Gender Differences in Attitudes toward IT among IT Majors

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The decline in number of students choosing to pursue careers in computing requires a research focus on students' attitudes toward the subject-matter. The focus on reducing gender disparity across all computing-related fields takes on greater urgency as the nation cannot afford to ignore the potential contributions of half of its population. For the purposes of this article, all computing-related science, technology, and business programs are being referred to by a common title Information Technology (IT). The purpose of this study was to investigate attitudes toward IT among undergraduate IT majors, using an existing scale that comprises of five factors. In particular, the intention was to seek deeper insights into attitudes of IT majors toward female participation in IT and explore the differences by gender and class standing. The population consisted of IT-related majors at a large public institution. An analysis of data revealed crucial differences by gender and class standing for key factors that contribute to the overall attitude toward IT.

INTRODUCTION

The investigation of students' attitudes toward information technology (IT) has been a substantive feature of the work of the education research community for the past few decades (George, 2006). Its current importance is emphasized by evidence of continued insufficient interest in this field resulting in a shortfall of computer scientists, engineers, and technologists in the workforce (Daempfle, 2003; National Council for Research on Women, 2001; Whalen & Shelley, 2010). This challenge is exacerbated by a projected demand for these professions; in the U.S., it is predicted to increase by 22%, whereas the labor force will increase by only 15% (Bureau of Labor Statistics, 2011). Maintaining a diverse enrollment to include women, who now make up nearly half of the labor force, is of even more concern (Dorpenyo, 2011).

The continuing insufficiency in the number of students choosing to pursue careers in computing requires a research focus on students' attitudes toward IT if the nature of the problem is to be understood and remediated (Osborne, et al. 2003). An increase in women pursuing technical majors does not necessarily translate into women entering and succeeding in scientific and technological careers (Etzkowitz, et al., 2000). Several studies have identified attitude as one of the strongest factors influencing on-the-job success in a technical field (Agbonlahor, 2008). Holt and Crocker (2000) observed that successful use of technology in a business depends not only on the technology itself, but also on the levels of skills and expertise of the employees using the technology. They, however, noted that though the

skills of an individual can be improved by proper training, the attitudes of a user towards the technology will affect his/her willingness to learn about the technology, the decision to use the technology, and the actual uses to which the technology is put.

According to a study of bachelor degrees awarded between 1966 to 2001 women hold nearly half of all the degrees awarded; however, the gap between the number of women receiving science and engineering degrees as opposed to other degrees has increasingly widened (National Science Foundation, 2004). The authors of this study set out to investigate the attitudes of students in computing-related majors toward IT in general and particularly toward female participation in IT. For the purposes of this article, all computing-related science, technology, and business programs are being referred to by a common title – Information Technology.

REVIEW OF LITERATURE

This section reviews literature that establishes the importance of studying students' attitudes because of the relationship between attitudes and the careers that students pursue. Also, studies that focus on gender differences in attitudes toward IT are analyzed along with the treatments that help students overcome those differences.

Correlation Between Attitude and Behavior

Attitude is an important concept that is often used to understand and predict people's reaction to an object or change and how behavior can be influenced (Fishbein and Ajzen, 1975). Perhaps the most influential definition has been that of Allport, presented in 1935, and emphasized in two succeeding editions of The Handbook of Social Psychology (1968): "An attitude is a mental and neutral state of readiness, organized through experience, exerting a directive or dynamic influence upon the individual's response to all objects and situations with which it is related." Features of the above can be found in most definitions of attitude.

Fishbein and Ajzen's Theory of Reasoned Action (Fishbein 1963; Fishbein 1967; Fishbein and Ajzen 1974; Fishbein and Ajzen 1975; Fishbein and Ajzen 1975; Ajzen and Fishbein 1980; Ajzen 1985; Ajzen and Madden 1986) has had broad application in explaining behavior. The theory proposes that an individual's behavior is ultimately determined by the beliefs and attitudes of that individual. A short overview of the Theory of Reasoned Action is given below as the conceptual foundation for the study.

Theory of Reasoned Action

This theory is built using five constructs: beliefs; attitudes; intentions; subjective norms; and behaviors. The theory uses the following definitions for these constructs (Ajzen and Fishbein 1980). Beliefs represent the information an individual has about an object. A belief links an attribute to an object. Attitude refers to a person's degree of evaluative affect toward a target behavior. Intention is the subjective probability that an individual will perform a specified behavior, it is considered a type of belief where the target is always the individual and the attribute is always some behavior. Subjective norm is a person's perception of the social pressures applied to perform or not perform the behavior in question by important referents. Behaviors are specific observable acts of the subject. Behaviors may be defined with respect to the action performed, a specific target, the context, and the timeframe of interest.

