ISSN: 1545-679X

# Information Systems Education Journal

Volume 7, Number 1 http://isedj.org/7/1/ March 2, 2009

**In this issue:**

## Factors Influencing Females Whether to Become Computer Information Systems Majors

**D. Scott Hunsinger**
Appalachian State University
Boone, NC 28608 USA

**Ashley E. Holt**
Appalachian State University
Boone, NC 28608 USA

**Michael B. Knight**
University of Wisconsin - Green Bay
Green Bay, Wisconsin, USA

**Abstract:** Many U.S. universities have recently encountered decreases in computer-related majors, including Computer Information Systems (CIS), even though there is a shortage of skilled IS professionals. A disproportionate number of females choose to major in CIS. Previous research has cited various reasons why females may not choose computer-related majors. We began our study by using structured interviews to better understand why College of Business students at our university choose to major (or not major) in CIS. Based upon the interview findings, we then created and administered an online survey to 100 students at three U.S. universities to capture quantitative data for analysis. We based this survey upon the theory of planned behavior. This theory has been used in previous research to determine why people intend to behave in a certain manner. Even though students indicated that certain groups of importance to them (such as parents and professors) influence their actions, these referent groups strongly believe that students should NOT major or double-major in CIS. The interviews and surveys also indicated that students lack knowledge about the CIS major and believe that it is a difficult major. Future researchers and stakeholders can use our study's results to focus on the most influential factors that encourage or discourage females to enter the CIS major.

**Keywords:** females, IS worker shortage, computer information systems, IS majors, women

---

**Recommended Citation:** Hunsinger, Holt, and Knight (2009). Factors Influencing Females Whether to Become Computer Information Systems Majors. *Information Systems Education Journal, 7* (1). http://isedj.org/7/1/. ISSN: 1545-679X. (Preliminary version appears in *The Proceedings of ISECON 2007:* §2712. ISSN: 1542-7382.)

This issue is on the Internet at **http://isedj.org/7/1/**

The **Information Systems Education Journal** (ISEDJ) is a peer-reviewed academic journal published by the Education Special Interest Group (EDSIG) of the Association of Information Technology Professionals (AITP, Chicago, Illinois). • ISSN: 1545-679X. • First issue: 8 Sep 2003. • Title: Information Systems Education Journal. Variants: IS Education Journal; ISEDJ. • Physical format: online. • Publishing frequency: irregular; as each article is approved, it is published immediately and constitutes a complete separate issue of the current volume. • Single issue price: free. • Subscription address: subscribe@isedj.org. • Subscription price: free. • Electronic access: http://isedj.org/ • Contact person: Don Colton (editor@isedj.org)



EDSIG activities include the publication of ISEDJ and JISAR, the organization and execution of the annual ISECON and CONISAR conferences held each fall, the publication of the Journal of Information Systems Education (JISE), and the designation and honoring of an IS Educator of the Year. • The Foundation for Information Technology Education has been the key sponsor of ISECON over the years. • The Association for Information Technology Professionals (AITP) provides the corporate umbrella under which EDSIG operates.

# Factors Influencing Females Whether to Become Computer Information Systems Majors

D. Scott Hunsinger
Appalachian State University
hunsingerds@appstate.edu

Ashley E. Holt
Appalachian State University
Ah71079@appstate.edu

Michael B. Knight
University of Wisconsin – Green Bay
Knightm@uwgb.edu

## Abstract

Many U.S. universities have recently encountered decreases in computer-related majors, including Computer Information Systems (CIS), even though there is a shortage of skilled IS professionals. A disproportionate number of females choose to major in CIS. Previous research has cited various reasons why females may *not* choose computer-related majors. We began our study by using structured interviews to better understand why College of Business students at our university choose to major (or not major) in CIS. Based upon the interview findings, we first pilot-tested our initial survey at our institution. After making improvements to the survey instrument, we administered our revised online survey to students at three U.S. universities to capture quantitative data for analysis. We based this survey upon the theory of planned behavior. This theory has been used in previous research to determine why people intend to behave in a certain manner. We integrated the findings from the thematic analysis of the interviews and our final survey results. From our qualitative and quantative analysis, we uncovered several recurring themes: Lack of knowledge and time, role model influence, lack of confidence, stereotypes, and an overall lack of intent of females to major or double-major in CIS. Future researchers and stakeholders can use our study's results to focus on the most influential factors that encourage or discourage females to enter the CIS major.

**Keywords:** females, IS worker shortage, computer information systems, IS majors, women

## 1. INTRODUCTION

Previous studies have stated that a disproportionate number of females choose to major in computer-related fields, including Computer Information Systems (CIS).

Researchers have found that enrollment in computer courses has decreased for reasons including the outsourcing of IT jobs overseas, the economy in general, the dot.com failure, and the decline in students' analytical abilities (Pollacia and Lomerson, 2006). In 2004 and early 2005, the number of IT professionals seeking employment decreased ("IT Labor Supply," 2007).

Many U.S. universities have encountered decreases in the number of CIS majors (Lenox et al., 2005). Over 500 students majored in CIS at our university in 2000; we now have about 200 CIS majors, a 60% decrease. About one-third of students in the College of Business at our university are females. However, only 10% of our CIS majors are females, which is the lowest percentage of females in any major in the College of Business.

