Perceptions from Students in Puerto Rico about Information Technology Professionals

Diana M. López Robledo, DBA[1]

Abstract

Women's presence in undergraduate programs has grown. However, women remains been minority in undergraduate programs related to technology in Puerto Rico. Therefore, the main purpose of the research was to identify student's perceptions about information technology professionals and explore some perceptions about females in this career. A questionnaire was designed and completed by 517 students in undergraduate programs in Puerto Rico, including private and public institutions. Results suggest that undergraduate students in Puerto Rico perceive computer and information technology fields as being oriented to computers, but they don't identify it as male oriented. Students ignore the gender gap that exists in the technology field and females expect a lower salary as compared to men. There is no negative perception about female's capabilities related to technology, students perceive that females can be software developers and may have the same employment opportunities as men in the field. It may be important for academic institutions in Puerto Rico to provide female role models in technology so they can engage in providing guidance to young females and also develop different opportunities directed to females in high school, so they can consider to pursue a career in technology.

Keywords: Information Technology, STEM, minority, women, perceptions, Puerto Rico

I. Introduction

In several countries, including the United States and Puerto Rico, studies has found a gender gap in academic programs related to information science and computers. One possible cause is a distorted image that students have regarding the information systems professionals.

[1] Universidad del Turabo, Gurabo, Puerto Rico, dlopezrobledo@gmail.com

In the portal of the White House of the current President of the United States of America, Barack Obama, an effort is mentioned to expand the areas of science, technology, engineering and mathematics (STEM) to minority groups, including women. In Puerto Rico, STEM behavior is similar to the United States. The administration of universities seem not to have explored these significant differences by gender. According to Anasi (2012), women should be equally represented in the workforce in technology, as it provides a different perspective.

There is a majority of women in several institutions of undergraduate programs in Puerto Rico. However, it can be noticed that woman in information science and computers in Puerto Rico is still a minority in undergraduate and graduate programs (Soe & Yakura, 2008; Etzkowitz & Ranga, 2011; Varma & Hahn, 2008). At the University of Puerto Rico Río Piedras, the participation of women in Computer Science programs dropped from 48.57% in 1998 to 29.33% in 2002 and Information Systems programs were reduced by 44.78% in 1998 to 34.63% in 2002 (Martínez, Lugo & Rivera, 2007). More recent data from the Education Council of Puerto Rico also show that, of all graduates of bachelor's degree programs in information and computer science during the academic years from 2007 to 2011 only 29.32% are women, while a 70.68% are male.

It is possible that, for some reason, women continue to consider the field of technology as male-oriented, as suggested by Martínez Lugo and Rivera (2007). The International Labor Organization suggests that technology over the years is an area that has a tendency to continue to grow and could be important for academic programs in technology show the same growth. As stated by Martín Llaguno (2007), "the identification of gender bias and knowledge on the part of individuals, organizations and society, is the first step to eradicate it".

1.1 Limitations

Areas of science, technology, engineering and mathematics have a variety of academic programs in different institutions of higher education in Puerto Rico. However, it will entail a very large and complex study. Therefore, the investigation was limited to the area of technology in undergraduate programs, which is referring to programs of information systems related areas according to classification code provided (National Center for Education Statistics, 2010).

2. Literature Review

Wilson (2003) stated: "The culture of computing, particularly the cultural image of the computer, is not attractive to women". Although, the diffusion of technology may have changed this perspective, there is still a gender gap. According to Anasi (2012), women does not have to be excluded or left aside when it comes to the digital revolution and technology. They need to develop the full potential they have and also contribute to the development of their country. Etzkowitz and Ranga (2011) coincided with Anasi (2012) and suggested the need to eliminate stereotypes about women in technology, as these may represent an unfavorable perception.

A study performed by Harrys, Crushman, Kruck and Anderson (2009) presented the perceptions of university students in relation to the field of Information Systems and Computer Science, also known as IT fields (acronym for Information Technology). They concluded that IT careers have an image problem, specifically in perception as to the field and how it relates to people. In the study, 70% of participants, men and women, indicated that IT career is computer-oriented and they prefer to work with people. This is a misconception because, according to a study by Verges (2012), the practice in information technology and computers is not as a social as often occurs. Sociability is given in the organization in heterogeneous and cross-disciplinary groups, but students' perceptions can have a negative influence. Dorpenyo (2011), Etzkowitz and Ranga (2011) and Blickenstaff (2005) are some of the authors who identified the IT field as mostly male oriented and have indicated that, although females have been present in non-traditional fields, women remain as a minority in educational programs and STEM jobs.

