2%)
D	35 (13.1%)
SD	28 (10.5%)
NA	12 (4.5%)
NR	3 (1.1%)

The single highest response from the male participants for this statement was the option "agree." The combined percentage for the options of "strongly agree" and "agree"

totals 53.6%, a little more than half of the male responses.

Statement: Computing a field mostly for men.

SA	8 (3%)
A	25 (9.4%)
U	62 (23.2%)
D	105 (39.3%)
SD	53(19.9%)
NA	9 (3.4%)
NR	5 (1.9%)

The combined percentage for the options of "disagree" and "strong disagree" totals 59.2% of the male responses. A very close percentage choose either the "undecided" option, 23.2% or the "strongly disagree" option, 19.9%.

Statement: Computing is a field that mostly deals with programming.

SA	7 (2.2%)
A	64 (24%)
U	73 (27.3%)
D	91 (34%)
SD	19 (7.1%)
NA	9 (3.4%)
NR	4 (1.5%)

The highest single response from the male participants was the option "disagree" at 34%. "Undecided" was the second highest response at 27.3%.

Statement: Computing is a field that mostly deals with robots.

SA	6 (2.2%)
A	17 (6.4%)
U	59 (22%)
D	123 (46.1%)
SD	47 (17.6%)
NA	9 (3.4%)
NR	6 (2.2%)

Forty-six percent of the male respondents choose the "disagree" option for this statement. The combined percentage for the options of "disagree" and "strongly disagree" totals 63.7%. A very close percentage choose either "undecided," 22%, or "strongly disagree."

Statement: Computing is a field that mostly deals with video games.

SA	8 (3%)
A	25 (9.4%)
U	63 (24%)
D	110 (41.2%)
SD	48 (18%)
NA	0 (3.8%)
NR	3 (1.1%)

The single highest response from the male participants was for the option "disagree." The combined percentage for the options of "disagree" and "strongly disagree" totals 59.2%. Only a six percent difference exists between the options "undecided" and "strongly disagree."

Statement: Computing is a field that requires a lot of knowledge about mathematics.

SA	24 (9%)
A	83 (31%)
U	77 (28.8%)
D	56 (21%)
SD	13 (4.9%)
NA	8 (3%)
NR	6 (2.2%)

The single highest response chosen by the male participants for this statement was "agree." The combined percentage of the options of "strongly agree" and "agree" totals 40%. An almost equal percentage of respondents choose either the "agree" or "undecided" options.

Statement: I could build my own working computer if I want to.

SA	28 (10.5%)
A	39 (14.6%)
U	33 (12.4%)
D	62 (23.2%)
SD	93 (34.8%)
NA	9 (3.4%)
NR	3 (1.1%)

The combined percentage for the options of "disagree" and "strongly disagree" totals 58%, more than half of the male responses. The highest single response for this statement was the option "strongly disagree."

Statement: I have built my own working computer.

SA	23 (8.6%)
A	16 (6%)
U	24 (9%)
D	54 (20.2%)
SD	102 (38.2)
NA	44 (16.5%)
NR	4 (1.5%)

The combined percentage for the options of "disagree" and "strongly disagree" totals 58.4%, more than half of the male responses. The highest single response for this statement was the option "strongly disagree."

Statement: Most computer jobs have been outsourced to other countries.

SA	16 (16%)
A	51 (19%)
U	114 (43%)
D	42 (15.7%)
SD	20 (7.5%)
NA	20 (7.5%)
NR	4 (1.5%)

The option "undecided" received the highest number of male responses for this statement.

Statement: I was advised NOT to major in a computer-related field.

SA	13 (4.9%)
A	19 (7.1%)
U	41 (15.4%)
D	75 (28.1%)
SD	79 (30%)
NA	37 (13.9%)
NR	3 (1.1%)

The "strongly disagree" option received the highest number of male responses for this statement followed closely by the "disagree" option. The combined percentage for these two options totals 58.1%, more than half of the total male responses.

5.0 DISCUSSION

5.1 DEMOGRAPHICS

The participants in this survey were all first-year students between the ages of 17 and 22. The majority of the respondents were male (61%). Eighty percent of the male respondents were graduates of Pennsylvania high schools as compared to 83% of the female respondents. These findings were expected. XXX University has a long history of attracting students primarily from the Western Pennsylvania region. The high schools in the area are diverse in their populations and this is seen in the size of the respondents' high school graduating class. The ratio of male versus female first year student at xxx University has varied for a couple of decades and these percentages are within the norm.