Beliefs form the building blocks in the framework. Based on observations, reflection and experiences, an individual develops a belief system. This belief system at any given time determines the individual's attitudes, subjective norms, intentions, and behaviors. This approach assumes a rational individual whose beliefs, attitudes, subjective norms, and intentions are internally consistent with one another and externally consistent with reality. Using the set of beliefs toward the outcomes of performing a specific behavior, an individual then forms a favorable or unfavorable attitude about performing that behavior (for example, selecting a major). Based on this attitude and the subjective norm for performing the behavior that the individual perceives, a person forms an intention to perform the behavior. This intention corresponds directly to a related specific behavior. However, individuals may not perform according to

their intentions due to a lack of volitional control to carry out an intended behavior, adding even more complexity to understanding the behavior patterns.

Based on the above theory, although not directly salient to a student's intention to pursue an IT-related major or enter the IT workforce, it is likely that an individual's attitude toward IT might influence these types of behaviors. For this reason, an empirical study was conducted to identify attitudes toward IT of undergraduate students in IT-related majors.

Correlation Between Gender and Attitude toward IT

Of all the variables that may influence attitude toward IT, gender has generally been shown to have a consistent influence (Weinburgh, 1998). Research shows that there are no significant gender differences in attitudes toward technology among students in elementary grades (Simpson and Oliver, 1990; Jones et al., 2000; Mullis et al., 2000; Breakwell and Robertson, 2001). These differences start to emerge with teenage students and continue thereafter. Studies on women and science found significant gender differences, with women being less positive toward science (Fox and Firebaugh, 1992; Trankina, 1993; Pifer, 1996; Barke et al., 1997). Females can succeed in school including science and math and yet have less positive attitudes toward science. Additionally, studies have shown that men, in spite of lower proficiency in math and science are more apt to continue studying science (Weinburgh, 1998). In a study of students who planned to major in science and technology, it was found that females generally found these disciplines uninteresting and these professionals' lifestyle (as perceived by them) unattractive (Miller, et al., 2006). So the question arises, how do students form more positive attitudes toward IT? Research posits that positive attitudes toward computing could be influenced with greater exposure to IT and thereby reducing differences in gender.

Correlation Between Exposure to IT and Attitude toward IT

The complex relation between knowledge of and attitudes toward IT has been the object of numerous studies. Empirical efforts aiming at understanding the patterns of this relationship suggest that knowledge has an effect on the consistency and discrimination with which attitudes are held (Evans and Durant, 1995). Research has demonstrated that attitudes toward IT become more positive with greater exposure to these disciplines (Gogolin & Swartz, 1992). In addition, the number of math and science courses taken in high school has been shown to directly influence the major chosen in college (Maple & Stage, 1991). Therefore, one can reasonably expect that there would be minimal gender differences in attitudes toward IT among IT majors.

PURPOSE OF THE STUDY

The purpose of this study was to investigate attitudes toward IT among IT majors. In particular, this research intends to provide deeper insights into attitudes of IT majors toward female participation in IT and explore the differences by gender and class standing.

RESEARCH QUESTIONS

The research questions examined in this study were these:

1. Is there a significant difference in attitude toward IT between male and female students in IT-related majors?
2. Is there a significant difference in attitude toward IT between freshman and seniors in IT-related majors?
3. Is there a significant difference in attitude toward female participation in IT between male and female IT-related majors?
4. Is there a significant difference in attitudes toward female participation in IT between freshman and seniors in IT-related majors?

POPULATION AND SAMPLE

The population for this study comprised of students in IT-related majors at a large, public, moderately selective four-year institution in Illinois. The IT-related majors include accounting information systems, business information systems, computer science, computer systems technology, information systems, and telecommunications management. The sample consisted of freshman and senior students enrolled in the IT-related majors mentioned above, and they fully represent the diversity of the University and the State of Illinois – from Chicago urban areas to small rural communities. Typically, the university accepts seventy-five percent of the freshman applicants, and based on self-identification, about 80 percent of the students are White, with an ACT composite test average around 24, compared with the national average of 21. These statistics present a picture of a moderately selective institution with a diverse student body fairly similar to that of other moderately selective US four year institutions of higher education.

