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ABSTRACT

At a time when demand for employees with information technology (IT) skills is booming, there is a decline not only in the number of females entering this field of study in most western countries but also in the number of females taking computer courses (Nielsen, von Hellens, Wong, 2000). Moreover, the gap in computer access and training for minorities is not declining (Hoffman and Novak, 2002). However, data from Australia indicate that under-representation of women and minorities is somewhat less pronounced in programs in IT or Software Engineering than in programs in Computer Science (CS) or Computer Engineering (von Hellens and Nielson, 2000). This paper examined whether there are similar differences in the state of Georgia in the U.S. Results indicate that in Georgia there is evidence that the gender gap exists.While 58% of all undergraduates in the state are female,females account for a much smaller percent of those selecting IT, IS, or CS as their major. It appears that there is also a difference among students seeking these degrees when comparing ethnicity of these students versus the undergraduate population as a whole. IT, IS, and CS majors appear to be more diverse than the student population as a whole. This diversity appears to be greater at institutions that are not classified as research institutions. Appended is a list of institutions responding to the survey on undergraduate enrollment data and institutions failing to respond. Includes 10 tables. (Contains 14 references.) (Author/AEF)

DEMOGRAPHY AND IT/IS STUDENTS: IS THIS DIGITAL DIVIDE WIDENING?

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ABSTRACT

At a time when demand for employees with IT skills is booming, there is a decline not only in the number of females entering this field of study in most western countries but also in the number of females taking computer courses [Nielsen, von Hellens, Wong, 2000]. Moreover, the gap in computer access and training for minorities is not declining [Hoffman and Novak, 2002]. However, data from Australia indicate that under-representation of women and minorities is somewhat less pronounced in programs in IT or Software Engineering than in programs in Computer Science or Computer Engineering [von Hellens and Nielson, 2000]. This paper seeks to determine whether there are similar differences in the state of Georgia in the U.S.

INTRODUCTION

According to a National Science Foundation-backed report from Carnegie Mellon University, the number of vacant IT positions is increasing by 25 percent per year ["How to Get More...," 2000]. At a time when the law of supply and demand should be bringing females and minorities into high-paying IT jobs and companies want diversified personnel, the number of women and minorities in the workforce remains low [Gaudin, 1999]. In fact in Canada the number of women graduating from IT programs has fallen by more than 50 percent in the last 15 years. While women make up 52 percent of the overall population, last year less than 25 percent of the computer technology graduates in Canada were female [Clow, 2002].

Data for Australia indicates that the under representation of women and minorities is somewhat less pronounced in programs in IT or Software Engineering than in programs in Computer Science or Computer Engineering [von Hellens and Nielsen, 2001]. The aim of this research is to determine whether there are similar differences in the state of Georgia.

REVIEW OF LITERATURE

The evidence of a gender gap in those embracing technology is exhibited long before students arrive at universities. The American Association of University Women reports that boys are significantly more likely to take advanced computer classes in high school, to spend hours after school on a computer at home, and to enroll in computer camps ["Girls and Technology," 1999]. While 56 percent of students enrolled in college are females, students who select a technology based major are predominately male. Some researchers feel that technology classes are presented in such a way, beginning as early as middle school, that females are discouraged from participating. In a study of high school students, females reported computing as boring, involving logic or math skills and little contact with

other people [Nielsen, et al., 2000] and were put off by the perceived heavy work load in computer classes [Clow, 2002]. In fact in a British survey cited by the Canadian Information Processing Society, it was reported that young women would rather be undertakers than work in IT [Clow, 2002]. Other research suggests that the masculine meaning that is ascribed to computing is offputting to females [Greenhill, von Hellens, Nielsen, Pringle, 1996].

The field of technology is not losing just the interest of females in middle and high schools. IT is rarely marketed to minorities. At an age when teenagers are very impressionable, minorities are almost never seen in print media advertisements. Few technology advertisements can be found in magazines aimed at the African American market, such as *Emerge*, *Essence*, *Vibe*, *The Source*, and *Black Enterprise*. The image of an IT professional is not marketed as "cool" to minorities. [Eglash, 2000].

When examining computer usage by race in the U.S., whites are significantly more likely to have a computer in their home and slightly more likely to have computer access at work. Studies show that even when adjusting for income and education, blacks and Hispanics have lower computer usage, computer access, and computer ownership. This gap is larger for high school graduates than for those without a high school degree, implying that education does not account for this gap. In recent years the percent of women owning computers has increased for whites but not for black women [Hoffman and Novak, 2002]. If minorities have limited exposure and access to computers, it is difficult for them to have the knowledge of and excitement for IT programs. Knowing what to expect in an IT degree program of study appears to be a problem that is not limited to minority populations.