Since the 1980s, many of the high schools in the area have been offering a variety of computer courses. The majority of the students entering xxx University have taken a course in Word Processing, Typing, Keyboarding, and/or MSOffice (usually MSWord and MSExcel). This fact is reflected in the data.

It is no surprise that the majority of the respondents did not take a collegiate computer class while in high school. In the past, many of the college and universities in the Western Pennsylvania area offered a few collegiate courses to an elite number of high school students. However, very few students took advantage of these courses.

5.2 HIGH SCHOOL INFLUENCES

A little more than 50% of both the male and female respondents reported that a college professor did not visit their high school (Table 7). This was an expected result. Most of the time, the individuals who visit a high school are the enrollment management managers of a given college/university and not faculty members.

Those females who remember a college/university professor visiting their high school reported that there were both male and female professors who talked about a major they were interested in. Forty-six percent of these females remember the visitor speaking about majors in computer-related fields (Table 8). The males who remember a college/university professor visiting their high school report similar experiences (Table 9). The same percentage of males and females remember the visitor speaking about majors in computer-related fields.

5.3 MAJOR SELECTION

Table 15 compares the current study and that of Pollaci and Lomerson regarding participants' responses if they ever considered a college major dealing with computers.

Only 11.9% of the participants in the current survey indicated that they were currently studying a computer-related major. This data does not agree with that of the Pollacia and Lomerson study which found 25% of their respondents studying such a major. The current study found that 25.8% of the respondents had considered a computer-related major, but did not pursue it. This finding agrees with that of Pollacia and Lomerson who reported 26% for this option. A greater percentage of respondents in the current study (62%) answered "No" to this question than in the Pollacia and Lomerson study (Pollacia and Lomerson, 2006, p. 222).

Table 16 compares the two studies as to the participants' responses regarding why they did not consider a college computer-related major. Both studies agree in that the majority of the respondents indicated that they were not interested in technical careers. The current study found higher response rates for the options "People who use computers are strange" and "I didn't think the employment prospects were good." Whether this is due to geographic or personal biases or misinformation is unknown (Pollacia and Lomerson, 2006, p, 223).

Table 17 compares the two studies regarding the participants' reasons for considering a computer-related major but not pursuing it. The respondents in both study agreed that they did pursue a computer-related major because they didn't think they would like the work. The studies also agree as to the second highest response which was the option "I thought it would be too technical." Twenty-four percent of the respondents in the Pollacia and Lomerson study reported that they did not purse a computer-related major because they thought it would be too hard. This option had the lowest response rate in

the current study (Pollacia and Lomerson, 2006, p. 222).

Table 18 compares the current study and the Pollacia and Lomerson study as to who the participants selected their major.

Like the Pollacia and Lomerson study, the current study data found that the majority of the respondents selected their collegiate major via self-collected input. The studies also agree that the second most popular way participants choose their collegiate major was by input from family (Pollacia and Lomerson, 2006, p. 233). In the current study, just slightly less than half of the total number of respondents who remembered college/university professors visiting their high school and speaking about computer-related fields and just a little more than half of the total number of respondents reported they chose their major from self-collected input, it begs the question "what was said by these visitors?" The current study also collected data about whether or not the respondent had a family member who works in a computer-related field. Thirty-nine percent of the total respondents indicated that they had such a family member, but did these respondents also report that their most popular method of selecting a major was self-collected inputs or was it input from family? Fifty-one of these individuals (20%) indicated that selected their major by input from family and 121 (71%) indicated they used self-collected inputs.

5.4 HIGH SCHOOL GUIDANCE COUNSELING EXPERIENCE

The Pollacia and Lomerson study asked respondents about the effectiveness of their high school counseling experience regarding college majors, specifically those majors related to computers. Using a Likert scale of SD (Strongly Disagree), D (Disagree), N(Neutral), A (Agree), or SA (Strongly Agree), they asked participants to describe their level of agreement with the following statements:
1) S(he) gave me good ideas concerning my college major,
2) S(he) as knowledgeable about careers in the computing field,
3) S(he gave me good counseling con cerning computer-related careers, and
4) Overall I a m satisfied with the college

and career counseling I received in high school (Pollacia and Lomerson, 2006, p. 224).