There is a real difference in the distribution of participants in IT, specifically gender, from students at the undergraduate level to members of the workforce in IT. Young (2000) presented the findings of a study that involved 220 females and 240 males, high school students. The study found a significant gender difference in attitudes students have towards computers. According to Young (2000), males showed greater confidence in using computers. In addition, males perceive computers as masculine elements, coinciding with Martinez, Lugo and Rivera (2007). According to Young (2000), this claim was rejected by the women in the study.

Other researches (Etzkowitz & Ranga, 2011; Stoilescu & McDougall, 2011) confirmed that today there is a gender difference in IT programs. Statistics presented by the United States Bureau of Labor Statistics indicated that in 1971 women accounted for only 9% of computer analysts and other technology specialists. The Department of Commerce of the United States ensures that the areas of science, technology, engineering and mathematics represent an opportunity for innovation and global competitiveness. Specifically in 2008-2009, only 17.8% of computer science degrees were earned by women (National Center for Education Statistics, 2009).

The growth in IT programs has been slow for both genders, being less in women. Buzzetto, Ukoha and Rustagi (2010) concluded that the lack of experience in courses related to computers and lack of previous exposure to college programming courses were barriers identified by students for careers in technology. The obstacle was pointed out by some students who considered a career in technology, started at this academic program and for some reason changed their concentration and by those who did not started it.

According to Ong (2011), the low participation of women in academic degrees obtained in Computer Science, should be a concern for educators. The data reported by the National Science Foundation (NSF for its acronym in English) in 2011 show a significant reduction of Hispanic women who obtain doctoral degrees in Computer Science. In 2004, only 9 doctoral degrees were reported for hispanic women while in 2008 only two were reported, representing only 0.3% of total degrees conferred.

Meanwhile, Bonilla López Cintrón, Ramírez and Román (2005) conducted an analysis of 18 studies in different Latin American countries including Bolivia, Brazil, Chile, Cuba, El Salvador, Honduras, Nicaragua, Paraguay, Peru, Dominican Republic , Perú, Venezuela, Uruguay, Panamá, Costa Rica, Colombia, Argentina and Mexico on the factors that have facilitated the education of women, the feminization of enrollment trends by gender on career choices and proposals reasons for the selection of careers that women do. In the analysis, findings present evidence that enrollment in universities are composed mostly of women. This is called in this research the enrollment feminization phenomenon. The area of science and technology is the second choice of preference for males, while engineering is the first choice. For women, the first choice of study is education, followed by social sciences and health.

The authors conclude the following "based on trends in enrollments and expenditures in different countries, both women and men are opting mostly by traditional careers for their respective genres". The authors further suggest performing quantitative and qualitative studies to identify which factors influence career choices by gender.

2.2 IT Pipeline

The theory of the development pipeline of women in IT *("Women IT Pipeline")* is usually used to describe the phenomenon of the under-representation of women through the different stages in their academic careers and finally the workforce (Soe & Yakura, 2008; Etzkowitz & Ranga, 2011; Varma & Hahn, 2008). Each of these lines has some leakage, which results in losses, as shown in Figure 1.
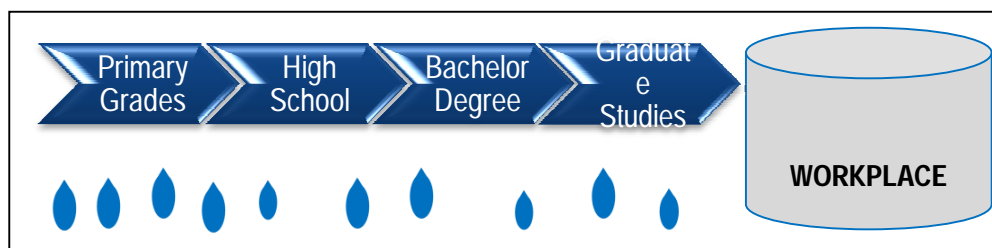

Figure 1. IT Pipeline

Source: Designed by the investigator based on literature about IT Pipeline (Soe & Yakura, 2008; Etzkowitz & Ranga, 2011; Varma & Hahn, 2008)

As suggested by a report of the International Labor Organization (Organización Internacional del Trabajo, 2013), "From school to work, girls and women are lagging behind in scientific and technological fields. Traditional attitudes, as well as direct and indirect discrimination, constitute obstacles to progress." The pipeline theory has been quite used in different areas of STEM, since in these areas women have little representation. Although the line of development of women does not necessarily represent a channel having a sequential step, the output of women in any stage explains the fact that the next stage has less female representation.