In surveying first year IT students at Griffith University in Australia, researchers discovered that both male and female students found introductory IT courses to be difficult and to differ greatly from the students' expectations. This led to discouragement and disappointment [Nielsen, et al., 2000]. Most of these students also had trouble envisioning the type of career they aspired to develop upon completion of the degree program [Greenhill, et al., 1996]. This may be in part due to the fact that IT is both a new and an evolving field [Nielson, von Hellens, and Wong, 2001]. The technical knowledge necessary to support the IT industry is increasing and expanding continually, as are career opportunities [von Hellens, Nielsen, Doyle, and Greenhill, 1999].

When comparing males and females, females were more likely to be looking for security and stability in a career and rated the ability to work from home as an important factor when considering a job. Females are also more interested in jobs that are people-oriented and require communication skills [Nielson, et al., 2001]. While these skills are needed in many jobs in IT (women are typically strong in data management and project management [Clow, 2002]), poor communication about this industry provides a false set of expectations and opportunities. Males on the other hand were interested in salaries and job satisfaction [Nielsen, von Hellens, Pringle, Greenhill, 1999].

IT employers seeking additional employees considered "soft" skills such as the ability to communicate, work in groups, adaptability, and self motivation more important than technical skills for new graduates. These skills are ones with which females are more likely to feel comfortable and are skills at which females are more likely to excel. It is easier for employers to teach technical skills in an industry in which technology is evolving. Yet females do not view these soft skills as skills needed for success in IT [von Hellens, Wong, and Orr, 2000].

It is interesting to note that in a study conducted in Australia it was found that successful women in IT had consciously chosen career over family. While many IT jobs provide the ability to work from home and many women would like to be able to take advantage of this, respondents stated that in an environment that is male-dominated, taking advantage of such perks as working from home or visibly placing family before career would impair their ability to advance and would result in the women not being taken seriously [Neilsen, et al., 2001].

Another striking difference in gender appears to be in the approach to group work. Females tend to view team projects as a collaborative effort and enjoy a sense of collectivism. On the other hand males shared information only on study related information and are more competitive [Nielsen, et al., 1999]. Male students also view females students as being less technically competent (which is not supported through testing) and tend to resist including females in projects or study groups [von Hellens, et al., 1999].

Females in IT programs experienced gender-based discrimination. In a study conducted at Griffith University in 1995, Asian women complained that their opinions were not valued and were largely ignored. Non-Asian women felt they were the focus of sexual harassment via loud boasting and uninvited e-mails. This group of females also complained of unwanted positive discrimination in the form of less strenuous evaluation by faculty [Nielsen, et al., 2001].

Females employed in IT positions believe that they experience gender-based pay discrimination. Statistics show that women make roughly 75 cents for every dollar their male counterparts earn. Some argue that the pay differentiation is a function of education and not gender. In a recent international survey for Deloitte & Touche of 1500 IT professionals, 84 percent of the women surveyed believed that there was a plateau above which members of there gender could not advance. Statistics from the Department of Labor support this belief. Only 11 percent of all corporate executives are female [Alfe, 2002].

The aim of this research is to determine whether the differences in gender and ethnicity that are being observed in computer related degree programs can also seen in the public institutions of the state of Georgia. Specifically this research will examine breakdown by gender and ethnicity of baccalaureate students in IT, IS, and CS programs as a whole and by type of public institution. Public baccalaureate or above institutions of higher education in Georgia are classified as research universities, regional institutions, state universities, and state colleges (see Appendix A for a breakdown of Georgia institutions by type). Research universities have a statewide scope of influence in academic achievement, research, and public service and provide baccalaureate, masters, and doctoral degrees as well as a wide range of professional programs. Regional universities have a scope influenced by a specific region of the state as well as academic programs, research, and public service that are focused on regional need. State universities are influenced by the needs of an area of the state. State colleges are influenced by the needs identified within the local area in which they reside. By looking at programs and type of institutions, we can see if minorities and women are more likely to attend a specific type of university.

RESEARCH QUESTIONS

The goal of this research was to ascertain the breakdown by gender and ethnicity within public institutions offering baccalaureate or above degrees in Georgia, academic units within those institutions, and Information Technology and/or related programs of undergraduate students. Specifically gender and ethnicity was examined by college and degree programs that have a high level of technical content (i.e., Computer Science, Information Systems, and Information Technology).

Questions of interest were:

1. Is there a difference in gender mix between institutions, academic units within institutions, and IT-related programs within those institutions?