Of the 325 participants in this study, there were 143 seniors and 182 freshmen, and 105 females and 220 males. Participation in the study was strictly voluntary. Students indicated their agreement to participate in the study by completing the Scale, as was outlined in the directions of the survey. Prior to giving the survey, proper approval was obtained from the Institutional Review Board for the Protection of Human Subjects at the authors' home institution.

MEASUREMENT

This study used an existing scale to measure students' attitudes. Gokhale, Machina, and Brauchle (2012) developed and validated the Attitudes toward Information Technology (A-IT) Scale designed to measure attitudes of college students toward IT in general, and more specifically, the attitudes most relevant to female participation in those fields. The A-IT Scale contains 30 items. The statements are in the form of a Likert scale, with each statement having five choices, ranging from A to E, with 'A' indicating strongly agree, 'C' being neutral, and 'E' indicating strongly disagree. When assessing the Scale, the norm group consisted of freshman (N = 535) at a large four-year institution. Validity and reliability of the scale were examined using semantic analysis, Cronbach's alpha, and factor analyses.

The factor analysis revealed five factors; all five orthogonal factors had eigenvalues greater than unity. These analyses are a major justification for the validity of this Scale. Cronbach's coefficient alphas were calculated for the 30 item instrument as a whole, for all factors together, and individually for each of the five factors. The five factors together accounted for 51% of the variance in the instrument. The overall coefficient alpha for the 30-item instrument was 0.85. For the five factors composed of 23 out of 30 items, the coefficient alpha was 0.81.

The A-IT Scale measures the following factors that comprise attitudes toward IT: (1) interest in learning about IT, (2) practical value of IT, (3) positive effect of IT on work life, (4) gender equality of opportunity in IT, and (5) negative impact of IT. All extracted factors had eigenvalues of > 1. Items were determined to belong to a subscale if they had factor loadings of $\geq$ 0.425 on the associated rotated factor. Within each factor, correlations ranged from .627 to .749, which evidences that each factor measures a unique aspect of the students' attitudes towards IT. These results confirm the suitability of the scale for this study.

As recommended by the developers of the Scale, after conducting the surveys, during data entry, statements reflecting a positive attitude are scored 5-1 (A=5, B=4, C=3, D=2, E=1); statements reflecting a negative attitude are scored in reverse, from 1-5 (A=1 ... E=5). The positively- and negatively-worded statements were identified by the Scale developers.

In addition to the A-IT Scale, the study inquired about demographic information including gender (1 = male, 0 = female) and class standing (1 = freshman, 0 = senior). These demographic items were used as independent variables. The dependent variables were the five factors in the A-IT Scale administered to the participants of this study.

RESULTS

To analyze the data, a Multivariate Analysis of Variance (MANOVA) was conducted for each independent variable (gender and class standing), with the five factors as dependent variables. The results for each were then analyzed for significance using Wilks' Lambda, with an alpha value of 0.05. For tests having significance, a One-Way Analysis of Variance (ANOVA) was then conducted.

Table 1 lists the frequencies of the demographic information about participants in this study. Although the sample was evenly divided among freshman and seniors, the distribution was uneven with respect to gender. There were fewer females as compared to males, and these numbers are directly proportional to the gender ratio among IT majors.

Significant differences among means are indicated along with the level of significance in Tables 2 through 5. Tables 2 and 3 show means and standard deviations of students' attitudes in each subscale (dependent variables) by the independent variable: gender and class standing, respectively. Table 2 posits that when compared to females, males have greater interest in IT, regard that IT has practical value, and hold the belief that both genders have equal opportunity in IT. In other words, females believe that both genders do not have equal opportunity in IT, females have less opportunity than their male counterparts. Table 3 shows that when compared to freshman, seniors are more interested in learning about IT, and believe that IT has a positive effect on work life.

Tables 4 and 5 indicate the results of deeper analysis of data. As seen in Table 4, when compared to freshman females, freshman males are more interested in learning about IT and overwhelmingly believe in gender equality of opportunity in IT. However, it is interesting to note that senior males and females have equal interest in learning about IT, and senior males are not as emphatic in their belief of gender equality of opportunity in IT. Table 5 indicates that there is only one significant difference among freshman and senior females—senior females are more interested in learning about IT than their freshman counterparts.