Pollacia and Lomerson report their results based on a cumulative comparison of the responses to all of the questions. "Only 24% of their respondents answered favorably (agree or strongly agree) about their high school counseling experience" (Pollacia and Lomerson, 2006, p. 223).
Pollacia and Lomerson's questions were asked in the current study along with a few more in depth questions regarding the participant's general high school guidance counseling experience.

Statement: I visited my high school career counselor more than once regarding my college major.

More than half of both the female and male participants in the current study answered favorable (agree or strongly agree) regarding this statement.

Statement: My high school career counselor gave me good ideas concerning my college major.

Approximately 47%, a little less than half, of all participants responded favorably to this statement.

Statement: My high school career counselor was knowledgeable about careers in the computing field.

Twenty-nine percent responded that they were undecided about this statement. No designator was clearly in the majority for this statement.

Statement: My high school career counselor gave me good counseling concerning computer-related careers.

No designator was clearly in the majority for this statement.

Statement: Overall, I am satisfied with the college and career counseling I received in high school.

More than half, 53.5%, of the participants responded favorably to this statement.

Statement: I was advised NOT to major in a computer-related field.

The vast majority of both the male and female respondents either disagreed or strongly disagreed with this statement.

The data regarding the participants' high school guidance counseling experience in this study indicate favorable experiences regarding the general experience, but mixed experiences concerning computer-related knowledge and careers.

5.5 GENERAL BELIEFS ABOUT COMPUTING

Seven general statements concerning the computing field were asked of the survey participants. The majority of the both the male and female participants disagreed or strongly disagreed with the statements that computing was mostly for men, computing was mostly about robotics, and computing was mostly about video games. The majority also disagreed or strongly disagreed with the statements about building their own working computers. These results were expected.

Surprisingly, both the female and male respondents indicated that they were "undecided" about the statement that computing is a field that deals mostly with programming. Additionally, there was a tie between the options of "agree" and "disagree" for the male respondents. These two options each represented 24% of the total male response which was the second highest response. For the female participants, almost an equal percentage chose either to "agree" or "disagree." Like the male responses, these were the second highest options chosen. Also, surprising is that the majority of both female and male participants responded favorably to that statement 'computing is a field that requires a lot of knowledge about mathematics.' These findings definitely indicate that these are areas that need to be addressed.

The last general statement asked of the participants concerned whether or not they felt that most computer jobs had been outsourced to other countries. Undecided was the option chosen by the majority of both the female and male participants. These

findings suggest that this is yet another area that needs to be addressed.

6.0 CONCLUSIONS

The findings of both this and the Pollacia and Lomerson study confirm that students seem to have limited knowledge of the fields of computing and/or the career opportunities in these fields. Also needed is some work in breaking down the stereotypes students have regarding the computing fields.

It is clear from the data that some effort has been made by colleges/universities to have professors visit at the high school level and this is a good start, but much more needs to be done. Combined with this effort, perhaps all first-year courses should include material on how and why computers are used in that specific discipline. This knowledge would help counter the stereotypes and inaccurate data the student has gathered on their own and provide them with the foundations on making an accurate and timely decision regarding their career path.

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APPENDIX A RESULTS TABLES

Sex/Age	Female	Male
17	1 (0.58%)	6 (2.25%)
18	128 (74.4%)	165 (61.8%)
19	42 (24.1%)	88 (33%)
20	1 (0.58%)	5 (1.87%)
21	0 (0%)	2 (0.75%)
22	0 (0%)	1 (0.37%)
Total	**172**	**267**

N=439

Table 1 Age and Sex of Survey Respondents

Graduate of PA High School	Fe-male	Male
Yes	143 (83%)	213 (80%)
No	29 (17%)	54 (20%)
Total	**172**	**267**