2. Is there a difference in the gender mix and/or ethnicity between the institutions by classification?

METHODOLOGY

The provost/academic vice presidents at each selected Georgia public institution were contacted by e-mail and letter and provided a survey instrument. A follow-up contact was made via e-mail/telephone approximately two weeks after the initial contact. The respondent was asked if he/she would be willing to share the breakdown by gender and ethnicity of students at his/her institution. Specifically this research was seeking a breakdown by schools or colleges within the university as well as a breakdown within certain majors.

To provide for consistency in data reporting, Spring 2002 was specified in the data collection instrument as the enrollment data benchmark period. Since all Uni-versity of Georgia System institutions are on the semester system such a designation was possible.

This study will serve as a pilot study. There are plans in place to follow-up this research to include institutions whose deans/directors participated in the Computer Research Association (CRA) Deans/Directors meetings and institutions affiliated with the newly formed Society for Information Technology Education (SITE). Future research will likely include discussions with focus groups composed of undergraduates who have chosen IT or an IT-related major at select Georgia institutions. Interaction with these groups may help provide information on how and why students select their field of study.

RESULTS

The state of Georgia has 20 public baccalaureate or higher degree granting institutions. Fifteen, or 75 percent, responded to this survey. One research

institution, three state universities, and one state college failed to respond (see Appendix A). Two of the three state universities excluded from the results are historically black institutions. The inclusion of data from these two universities may have provided slightly different breakdowns of the student population by gender and ethnicity.

With 75 percent of the institutions reporting, data indicates that female students outnumber male students (58 percent versus 42 percent). As Table 1 illustrates, the disparity is greater at state universities and colleges than at research or regional universities.

While institutions of all types are comprised of more female than male undergraduates, this is not true of IT and IT-related degree programs. Only slightly more than 30 percent of the 873 undergraduates enrolled in IT degree programs statewide are female (see Table 2).

Overall females make up a slightly greater percent of the IS student population (36 percent versus 31 percent). When examining undergraduate IS majors at research institutions, female students are almost equal in number to male students (see Table 3).

The greatest gap in undergraduate population by gender in the programs compared in this study is the Computer Science degree program. When comparing Computer Science students by gender, less than 20 percent of these degree majors are female (see Table 4).

TABLE 1
BREAKDOWN BY GENDER FOR TOTAL UNDERGRADUATE POPULATION

	Research	Regional	Universities	Colleges	Total
Female	56%	55%	60%	66%	58%
Male	44%	45%	40%	34%	42%
Total Enrollment	27,957	17,768	41,200	3,626	90,551

TABLE 2
BREAKDOWN BY GENDER FOR INFORMATION TECHNOLOGY MAJORS

	Research	Regional	Universities	Colleges	Total
Female	0%	20%	30%	37%	31%
Male	0%	80%	70%	63%	69%
Total Enrollment	0	121	380	372	873

TABLE 3
BREAKDOWN BY GENDER FOR INFORMATION SYSTEMS MAJORS

	Research	Regional	Universities	Colleges	Total
Female	47%	31%	38%	0%	36%
Male	53%	69%	62%	0%	64%
Total Enrollment	406	297	1,231	0	1,934

TABLE 4
BREAKDOWN BY GENDER FOR COMPUTER SCIENCE MAJORS

	Research	Regional	Universities	Colleges	Total
Female	12%	19%	24%	0%	19%
Male	88%	81%	76%	0%	81%
Total Enrollment	1,719	218	2,104	0	4,041

When breaking down the undergraduate population by ethnicity, 73 percent is white, 19 percent is black, and 8 percent is of other race (see Table 5). These percentages do shift greatly when examining the different types of institutions in Georgia. Black students are a much smaller percent of the student body at research universities, "other" ethnic groups are a much higher percent. While the breakdown by ethnicity provides similar percentages at regional and state universities, 2 historically black state universities did not respond to the survey.

While statewide student population at Georgia institutions is 19 percent black, 32 percent of IT degree majors are black (see Table 6). When comparing the IT student population at the different types of institutions that have IT programs of study, the smallest percentage of black undergraduates is 25 percent at state colleges.

Breakdown by ethnicity in IS degree programs yields varying results. Overall, blacks and "other" races are over-represented when compared to the population of all undergraduates (see Table 7). However, at research institutions ethnic lines in the IS program closely follows those of the general population at these institutions.

When comparing the ethnic breakdown of students in the Computer Science degree program at institutions that offer this degree, there is once again a high concentration of blacks and "other" races (see Table 8). At research institutions, this degree program has a very high percentage of students from other ethnic backgrounds.