Women interested in computing fields face many barriers when preparing for a college degree. It is not often that parents, peers, and guidance counselors encourage women to major in a computing field. The few women who declare a computing major tend to experience continued lack of support throughout their education. Even faculty can discourage women. This lack of support can decrease a woman's interest in computing (Cohoon, 2002).

Part of the under-representation of women in the computer field at the undergraduate level is inherited from the secondary school level, where girls do not participate in computer courses and related activities as much as boys. Understanding why computer courses in particular do not appear to attract many female applicants has become an important issue (Durndell et al., 1990). Given our society's representation of computers as a male activity, few women are likely to consider a computer major unless they are clearly encouraged to do so (Cohoon, 2002).

The purpose of our study is to begin determining which factors are *most* influential when a female student decides whether or not to become a CIS major. To accomplish this, we conducted interviews with both CIS and non-CIS majors in the College of Business at our university (Appalachian State University) to find out which factors influenced them to choose their major. Based upon the findings from the interviews, we created and administered an online survey to students at three U.S. universities to try to better understand which factors are most important in influencing students' intentions to become a CIS major.

The rest of our paper is organized as follows. The background literature section identifies the important influences that have been cited in previous research and explains the Theory of Planned Behavior. The methodology section explains how we conducted interviews with students and how the results are integrated into an online survey. In the findings section, we point out which factors were mentioned most often by the interviewees and we present the results from the survey. The discussion section provides suggestions for increasing the number of female CIS majors. We also discuss how we plan to use the theory of planned behavior to quantitatively analyze which factors are most important in predicting students' intentions to become CIS majors. This will allow future researchers to focus on the most important factors so we can increase the number of female CIS majors.

## 2. BACKGROUND LITERATURE

According to the U.S. Bureau of Labor Statistics, women made up only 26.7% of computer and mathematical positions in 2006 (Nobel, 2007). The IT professional shortage is an issue that could possibly threaten the global technology leadership and economic strength of this country (Gaudin, 1999). The shortage of skilled IT professionals will possibly drive up wages in 2007 according to a recent survey of IT salaries ("IT Skills," 2007). Research suggests that the information technology job market will generate high demand for skilled IT professionals over the coming year, as the potential for top level jobs increases ("IT Skills," 2007).

Lenox et al. (2005) indicated that the top six reasons for declining enrollment in computer-related majors were: 1) outsourcing of computer-related jobs, 2) the economy in general, 3) the dot.com failure, 4) the cyclic nature of business, 5) decline in students' analysis abilities, and 6) failure of institutions to actively recruit students.

Role models may influence females toward or away from technology. If society wants to see more females involved with computers, it is important to begin with the parents. There are many things parents can do to encourage girls to use technology. Whenever parents use technology on a regular basis in their daily lives for entertainment and/or in their occupations, their children will be more likely to do the same (Greer, 2002). Studies have found that women are more likely to enter the information technology field if some family members, especially their fathers, are employed within the IT field. "Parents are the most important, influential people in a child's life" (Canter and Canter, 1991). Mento et al. (2006) found that Computer Science, Engineering, and Mathematics (CSEM) role models have had a positive effect on females' attitudes about computing.

Even though there is a great need for skilled IT workers, previous studies have found that high school students often possess little or no knowledge about the CIS major and field.

High school counselors play a role when it comes to influencing students to choose a major for college (Pollacia and Lomerson, 2006). The educational system and teachers are believed to influence the gender gap in the use of computers. One argument states that the gender separation in the use of the Internet begins as far back as kindergarten.

> "As such, many industry leaders and experts believe the long-term solution to the gender imbalance in IT lies in women technologists going back to school -- way back, to high schools and even elementary schools to mentor young girls, who too often give up on math and science at an early age. There's the perception that if you don't see a lot of women in the field, it must not be a very good field for women" (Nobel, 2007).

Females at an early age are steered away from math and science and are less likely to use computers than boys (Li et al., 2004). During a female's teenage years, many changes are occurring which can have a negative impact on their character and future choices. Furthermore, females feel inferior to their peers or wish to cover up their leadership skills and intelligence and turn down their chances to participate in clubs, student government, or challenges that may cause disappointment (Greer, 2002). By increasing the number of female students studying for the computer field at the high school level, this may boost the number of female undergraduates who major in computer information systems. Increasing female undergraduate students may reach a "critical mass" that will create a higher percentage of female graduate students (Graham, 2004).

In addition to the educational system and their influences, one argument states that relying on faculty role models in the university might create the risk of discouragement for preliminary students who are not able to see themselves as reaching high-level achievements (Roberts et al., 2002). However, the number of women faculty in IT and other engineering areas is still quite low (Varma, 2001). This seems to reinforce the image that these disciplines are not meant for females. Without female faculty member support, many female students in computer-related majors may feel isolated (Varma, 2001). The attitudes and practices of the faculty and the experience of undergraduate women have a significant impact on whether women stay in the field or switch to other majors.