N=439
Table 2 Survey Respondents Who Are PA High School Graduates

Size of Graduate Class	Female	Male
Home Schooled	1 (0.58%)	2 (0.75%)
Less than 50	5 (2.9%)	4 (1.5%)
50-99	19 (11%)	28 (10.5%)
100-149	35 (20%)	33 (12.4%)
150-199	18 (10.5%)	40 (15%)
200-249	20 (11.6%)	24 (9%)
250-299	18 (10.5%)	29 (10.9%)
300-349	8 (4.65%)	23 (8.6%)
350-399	9 (5.23%)	16 (6%)
400-449	8 (4.65%)	18 (6.74%)
450-499	13 (7.56%)	14 (5.24%)
500 or greater	18 (10.5%)	36 (13.5%)
Total	**172**	**267**

N = 439
Table 3 Size of High School Graduating Class of Respondents

Took a Computer Class in High School	Female	Male
Yes	135 (78.5%)	244 (91.4%)
No	37 (21.5%)	23 (8.6%)
Total	**172**	**267**

N=439
Table 4 Respondents Who Took A High School Computer Class

High School Computer Class	Female	Male
MS Word	102 (76%)	174 (71.3%)
MS Excel	90 (67%)	144 (59%)
MS Access	41 (30.4%)	60 (24.6%)
MS PowerPoint	18 (13.3%)	11 (4.5%)
Visual BASIC	14 (10.4%)	41 (16.8%)
Java	4 (3%)	32 (13.1%)
C++	4 (3%)	24 (9.8%)
Front Page	17 (12.6%)	26 (10.7%)
Page Maker	9 (6.7%)	18 (7.4%)
Photo Shop	31 (23%)	58 (23.8%)
HTML	25 (18.5%)	51 (21%)
Dream Weaver	12 (8.9%)	23 (9.4%)
Flash	11 (8.1%)	28 (11.5%)
Other	33 (24.4%)	64 (26.3%)
	N=135	**N=244**

Table 5 High School Computer Class Taken
      By Respondents

Took a Collegiate Computer Class while in High School	Female	Male
Yes	6 (3.5%)	21 (7.9%)
No	166 (96.5%)	246 (92.1%)
Total	**172**	**267**

N=439
Table 6 Respondents Who Took a Collegiate Computer Class
      While In High School

Did college professors visit your High School	Female	Male
Yes	79 (46%)	125 (47%)
No	93 (54%)	142 (53%)
Total	**172**	**267**

N=439

Table 7 Respondents Who Remember College/ University Professors Visiting Their High Schools

High School Visitors	Yes	No	Don't Remember
Males	27 (34%)	2 (2.5%)	18 (23%)
Females	21 (27%)	4 (5%)	19 (24%)
Some Male & Some Female	53 (67%)	5 (6.3%)	16 (20%)
Talked about a major I was interested in	44 (56%)	23 (29%)	12 (15%)
Talked about majors in computer-related fields	36 (46%)	23 (29%)	19 (24%)

N=79

Table 8 Female Responses – Characteristics of the Professor(s) Who Made A High School Visit

High School Visitors	Yes	No	Don't Remember
Males	57 (46%)	3 (2.4%)	33 (26.4%)
Females	40 (32%)	9 (7.2%)	32 (25.6%)
Some Male & Some Female	75 (60%)	7 (5.6%)	30 (24%)
Talked about a major I was interested in	68 (54%)	32 (25.6%)	25 (20%)
Talked about majors in computer-related fields	57 (46%)	39 (31.2%)	29 (23.2%)

N=125

Table 9 Male Responses – Characteristics of the Professor(s) Who Made A High School Visit

Family Member working in a computer-related field	Female	Male
Yes	75 (43.6%)	96 (40%)
No	97 (56.4%)	171 (60%)
Total	**172**	**267**

N=439

Table 10 Respondents Who Have A Family member Working in A Computer-Related Field

Did you consider a college major dealing with computers?	Female	Male	Combined
Yes, I am currently studying a computer-related major	14 (8.1%)	38 (14.2%)	52 (11.9%)
Yes, but I did not pursue it	26 (15.1%)	87 (32.6%)	113 (25.8%)
No	130 (75.6%)	142 (53%)	272 (62%)
NR	2 (1.2%)	0 (0%)	2 (0.5%)
Total	**172**	**267**	**439**