Even if a greater number of women are interested in pursuing careers in IT, through their years of academic preparation, a high percent drop out for some reason and this causes underrepresentation in the workplace (Soe & Yakura, 2008; Etzkowitz & Ranga, 2011; Varma & Hahn, 2008). The International Labor Organization indicated that women are perceived as less interested or capable than men. Furthermore, they argue that the reason why women fall behind is not for skills, but by attitudes.

2.3 Role Models

Varma and Hahn (2008) suggest that role models in the area of IT have a role in recruiting students in STEM. It has been found that the lack of women in IT discourages participation of other women and that the presence of a mentor and role model is important for women to remain in IT (Harrys, 2009; Beyer, 2008; Verges, 2012; Leventman 2007; Wynarczyk & Renner, 2006). These authors have suggested that it could establish a relationship between the role model and the decision of students to stay in these areas of study in the case they considered a career change.

Often young people use close friends or acquaintances who have been successful and are guided by these people. On this regard, Williamson (2012) in his doctoral thesis studied the Hispanic female participation in nursing programs in the United States. Her findings suggest that the guidance received by women who participated in the study during high school helped them have a better perception of this career. Participants identified their counselors as role models and also noted that family also influenced the perception of careers and their decision to pursue it.

2.4 Salaries

Wage inequality has also been studied in different areas and at different times. The IT field is not an exception and not a topic that has recently emerged. Truman and Baroudi (1994) found a significant difference in wages by gender for a group of systems professionals. The authors suggest discriminatory practices and avoiding giving recognition to women. Beede and colleagues (2011) compared interesting data presented in the report of the Department of Commerce of the United States, which are related to the hourly wage average reporting citizens. The salary was compared divided into two groups.

The first group corresponds to work in the areas of science, technology, engineering and mathematics. The second group corresponds to work in other areas. They did a gender comparison. These data indicated that in the US the average for STEM jobs were ranging from $ 36.34 to $ 31.11 for men and women. In the case of other jobs, salary ranges from $ 24.47 to $ 19.26 for men and women. These wages presented two important facts that should be emphasized. First, it shows evidence of higher wages in jobs related to science, technology, engineering and math compared to other areas. Secondly, it was noted that there is a gap in the salary of a man and a woman working in both sectors. In STEM jobs, the gap is 14%, which in simple terms means that for every dollar of male's income, a woman has an income of $ 0.86, as the article states. For jobs in other fields, the gap is even greater (21%).

2.5 Women in Puerto Rico

In the specific case of Puerto Rico, there has seen an increase in women participation in economic activity over recent decades. Data from the Department of Labor and Human Resources of Puerto Rico (Departamento del Trabajo y Recursos Humanos, 2010) showed that the rate of labor participation of women had an increase from 28 to 31 percent for 1970 and 1990 respectively. In 2013, women represented 32% of total employment. One factor causing the increase in the participation rate in the labor field is the education they received women, which enables them to compete in the labor market and have an active participation. For example, in 1970 only 21% of women in the workforce had a year or more of college, while in 2013, 74% had such studies.

While in Puerto Rico participation of women in IT programs is not excluded, little has been studied about it. However, according to Martínez, Lugo and Rivera (2007), at the University of Puerto Rico Río Piedras there is greater involvement of men in programs of Computer Science and Information Systems at the undergraduate level. In the case of Computer Science in 1998 women holds a nearly equal to that of men in this room (48.57%). For 1999, the turnout was 36.96%, in 2000 was 40.91%, in 2001 was 33.33%, and in 2002 was 29.33%. You can see a fairly significant reduction over a period of five years. In Information Systems program participation for the same years was 44.78%, 42.41%, 38.20%, 35.91% and 34.63% respectively. Therefore, Martínez Lugo and Rivera (2007) defined the field as male oriented.

Data collected from Puerto Rico Education Council presented students graduated from different programs for the academic years 2007 to 2011 by gender. In the specific case of IT programs or related fields, there is a difference by gender, as we can see in

Graph 1.