Computing has been long considered as a male dominated field. A common stereotype is that women are not as competent as men when it comes to technology (Cooper and Weaver, 2003, p. 96). Cory et al. (2005) found that high school students typically perceive technology professionals as males. Females are often reluctant to enter a technology field (Nicolai, 2001). One of the differences between males and females is not in achievement or in opportunities to learn, but in the confidence in mathematics, science, and computing. Even when females seem to have similar exposure to courses and similar achievement level, they are less confident of their ability, feel less prepared, and lack interest in information systems education (Varma, 2001).

However, females as a whole are more than likely to do what is required in a class and use techniques taught in class. Furthermore, a woman may enter a program with enthusiasm about being an information systems major, but their confidence and interest may begin to erode away after a few semesters. There is clearly a range of psychological and socialization factors that contribute to women who perceive themselves as individuals who pick up slower ideas compared to male students who seem to do well without really trying (Margolis et al., 2000).

A nerdy-looking guy with glasses and bad clothing who sits alone working at a computer day and night is a typical stereotype that individuals think about when someone mentions computers (Foster, 2005). This stereotype has been another factor that may push women away from the information systems major. Women are less likely to display obsessive behavior when it comes to computers compared to their male peers.

It is evident that males and females are attracted to the computer field for several different reasons. To a female, a computer is like a tool which is used to strengthen her capabilities to help accomplish tasks more effectively (Bernstein, 1999). Other reasons may include the desire for secure employment, usefulness of computer information systems, and the exciting changing field

(Margolis et al., 2000). In contrast, males may look at it as a time to play and get paid as well.

The theory of planned behavior (Ajzen, 1991) has been used in many fields, including Information Systems, to help researchers to understand why people intend to behave in a certain manner. The theory measures a person's attitude, subjective norms, and perceived behavioral control. Subjective norms are defined as the influence that other people who are important to a person have on him or her (Ajzen, 1991). Perceived behavioral control refers to a person's perceptions of "… the presence or absence of requisite resources and opportunities" (Ajzen and Madden, 1986). The theory of planned behavior suggests that attitude, subjective norm, and perceived behavioral control influence a person's intention to do something. Previous studies have found a strong relationship between a person's intention and their actual behavior.

## 3. METHODOLOGY

For this study, we first conducted face-to-face interviews with a sample of ten females (juniors and seniors) from our university's College of Business. We interviewed both CIS and non-CIS majors. Using structured interviews (see Appendix A) we asked fifteen questions to investigate female students' beliefs, thoughts, and attitudes about the CIS major. All interviews were audio-taped and transcribed to ensure that we properly recorded each student's responses. We categorized the responses for each question to allow us to determine the most popular answers for each. We used thematic analysis (Aronson, 1994; Boyatzis, 1998), going back through the data repeatedly to identify patterns among the students' responses.

Based upon the findings from the interviews, we created an initial, online survey using SurveyMonkey (www.surveymonkey.com). We integrated the findings from the interviews with the theory of planned behavior constructs (attitude, subjective norms, and perceived behavioral control) to begin empirically analyzing female students' intentions to become a CIS major. We emailed 152 female sophomores in the College of Business at our university, asking them to complete the online survey. To encourage them to participate, we informed them that we would randomly select three participants and present each of them a $25 Staples gift card. Twenty students completed the survey. We used this initial survey to ensure that the wording of each question was clear to the student. We also allowed students to recommend improvements to the survey. These changes were implemented in the final survey instrument.

For our final online survey, we asked students in the College of Business at three US universities to participate: Appalachian State University, Idaho State University, and University of Hawaii at Hilo. We received exactly 100 responses from students.

## 4. FINDINGS

We have integrated the findings from the thematic analysis of the interviews and our final survey results. Under each subheading, we first present quotes from interviews, followed by descriptive statistics from the survey results. The subheadings indicate the most common themes from the interviews. The descriptive statistics for each survey question are provided in Appendix B.

### Lack of Knowledge and Time

A female CIS major stated, "I feel that they [females] think it's more computer science oriented, not so much on the business side, and they do not know much about it. It is not advertised enough." A non-CIS major stated, "I think a lot of people wrongly assume that putting together and taking apart a computer is what CIS majors do and females are just not typically attracted to that type of job. I think it would help if there was more clarification as to what a CIS major involves." All but one of the non-CIS majors we interviewed knew little or nothing about our college's CIS program, even though all of the respondents are enrolled in the College of Business.

Only 44% of the survey respondents indicated that they possess enough knowledge about the CIS major to decide whether to major or double-major in it. Even fewer students (20%) believed they have the time to major or double-major in CIS.

Table 1 provides descriptive statistics from the survey for each question relating to factors that might restrict females from becoming a CIS major. Students were asked to

rate each statement ranging from Strongly Agree (1) to Strongly Disagree (7).

Each question in Table 1 was proceeded with, "I _____ to major or double-major in CIS before graduating from college."