TABLE 1
DEMOGRAPHIC DATA

Independent Variables	Level	Frequency	Percent
Gender	Male	219	67%
	Female	106	33%
Class Standing	Freshman	172	53%
	Seniors	153	47%

TABLE 2
T-TEST RESULTS WITH MEANS AND STANDARD DEVIATIONS BY GENDER FOR FACTORS OF ATTITUDE TOWARD IT SCALE

Gender	Factor 1 Interest in learning about IT	Factor 2 Practical value of IT	Factor 3 Negative impact of IT	Factor 4 Gender equality of opportunity in IT	Factor 5 Positive effect of IT on work life
Female (106)	3.34 (.59)	3.45 (.51)	2.57 (.67)	3.04 (.70)	3.42 (.37)
Male (219)	3.59* (.74)	3.61* (.57)	2.67 (.80)	3.49*** (.77)	3.50 (.40)

*p < .05, ** p < .01, *** p< .001

TABLE 3
T-TEST RESULTS WITH MEANS AND STANDARD DEVIATIONS BY CLASS STANDING FOR FACTORS OF ATTITUDE TOWARD IT SCALE

Class Standing	Factor 1 Interest in learning about IT	Factor 2 Practical value of IT	Factor 3 Negative impact of IT	Factor 4 Gender equality of opportunity in IT	Factor 5 Positive effect of IT on work life
Senior (153)	3.66** (.68)	3.57 (.56)	2.63 (.74)	3.37 (.79)	3.51* (.39)
Freshman (172)	3.32 (.71)	3.52 (.55)	2.71 (.83)	3.32 (.77)	3.42 (.41)

*p < .05, ** p < .01, *** p< .001

TABLE 4
T-TEST RESULTS WITH MEANS AND STANDARD DEVIATIONS BY GENDER WITHIN CLASS STANDING FOR FACTORS OF ATTITUDE TOWARD IT SCALE

	Factor 1 Interest in learning about IT	Factor 2 Practical value of IT	Factor 3 Negative impact of IT	Factor 4 Gender equality of opportunity in IT	Factor 5 Positive effect of IT on work life
Freshmen					
Male (n = 106)	3.41* (.74)	3.57 (.60)	2.71 (.89)	3.53*** (.71)	3.46 (.39)
Female (n = 58)	3.13 (.62)	3.46 (.45)	2.63 (.58)	2.92 (.72)	3.39 (.45)
Seniors					
Male (n = 113)	3.70 (.73)	3.62 (.55)	2.64 (.75)	3.45* (.80)	3.53 (.41)
Female (n = 48)	3.51 (.51)	3.44 (.54)	2.51 (.73)	3.14 (.68)	3.45 (.29)

*p < .05, ** p < .01, *** p< .001

TABLE 5
T-TEST RESULTS WITH MEANS AND STANDARD DEVIATIONS BY CLASS STANDING AMONG FEMALES FOR FACTORS OF ATTITUDE TOWARD IT SCALE

T-test results of the perceptions of S & T by class within Females					
	Factor 1 Interest in learning about IT	Factor 2 Practical value of IT	Factor 3 Negative impact of IT	Factor 4 Gender equality of opportunity in IT	Factor 5 Positive effect of IT on work life
Freshmen Female (n = 58)	3.14 (.62)	3.45 (.45)	2.64 (.59)	2.92 (.72)	3.39 (.45)
Senior Female (n = 48)	3.51** (.51)	3.44 (.55)	2.52 (.73)	3.14 (.68)	3.45 (.29)

*p < .05, ** p < .01, *** p< .000

DISCUSSION

This study produced crucial differences by gender and class standing for key factors that contribute to the overall attitude toward IT.

Interest in Learning about IT

This study found that as compared to females, males are more interested in IT; the significance was at the 0.05 level as shown in Table 2. Additionally, seniors as compared to freshman have more interest in IT; the significance was at the 0.01 level as shown in Table 3. However, upon looking deeper, it was found that females who have taken more courses in IT demonstrate more interest in the field, which relates directly to the class standing. This is evident from Table 4 which shows no significant difference among male and female seniors regarding interest in IT, and a significant difference at the 0.01 level as shown in Table 5 depicting that senior females have more interest in IT as compared to freshman females. Since this was not a longitudinal study, however, these results do not by themselves show that increased interest in IT is the result of taking courses in IT; it is possible that the higher average interest level within the population of senior females results from female attrition in IT majors due to lack of interest, so that only those females who were antecedently more interested pursued their IT major all the way to the senior year.