N=439
Table 11 Respondents' Consideration of a College Computer Major

I did not consider a college computer-related major because:	Female	Male	Rank Female	Rank Male
I never heard any information about computer careers	7 (5.4%)	13 (9.2%)	5	4 (tie)
I am not interested in technical careers	114 (87.7%)	99 (69.7%)	1	1
I don't like using computers	16 (12.3%)	16 (11.3%)	2	3
People who use computers are strange	6 (4.6%)	9 (6.3%)	6	6
I didn't think the employment prospects were good	9 (6.9%)	13 (9.2%)	4	4 (tie)
I don't have access to a personal computer	0 (0%)	2 (1.4%)	7	7
Other	13 (10%)	19 (13.4%)	3	2

N=130   N=142
Table 12 Reasons Why Respondents Did Not Consider a College Computer-Related Major

I did not pursue a computer-related major because:	Female	Male	Rank Female	Rank Male
I could not find enough information about computer careers	2 (7.7%)	9 (10.3%)	6	5
I thought it would be too hard	3 (11.5%)	5 (5.7%)	5	6
I thought it would be too technical	6 (23%)	17 (19.5%)	3 (tie)	2
I didn't think I would like the work	10 (38.5%)	41 (47%)	1	1
I didn't think the employment prospects were good	7 (26.9%)	14 (16%)	2	3 (tie)
Other	6 (23%)	14 (16%)	3 (tie)	3 (tie)

N=26   N=87
Table 13 Reasons Why Respondents Did Not Pursue A Computer-Related Major

How did you select your major?	Female	Male	Female Rank	Male Rank
I have not yet selected a major	33 (19.2%)	37 (13.9%)	3	4
Input from family	58 (33.7%)	76 (28.5%)	2	2
Input from school counselor	30 (17.4%)	42 (15.7%)	4	3
Input from peers	20 (11.6%)	35 (13.1%)	7	5
Self-collected input	116 (57.4%)	177 (66.3%)	1	1
Heard about the field from books, TV, etc.	21 (12.2%)	29 (10.9%)	6	6
Other	24 (14%)	27 (10.1%)	5	7

N=439

Table 14 Respondents' Selection of a College Major

Did you consider a college major dealing with computers?	Current Study	Pollacia and Lomerson
Yes, I am currently studying a computer-related major	52 (11.9%)	36 (25%)
Yes, but I did not pursue it	113 (25.8%)	38 (26%)
No	272 (62%)	71 (49%)
NR	2 (0.5%)	0 (0%)
Total	**439**	**145**

Table 15 Comparison of Current Study and Pollacia and Lomerson Study
Did Respondent Consider a College Major Dealing with Computers

I did not consider a college computer-related major because:	Current Study	Pollacia and Lomerson
I never heard any information about computer careers	20 (7.4%)	6 (8%)
I am not interested in technical careers	213 (78.3%)	43 (61%)
I don't like using computers	32 (12.3%)	13 (18%)
People who use computers are strange	15 (11.8%)	1 (1%)
I didn't think the employment prospects were good	21 (7.7%)	2 (3%)
I don't have access to a personal computer	2 (0.7%)	4 (6%)
Other	32 (11.7%)	13 (18%)

N=272   N=71

Table 16 Comparison of Current Study and Pollacia and Lomerson Study
Why Respondent Did Not Consider a College Computer-Related Major

I did not pursue a computer-related major because:	Current Study	Pollacia and Lomerson
I could not find enough information about computer careers	11 (9.7%)	7 (18%)
I thought it would be too hard	8 (7%)	9 (24%)
I thought it would be too technical	23 (20.4%)	10 (26%)
I didn't think I would like the work	51 (45%)	17 (45%)
I didn't think the employment prospects were good	21 (18.6%)	5 (13%)
Other	20 (17.7%)	3 (8%)

N=113   N=38

**Table 17 Comparison of Current Study and Pollacia and Lomerson Study
Reasons Why Respondents Who Considered a Computer-Related Major
Did Not Pursue It**

How did you select your major?	Current Study	Pollacia and Lomerson
I have not yet selected a major	70 (16%)	Not Reported
Input from family	134 (30.5%)	44 (30%)
Input from school counselor	72 (16.4%)	8 (6%)
Input from peers	55 (12.5%)	12 (8%)
Self-collected input	233 (53%)	99 (68%)
Heard about the field from books, TV, etc.	50 (11.4%)	7 (5%)
Other	51 (11.6%)	18 (12%)

N=439   N=145

**Table 18 Comparison of Current Study and Pollacia and Lomerson Study
How Did Respondent Select Their College Major**