The percentages shown for "% Agree" and "% Disagree" do not add to 100% since some students chose Neutral for each question.

| Statement | Avg | % Agree | % Disagree |
|---|---|---|---|
| Have the time | 5.18 | 20% | 72% |
| Possess enough knowledge about the CIS major to decide whether | 3.88 | 44% | 40% |

**Table 1. Survey responses concerning lack of time and knowledge**

**Role Model Influence**

An international business major stated, "Several people influenced me, but I think that choosing a major is something that you need to do by yourself and for yourself, or else you'll never be content. My parents definitely did have an impact on me though." A female CIS major said, "I grew up around computers because of my dad and decided to choose this [major] because it is business-oriented." Another CIS female stated, "My two biggest influences were my parents and my professor that I had when I was a sophomore in college. My professor had explained the benefits of a CIS major and from this I became interested. I am now double majoring in Management and Computer Information systems. Also, my parents started an IT firm which has influenced me as well." Forty percent of the *interviewed* students acknowledged that their parents influenced them to choose their current major, while 20% were influenced by professors.

In the survey, we asked students to indicate whether certain role model groups believe they should major or double-major in Computer Information Systems (CIS). We used a seven-point scale ranging from Strongly Agree to Strongly Disagree to capture data about the following referent groups: 1) Parents, 2) friends, 3) professors, and 4) other people of importance to the student. Students used the seven-point scale to respond to the statement: _____ think I should major or double-major in Computer Information Systems before graduating from college.

Seventeen percent of students agreed (strongly agree, agree, or somewhat agree) that their parents think they should major or double-major in CIS. The percentage of students agreeing that the other referent groups think they should major or double-major in CIS were: 6% for "my friends", 23% for "my professors", and 14% for "others important to me". The data suggests that these referent groups do NOT believe students should major or double-major in CIS.

We also asked each student whether they tend to do what each referent group thinks they should do. Sixty percent of the students indicated that they tend to do what their parents think they should do, followed by 55% for "others important to me", 46% for "my professors", and 37% for "my friends."

Table 2 provides descriptive statistics from the survey for each question relating to several role model groups' influence on the student. Students were asked to rate each statement ranging from Strongly Agree (1) to Strongly Disagree (7).

Each question in Table 2 was proceeded with, "_____ think I should major or double-major in CIS before graduating from college."

The percentages shown for "% Agree" and "% Disagree" do not add to 100% since some students chose Neutral for each question.

| Statement | Avg | % Agree | % Disagree |
|---|---|---|---|
| My friends | 4.86 | 6% | 48% |
| Other people important to me | 4.69 | 14% | 43% |
| My parents | 4.60 | 17% | 43% |
| My professors | 4.41 | 23% | 37% |

**Table 2. Survey responses concerning referent groups**

**Confidence and Stereotypes**

In the interviews, one CIS student mentioned, "Many females find it too challenging and because the field is male dominated, females do not feel equipped enough to be a CIS major." Another female majoring in CIS explained how the CIS field is maybe a "little intimidating" for females. She stated, "When females seem to need help, they usually turn to a male for their help rather than another female." Eighty percent of the interview respondents stated that the CIS major is dominated by males. An international business major stated, "Computers have just typically been a male dominated profession, and it's just hard to get away from that stereotype. Women as a collective whole believe the stereotype that women aren't good at computers."

The survey results indicated that 64% of the respondents believe that majoring or double-majoring in CIS would be difficult, and 75% thought it would be stressful. However, only 14% believe that majoring or double-majoring in CIS would be considered "nerdy." In addition, 87% of the respondents disagreed that majoring or double-majoring in CIS is not a good choice for them as females "because CIS is mainly for males."

Table 3 provides descriptive statistics from the survey for each question relating to confidence and stereotypes. Students were asked to rate each statement ranging from Strongly Agree (1) to Strongly Disagree (7).

Each question in Table 3 was proceeded with, "Majoring or double-majoring in CIS before graduating from college _____."

| Statement | Avg | % Agree | % Disagree |
|---|---|---|---|
| Would be difficult for me | 3.05 | 64% | 22% |
| Would be considered "nerdy" | 5.40 | 14% | 72% |
| Is not a good choice for me because CIS is mainly for males | 6.06 | 4% | 87% |

**Table 3. Survey responses concerning difficulty and stereotypes**

Again, the percentages shown for "% Agree" and "% Disagree" do not add to 100% since some students chose Neutral for each question.

**Lack of Overall Intent**

None of the non-CIS majors indicated that they plan to major or double-major in CIS before they graduated. In the survey, we asked several questions to gauge students' intentions to become a CIS major or double-major.

Table 4 provides descriptive statistics from the survey for each question relating to each student's intention to major or double-major in CIS. Students were asked to rate each statement ranging from Strongly Agree (1) to Strongly Disagree (7).

Each question in Table 4 was proceeded with, "_____ become a major or double-major in CIS before graduating from college."

| Statement | Avg | % Agree | % Disagree |
|---|---|---|---|
| I plan to | 6.08 | 5% | 91% |
| I intend to | 6.05 | 5% | 85% |
| If possible, I will | 5.84 | 8% | 85% |

**Table 4. Survey responses concerning intentions**

## 5. DISCUSSION

In today's society, females who work in the computing field can help make a difference by leading other females into the field. This may include mentoring other women and allowing IS leaders, male and female alike, to look for females within their own organizations and find ways to teach them skills. Having women to take on leadership roles will allow other women to know that is indeed possible to work in the computing field.