It is interesting to note that black women and women of "other" ethnicity are over-represented in IT, IS, and CS degree programs. While 21% of female undergraduates in Georgia are black, 33% of female CS majors, 37% of female IS majors, and 45% of female IT majors are black. Undergraduates of other ethnicity comprise 8% of the undergraduate population in the state of Georgia. Females of other ethnicity account for 15% of all undergraduate programs (see Table 9). In IT and IS degree programs, this select group of females makes up only 11% of the students, but in CS these women account for 20% of the CS majors.

The differences in the makeup of male undergraduates by ethnicity in the IT, IS, and CS degree programs and the general male undergraduate population are less pronounced (see Table 10). In IT and IS, the percent of male students who are black is higher than the overall male population while in CS the percentage is slightly lower. In IS and CS, the percent of males who are of "other" race is greater than what is seen in all undergraduates in Georgia.

TABLE 5
BREAKDOWN BY ETHNICITY FOR TOTAL UNDERGRADUATE POPULATION

	Research	Regional	Universities	Colleges	Total
Black	6%	26%	23%	36%	19%
White	83%	69%	69%	59%	73%
Other	11%	5%	7%	5%	8%
Total Enrollment	27,957	17,768	41,200	3,626	90,551

TABLE 6
BREAKDOWN BY ETHNICITY FOR INFORMATION TECHNOLOGY MAJORS

	Research	Regional	Universities	Colleges	Total
Black	0%	34%	37%	25%	32%
White	0%	61%	51%	67%	59%
Other	0%	5%	12%	8%	9%
Total Enrollment	0	121	380	372	873

TABLE 7
BREAKDOWN BY ETHNICITY FOR INFORMATION SYSTEMS MAJORS

	Research	Regional	Universities	Colleges	Total
Black	6%	41%	29%	0%	26%
White	76%	53%	60%	0%	62%
Other	17%	6%	11%	0%	12%
Total Enrollment	406	297	1,231	0	1,934

TABLE 8
BREAKDOWN BY ETHNICITY FOR COMPUTER SCIENCE MAJORS

	Research	Regional	Universities	Colleges	Total
Black	6%	37%	26%	0%	18%
White	68%	52%	60%	0%	63%
Other	27%	11%	14%	0%	19%
Total Enrollment	1,719	218	2,104	0	4,041

TABLE 9
BREAKDOWN BY ETHNICITY FOR WOMEN IN SELECTED DEGREE PROGRAMS

	IT Degree Programs	IS Degree Programs	CS Degree Programs	All Programs
Black	45%	37%	33%	21%
White	44%	51%	47%	71%
Other	11%	11%	20%	15%
Total Enrollment	274	693	758	52,790

TABLE 10
BREAKDOWN BY ETHNICITY FOR MEN IN SELECTED DEGREE PROGRAMS

	IT Degree Programs	IS Degree Programs	CS Degree Programs	All Programs
Black	25%	20%	15%	16%
White	66%	68%	67%	75%
Other	8%	12%	19%	8%
Total Enrollment	599	1,241	3,283	37,761

CONCLUSIONS

In Georgia there is evidence that the gender gap exists. While 58% of all undergraduates in the state are female, females account for a much smaller percent of those selecting IT, IS, or CS as their major. It appears that there is also a difference among students seeking these degrees when comparing ethnicity of these students versus the undergraduate population as a whole. IT, IS, and CS majors appear to be more diverse than the student population as a whole. This diversity appears to be greater at institutions that are not classified as research institutions.

While this research supports the belief that a difference exists in the gender and ethnicity of students in technical degree programs, it does not address why. This study is a pilot study. Future research will likely include discussions with focus groups composed of undergraduates who have chosen IT or an IT-related major at select Georgia institutions. Interaction with these groups may help provide information on how and why students

select their field of study. However by itself this research may help guide graduate schools and companies that are seeking to increase diversity within their programs and corporations to recruit at institutions which offer a greater diversity in their student body.

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APPENDIX A
INSTITUTIONS RESPONDING TO SURVEY ON UNDERGRADUATE ENROLLMENT DATA

Research Institutions:
University of Georgia
Georgia Institute of Technology

Regional Institutions:
Georgia Southern University
Valdosta State University

State Universities:
Armstrong Atlantic University
Augusta State University
Columbus State University
Fort Valley University
Georgia College and State University
Georgia Southwestern University
Kennesaw State University
North Georgia University
Southern Polytechnical University
West Georgia University

State Colleges:
Macon State College

INSTITUTIONS FAILING TO RESPOND TO SURVEY ON UNDERGRADUATE ENROLLMENT DATA

Research Institutions:
Georgia State University

State Universities:
Albany State University
Clayton College and State University
Savannah State University

State Colleges:
Dalton State College

U.S. Department of Education
Office of Educational Research and Improvement (OERI)
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