In many countries, students' attitudes toward IT appear to be becoming more negative, with females' perceptions being more negative than those of the males' (Gedrovics, Wareborn, and Jeronen, 2006). In a meta-analysis of 106 studies, Liao (1999) found that males had slightly more positive attitudes toward technology. In yet another study, male students indicated a statistically significant more positive attitude for STEM when compared to the female students (Mahoney, 2010). Although females tend to hold more positive attitudes toward school and learning, males continue to maintain better attitudes toward science and are more motivated to succeed in science (Simpson & Oliver, 1985). These results, showing that females can succeed in school yet still have less positive attitudes toward science, support the continued underrepresentation of women in the sciences.

With some exceptions, many studies find that the level of experience with technology correlates with liking and interest. Typically, computer liking and interest decrease with age for both males and females but more strongly for females (Gurer & Camp, 2002; Lage, 1991; Shashaani, 1993; Whitley, 1997). In order to be confident in the hands-on world of science and math problems, males are often much better prepared for what lies ahead than females, well before they even start at pre-school (Dorpenyo, Isidore Kafui, 2011). By the time they reach college, where labs involve hands-on type of environment, may males have had years of experience playing with building blocks, cars, video games and other technology which involves problem solving tools and equipment. This can put females at a real disadvantage at the start, but as they continue to study in the technical field, they become more comfortable and are able to compete with the males. By and large, existing literature finds that females' comfort level with technology increases (and anxiety decreases) with experience, which is in agreement with the findings of this study. This research thus tends to discount the possibility that the sole reason for greater interest in IT among senior female IT majors found in the present study is due solely to attrition of less interested females.

Equal Opportunity in IT

This study found significance at the 0.001 level as shown in Table 2 that males believe that they as compared to females have more opportunity in IT, or in other words, females believe that they as compared to males have less opportunity in IT. This belief structure becomes less prominent from freshman to senior, which can be concluded from the results in Table 4, where difference between genders is significant at the 0.001 level among freshman and at the 0.05 level among seniors. However, since there is no significant difference between freshman and senior females regarding their beliefs about equal opportunity for males and females in IT as shown in Table 5, it can be concluded that females consistently believe that they have less opportunity in IT as compared to their male counterparts.

Balian (1999 and 2005) argues that women have not achieved full equity in academic fields in the U.S. because of persistent gender schemas where women are expected to behave in certain ways that disadvantage them in academics. For example, women indicated less stronger support than men for advancement opportunities for women scientists, women more strongly agreed that women could make important scientific discoveries, and women more strongly disagreed that a woman in science is likely to be unhappy (Valian, 2010). These differences indicate a slight hesitation on the part of male students to support equity for women in the sciences. The author argues that these results reveal important differences between male and female college students that can impact the perception and attainment of gender equity in sciences. This leads to the conclusion that discrimination persists because of the accumulation of small disadvantages, rather than the existence of blatant sexism.

One reason that women may not persist in IT could be the negative impacts of a lack of full support for equity by their male peers. Even slight differences or lukewarm, rather than enthusiastic support, can impede women's progress (Fuselier, Linda, and J. Kasi Jackson, 2010). The authors report that it is especially significant that the difference between male and female students' attitudes toward women in IT became more pronounced as students completed more technical courses in their undergraduate program. This is crucial for women because STEM careers or academic programs may become less appealing over time because their male peers become less supportive overall. Small instances of discrimination and gender bias, accumulate to disadvantage women and impede their progress in scientific careers (NAS, 2007).

Other Factors

This study found that when compared to females, males believe that IT has more practical value. These findings are in agreement with existing literature. According to Hornig (1992), women and men respond differently to mock news stories about new developments in science and technology, with women associating more risk ($p \leq .05$) and less benefit ($p \leq .05$) than do men with reported developments overall. Hornig reports that results from administration of a questionnaire revealed that women are more likely than men to agree with anti-science statements. Although the Scale does not directly measure beliefs about dangers of IT, there was evidence for gender differences regarding practical value of IT.

CONCLUSIONS

Attitude toward a discipline is one of the factors in students' choice of majors. The low participation of women in IT-related careers is a matter of national concern. Countries that maintain a competitive edge and prosper will be countries that are the most effective in developing their human capital and in nurturing all individuals with the capabilities of developing new ideas and innovations, especially in the scientific and technological enterprise. IT is an enabler for increasing productivity across multiple sectors, as an area of economic activities in its own right, and as a tool in education. User beliefs and attitudes are key perceptions driving IT usage and innovation. Consequently, the promotion of favorable attitudes toward IT and greater female participation in IT-related majors, is a matter of increasing importance. Perhaps one good way is to start is to show female students that gender equality in IT is real; that might be enough to encourage more females to take enough IT coursework to become interested in learning more about the field.

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