Better informing high school and community college teachers, counselors, and students within the local population is a great way to help "recruit" women into the computing field (Cohoon, 2002). Throughout a female's high school education, it is important to communicate and express positive opinions towards the female's abilities which will help

boost self-confidence in computer skills. Allowing guest speakers from different universities to come and speak about CIS programs will help females learn about the possible options towards their career paths. Providing information about computer information systems and what exactly it is will also help females understand more about the field.

Our research indicates that females who are pursuing a major are influenced by several role models. Furthermore, the lack of knowledge about computer information systems can prevent an individual from becoming a CIS major. As previously stated, the stereotype about how males seem to dominate the computing field still stands as a perception in the minds of females. These factors provide support for why there are few females in the CIS major. The interview results provide us a better understanding of which factors are most important. The Association of Information Technology Professionals (AITP), as well as other organizations interested in increasing the number of CIS majors, can use these findings to target those areas needing more attention and to stimulate greater interest from female students.

In recent years, the shortage of females entering CIS or related computing fields has become a growing concern. The reasons behind this are due to many socialization and psychological factors. Our study found that several factors impact females' attitudes and beliefs about the CIS major. These include an overall lack of knowledge about the CIS major, the influence of role models such as parents and professors, confidence issues, and traditional stereotypes.

## 6. LIMITATIONS AND IDEAS FOR FUTURE WORK

A limitation of this study was the relatively small sample of females (ten interviews and 100 surveys) taken from the College of Business at three universities. Future research should include additional interviews and a survey administered to more students at more schools so that a larger sample can be reached. With a larger sample, the theory of planned behavior can be used to determine which factors are statistically significant in influencing a female whether to become a CIS major. We plan to ask other universities if they will allow their female students to complete our survey.

## 7. CONCLUSION

Our study provides evidence from both thematic analysis of interview data and results from descriptive statistics that several factors influence females whether to become CIS majors. Females may lack knowledge about the CIS major, perceiving it as more computer-science and technical as opposed to business-related. Even though several groups of role models (such as parents and professors) influence what female students decide to do, the survey results indicate that these referent groups do not believe that females should major or double-major in CIS. The female respondents believe that the CIS major is dominated by males and perceive technology-related jobs to be male-dominated as well. A majority of the respondents believed that it would be difficult and stressful to major or double-major in CIS. Confidence issues and stereotypes about the traditional technology worker also arose in this research.

The findings from our current study, combined with future work, research, and surveys, will help us to better understand the most effective ways to increase the number of female CIS majors. Collecting additional data from more universities will allow us to use the theory of planned behavior to determine which of these factors are truly significant in influencing females whether to become a CIS major.

## 8. REFERENCES

Ajzen, Izek. (1991) The Theory of Planned Behavior. Organizational Behavior and Human Decision Processes, 50, 179-211.

Ajzen, Izek and T.J. Madden (1986) Prediction of Goal-Directed Behavior: Attitudes, Intentions, and Perceived Behavioral Control. Journal of Experimental Social Psychology, 22, 453-474.

Aronson, J. (1994) A Pragmatic View of Thematic Analysis, Accessed 1 Oct. 2007, <http://www.nova.edu/ssss/QR/BackIssues/QR2-1/aronson.html>.

Bernstein, Danielle R. (1999) Java, Women and the Culture of Computing, Accessed 9 Feb. 2007,

<http://www.kean.edu/~dbernste/naccq.html>.

Boyatzis, R. (1998). Transforming Qualitative Information: Thematic Analysis and Code Development. Thousand Oaks, CA: Sage.

Canter, Lee and Marlene Canter (1991) Parents on Your Side: A Comprehensive Parent Involvement Program for Teachers, Lee Canter and Associates: Santa Monica, CA.

Cohoon, J.M. (2002) Recruiting and Retaining Women in Undergraduate Computing Majors. ACM SIGCSE Bulletin, 34 (2) 48-49.

Cohoon, J.M. and W. Aspray (2006) Women and Information Technology. The MIT Press, Cambridge, MA.

Cooper, Joel and Kimberlee D. Weaver (2003) Gender and Computers. Lawrence Erlbaum Associates, Mahwah, New Jersey.

Cory, S N, M.J. Parzinger, and T.E. Reeves. Are High School Students Avoiding the Information Technology Profession Because of the Masculine Stereotype? In The Proceedings of ISECON 2005, v 22 (Columbus OH): §3373. ISSN: 1542-7382.

Cukier, W, D Shortt, and I Devine. Gender and Information Technology: Implications of Definitions. In The Proceedings of ISECON 2001, v 18 (Cincinnati): §06a.

Durndell, A., Siann, G., and Glissov, P. (1990) Gender Differences and Computing in Course Choice at Entry into Higher Education. British Educational Research Journal, 16 (2) 149.

Foster, A.L. (2005) Student Interest in Computer Science Plummets. The Chronicle of Higher Education, May 27, 2005, pp. A31 – A32.

Gaudin, Sharon. (1999) The Critical Shortage of Women in IT. Network World, Accessed 10 Feb. 2007, <http://www.networkworld.com/news/1999/1122women.html>.

Graham, S. (2004) Waterloo Offers CS Seminar for High School Girls. Computing Research News, 16 (1) 2.

Greer, T. (2002) An Educator's Guide to Gender Bias Issues. University of Illinois, Accessed 11 Feb. 2007, <http://lrs.ed.uiuc.edu/wp/access/gender.html>.

IT Labor Supply Tightens. (2007) Computer Economics, Accessed 9 Feb. 2007, <http://www.computereconomics.com/page.cfm?name=Staffing%20Trends>.

IT Skills to Be In Short Supply In 2007. (2007) One Stop Click News, Accessed 7 Feb. 2007, <http://www.onestopclick.com/news/IT-skills-to-be-in-short-supply-in-2007_18051859.html>.

Lenox, T.L., C.R. Woratschek, and G.A. Davis. Exploring Declining CS/IS/IT Enrollments. In The Proceedings of ISECON 2005, v 22 (Columbus OH): §3124. ISSN: 1542-7382.

Li, S., H. Records, and K. Fougere (2004) An Exploratory Investigation of Gender Difference in Student Selection of a CIS Minor. Issues in Information Systems, 5 (2) 598.

Lomerson, William L. and Lissa Pollacia (2006). Declining CIS Enrollment: An Examination of Pre-College Factors. Information Systems Education Journal, 4 (35). http://isedj.org/4/35/. ISSN: 1545-679X.

Margolis, J., A. Fisher, and F. Miller (2000) The Anatomy of Interest: Women in Undergraduate Computer Science. Carnegie Mellon University, Accessed 8 Feb. 2007, <http://www.cs.cmu.edu/afs/cs.cmu.edu/project/gendergap/projects/ papers/anatomyWSQ99.html>.

Mathis, S G. Encouraging Undergraduate Women In Computing: A Preliminary Study. In The Proceedings of ISECON 2001, v 18 (Cincinnati): §06b.

Mento, B., S. Sorkin, and T. Prettyman. Encouraging Women and Minorities to Attain Degrees in Computing and Related Fields. In The Proceedings of ISECON 2006, v 23 (Dallas): §2343. ISSN: 1542-7382.

Neel, J.N. and P.A. Joseph. Women in Computing and Information Systems. In The Proceedings of ISECON 2006, v 23 (Dallas): §3534. ISSN: 1542-7382.

Nicolai, B J. Identifying Effective Factors for Women Participation in Technology: A Database Model. In The Proceedings of ISECON 2003, v 20 (San Diego): §3123. ISSN: 1542-7382.

Nicolai, B J. The Invisible Society of Women in Technology: Young Women's Reluctance to Enter the Technology Field. In The Proceedings of ISECON 2001, v 18 (Cincinnati): §06c.

Nobel, C. (2007) Women in Technology: A Call to Action. InfoWorld, Accessed 29 Jan. 2007, <http://www.infoworld.com/article/07/01/29/05FEwomentech_1.html>

Pollacia, L. and William Lomerson, (2006) William L. Analysis of Factors Affecting Declining CIS Enrollment. Issues in Information Systems, 7 (1) 220-221.

Roberts, Eric S., M. Kassianidou, and L. Irani (2002) Encouraging Women in Computer Science. ACM SIGCSE Bulletin, 34 (2) 86.

Varma, R. (2001) Barriers to Overcome: Women in Information Technology. Society for Engineering Education Annual Conference & Exposition, University of New Mexico, NM, 6.

Wilder, G., D. Mackie, and J. Cooper (1985) Gender and Computers: Two Surveys of Computer Related Attitudes. Sex Roles, 13 (3) 4.

**APPENDIX A - Interview Questions for Females in the College of Business**

1. Have you chosen a major? If so what year are you and what is your major?
2. What are some reasons why you chose this major?
3. What factors most influenced your decision to enter the XXXXXX major?
4. Have you taken any computer courses? Were they required?
5. Did anyone have an influence on you when it came to you choosing your major?
6. Are there any other influences (if any) that encouraged you to choose your major?
7. When did you decide to choose this major?
8. During college have you changed your major? If so, how many times and why?
9. Are there any factors that may be pushing you to consider changing your major?
10. What information do you know about the CIS major?
11. Do you enjoy working with computers? If so why?
12. How do you feel about being a CIS major?
13. How would you feel about becoming a double-major in CIS (as well as your current major)? Why?
14. What are your thoughts about why there are not many female students in the CIS major?
15. What do you think would encourage MORE females to become CIS majors?

**APPENDIX B – Descriptive Statistics from Survey**

| **Majoring or double-majoring in Computer Information Systems before graduating from college:** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Strongly Agree | Agree | Some what Agree | Neutral | Disagree Some-what | Disag-ree | Strongly Disag-ree | **Rating Aver-age** |
| Would enable me get a good paying job upon graduation from college. | 20.0% (20) | **40.0 % (40)** | 20.0 % (20) | 11.0% (11) | 3.0% (3) | 5.0% (5) | 1.0% (1) | 2.56 |
| Would be considered "nerdy." | 0.0% (0) | 1.0% (1) | 13.0 % (13) | 14.0% (14) | 12.0% (12) | **37.0% (37)** | 23.0% (23) | 5.40 |
| Would provide me a number of job oppor-tunities upon gradua-tion from college. | 24.0% (24) | **41.0 % (41)** | 23.0 % (23) | 9.0% (9) | 1.0% (1) | 2.0% (2) | 0.0% (0) | 2.28 |
| Would be worthwhile to me. | 3.0% (3) | 24.0 % (24) | **31.0 % (31)** | 19.0% (19) | 14.0% (14) | 8.0% (8) | 1.0% (1) | 3.45 |
| Is not a good choice for me as a female be-cause CIS is mainly for males. | 0.0% (0) | 0.0% (0) | 4.0% (4) | 9.0% (9) | 10.0% (10) | 31.0% (31) | **46.0% (46)** | 6.06 |
| Would be difficult for me. | 20.0% (20) | **28.0 % (28)** | 16.0 % (16) | 14.0% (14) | 10.0% (10) | 9.0% (9) | 3.0% (3) | 3.05 |

**_____ think I should major or double-major in Computer Information Systems before graduating from college:**

| | Strongly Agree | Agree | Somewhat Agree | Neutral | Disagree Somewhat | Disagree | Strongly Disagree | **Rating Average** |
|---|---|---|---|---|---|---|---|---|
| My parents | 3.0% (3) | 6.0% (6) | 8.0% (8) | **40.0% (40)** | 8.0% (8) | 24.0% (24) | 11.0% (11) | 4.60 |
| My friends | 3.0% (3) | 2.0% (2) | 1.0% (1) | **46.0% (46)** | 6.0% (6) | 32.0% (32) | 10.0% (10) | 4.86 |
| My professors | 3.0% (3) | 9.0% (9) | 11.0% (11) | **40.0% (40)** | 4.0% (4) | 24.0% (24) | 9.0% (9) | 4.41 |
| Other people important to me | 1.0% (1) | 3.0% (3) | 10.0% (10) | **43.0% (43)** | 7.0% (7) | 27.0% (27) | 9.0% (9) | 4.69 |
| No one important to me | 5.0% (5) | 13.0% (13) | 3.0% (3) | **44.0% (44)** | 5.0% (5) | 23.0% (23) | 7.0% (7) | 4.28 |

**I _____ to major or double-major in Computer Information Systems before graduating from college.**

| | Strongly Agree | Agree | Somewhat Agree | Neutral | Disagree Somewhat | Disagree | Strongly Disagree | **Rating Average** |
|---|---|---|---|---|---|---|---|---|
| Have the ability to choose whether | 19.0% (19) | **37.0% (37)** | 18.0% (18) | 9.0% (9) | 5.0% (5) | 7.0% (7) | 5.0% (5) | 2.85 |
| Possess enough knowledge about the CIS major to decide whether | 4.0% (4) | **26.0% (26)** | 14.0% (14) | 16.0% (16) | 19.0% (19) | 16.0% (16) | 5.0% (5) | 3.88 |
| Have the resources | 8.0% (8) | **34.0% (34)** | 18.0% (18) | 19.0% (19) | 4.0% (4) | 11.0% (11) | 6.0% (6) | 3.34 |
| Have the time | 1.0% (1) | 7.0% (7) | 12.0% (12) | 8.0% (8) | 22.0% (22) | **25.0% (25)** | **25.0% (25)** | 5.18 |

| **_____ become a major or double-major in Computer Information Systems before graduating from college.** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Strongly Agree | Agree | Some-what Agree | Neutral | Disagree Some-what | Disagree | Strongly Disagree | **Rating Average** |
| I intend to | 4.0% (4) | 0.0% (0) | 1.0% (1) | 5.0% (5) | 9.0% (9) | 34.0% (34) | **47.0% (47)** | 6.05 |
| If possible, I will | 3.0% (3) | 2.0% (2) | 3.0% (3) | 7.0% (7) | 11.0% (11) | 33.0% (33) | **41.0% (41)** | 5.84 |
| I plan to | 4.0% (4) | 0.0% (0) | 1.0% (1) | 4.0% (4) | 8.0% (8) | 36.0% (36) | **47.0% (47)** | 6.08 |

| **Generally speaking, I do what _____ think I should do.** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Strongly Agree | Agree | Some-what Agree | Neutral | Disagree Some-what | Disagree | Strongly Disagree | **Rating Average** |
| My parents | 10.0% (10) | 29.0% (29) | **31.0% (31)** | 13.0% (13) | 7.0% (7) | 8.0% (8) | 2.0% (2) | 3.10 |
| My friends | 0.0% (0) | 7.0% (7) | **30.0% (30)** | 17.0% (17) | 11.0% (11) | 22.0% (22) | 13.0% (13) | 4.50 |
| My profes-sors | 2.0% (2) | 17.0% (17) | **27.0% (27)** | 17.0% (17) | 9.0% (9) | 19.0% (19) | 9.0% (9) | 4.07 |
| Other people important to me | 3.0% (3) | 19.0% (19) | **33.0% (33)** | 10.0% (10) | 12.0% (12) | 14.0% (14) | 9.0% (9) | 3.87 |
| No one important to me | 0.0% (0) | 1.0% (1) | 0.0% (0) | 28.0% (28) | 9.0% (9) | **34.0% (34)** | 28.0% (28) | 5.59 |

**Having the _____to become a Computer Information Systems major or double-major would make it [much easier----------much more difficult] for me when deciding upon my emphasis in college.**

| | Much Easier | Easier | Some-what Easier | Neutral | Some-what More Difficult | More Difficult | Much More Difficult | **Rating Average** |
|---|---|---|---|---|---|---|---|---|
| Ability | 17.0% (17) | 22.0% (22) | 24.0% (24) | **31.0% (31)** | 2.0% (2) | 4.0% (4) | 0.0% (0) | 2.91 |
| Background Knowledge (about CIS) | 17.0% (17) | **30.0% (30)** | 21.0% (21) | 27.0% (27) | 2.0% (2) | 3.0% (3) | 0.0% (0) | 2.76 |
| Resources | 9.0% (9) | 22.0% (22) | 29.0% (29) | **35.0% (35)** | 4.0% (4) | 1.0% (1) | 0.0% (0) | 3.06 |
| Time | 25.0% (25) | **28.0% (28)** | 22.0% (22) | 18.0% (18) | 3.0% (3) | 3.0% (3) | 1.0% (1) | 2.59 |

**Becoming a major or double-major in Computer Information Systems before I graduate from college is a _____ idea.**

| | **Response Percent** |
|---|---|
| **Very Good** | **6.0%** |
| **Good** | **23.0%** |
| **Somewhat Good** | **24.0%** |
| **Neutral** | **18.0%** |
| **Somewhat Bad** | **11.0%** |
| **Bad** | **12.0%** |
| **Very Bad** | **6.0%** |

| Becoming a major or double-major in Computer Information Systems before I graduate from college is a _____ idea. | Response Percent |
|---|---|
| Very Positive | 8.0% |
| **Positive** | **31.0%** |
| Somewhat Positive | 20.0% |
| Neutral | 20.0% |
| Somewhat Negative | 4.0% |
| Negative | 13.0% |
| Very Negative | 4.0% |

| Becoming a major or double-major in Computer Information Systems before I graduate from college is a _____ idea. | Response Percent |
|---|---|
| Very Helpful | 6.0% |
| **Helpful** | **25.0%** |
| Somewhat Helpful | 24.0% |
| **Neutral** | **25.0%** |
| Somewhat Unhelpful | 5.0% |
| Unhelpful | 9.0% |
| Very Unhelpful | 6.0% |

| **Please rate the following statements on a scale from Very Undesirable to Very Desirable.** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Very Desirable | Desirable | Somewhat Desirable | Neutral | Somewhat Undesirable | Undesirable | Very Undesirable | **Rating Average** |
| Getting a good paying job upon graduation from college is | **72.0% (72)** | 21.0% (21) | 5.0% (5) | 2.0% (2) | 0.0% (0) | 0.0% (0) | 0.0% (0) | 1.37 |
| Being considered "nerdy" is | 0.0% (0) | 6.0% (6) | 18.0% (18) | **46.0% (46)** | 21.0% (21) | 7.0% (7) | 2.0% (2) | 4.11 |
| Having a number of job opportunities upon graduation from college is | **74.0% (74)** | 21.0% (21) | 3.0% (3) | 2.0% (2) | 0.0% (0) | 0.0% (0) | 0.0% (0) | 1.33 |
| Doing something worthwhile to me is | **68.0% (68)** | 27.0% (27) | 3.0% (3) | 2.0% (2) | 0.0% (0) | 0.0% (0) | 0.0% (0) | 1.39 |
| As a female, choosing a major which consists mainly of males is | 7.0% (7) | 18.0% (18) | 20.0% (20) | **46.0% (46)** | 7.0% (7) | 2.0% (2) | 0.0% (0) | 3.34 |
| Doing something difficult is | 8.0% (8) | 25.0% (25) | **37.0% (37)** | 15.0% (15) | 12.0% (12) | 3.0% (3) | 0.0% (0) | 3.07 |

| I would _____ becoming a Computer Information Systems major or double-major before I graduate from college. | Response Percent |
|---|---|
| Love | 6.0% |
| Somewhat Love | 15.0% |
| **Be Neutral** | **44.0%** |
| Somewhat Hate | 17.0% |
| Hate | 18.0% |

| I would _____ becoming a Computer Information Systems major or double-major before I graduate from college. | Response Percent |
|---|---|
| Be Excited About | 9.0% |
| Be Somewhat Excited About | 22.0% |
| **Be Neutral About** | **31.0%** |
| Be Somewhat Bored About | 19.0% |
| Be Bored About | 19.0% |

| **I would _____ becoming a Computer Information Systems major or double-major before I graduate from college.** | |
|---|---|
| | **Response Percent** |
| Be Happy | 11.0% |
| Be Somewhat Happy | 26.0% |
| **Be Neutral About** | **33.0%** |
| Be Somewhat Unhappy | 9.0% |
| Be Unhappy | 21.0% |

| **I would _____ becoming a Computer Information Systems major or double-major before I graduate from college.** | |
|---|---|
| | **Response Percent** |
| **Be Stressed** | **49.0%** |
| Be Somewhat Stressed | 26.0% |
| Be Neither Stressed nor Relaxed | 23.0% |
| Be Somewhat Relaxed | 1.0% |
| Be Relaxed | 1.0% |