IT Students Graduated from Bachelor's Programs in Puerto Rico
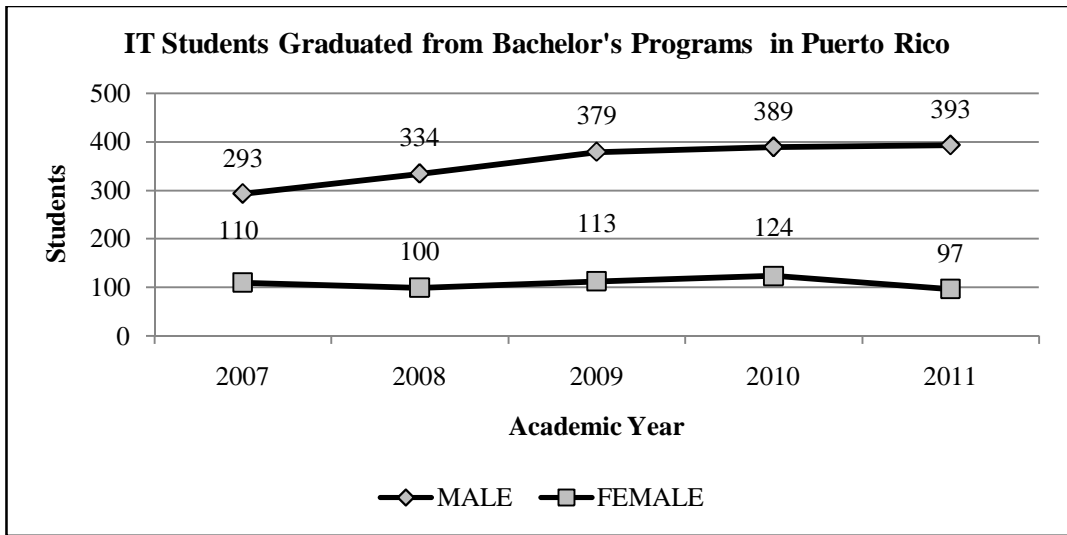
Graph 1- IT Students Graduated in Puerto Rico

Source: Designed by the investigator with data from Puerto Rico Education Council (2013)

Male students graduated from IT related programs in 2007, 2008, 2009, 2010, and 2011 were 293, 334, 379, 389, and 393. In these five years range, there is an increment every year.   Female graduated from IT programs has not shown the same increment as male. In the case of females, there were 110, 100, 113, 124, and 97 graduates in the same years respectively.

3. Methodology

The population of this research consists of students enrolled in undergraduate programs of public or private universities in Puerto Rico. Specifically, the populations investigated were students enrolled in institutions offering undergraduate programs classified as information science or computer science related fields, according to classification code provided (National Center for Education Statistics, 2010).

The protocol for this study was approved by the Institutional Review Board from Ana G. Méndez University System, Turabo University, with the number 13-451-13. In addition, application for approval was sent to different campuses according to the protocol of each institution. To recruit participants, a communication to the administrative staff of the institutions was sent and once the institution notified their consent, we proceed to personally visit institutions.

3.1 Sample

The research's sample was stratified, which is segmented according to population. According to Hernández Sampieri (2010), segments, called strata, are better suited to minority study groups and allows proportional representation for each group (Hernández Sampieri, 2010). Therefore, population was divided in two sub-populations, (1) students in academic programs related to IT and (2) students in academic programs not related to IT. Each sub-population has two sub-groups, which corresponds to male students and female students. To determine the appropriate sample of each sub-group, Raosoft Software was used (Raosoft, 2004). A margin error of 5% was determined.   The total sample (n) was 517.

3.2 Instrument

The instrument was developed by the researcher, divided into several sections: demographic data, perception, attitude and perceived barriers. The validation was divided in two parts. First, the instrument was validated by a panel of six experts who met the following inclusion criteria: graduate studies related to information systems or technology fields, more than 10 years of experience in the field. All experts evaluated each of the questions included in the questionnaire.

The content validity ratio (CVR) was calculated (range between 0.33 and 0.99), minor changes were made in various items as recommended by the panel of experts and several items were deleted.

After the evaluation of the panel, we proceeded to check the reliability of the instrument through a pre-test conducted with 30 participants, which is the minimum suggested in pilot tests (Johanson & Brooks, 2009). A Cronbach's alpha analysis was performed and 0.88 was obtained. According to Hernández Sampieri (2010), if it exceeds 0.75 it shows acceptable reliability of the instrument, so it was used for the final investigation. The analysis was performed in version 22 of IBM Statistical Package for the Social Sciences. Also, Cronbach's Alpha analysis was performed with the final sample, and a coefficient of 0.824 was obtained.

4. Results and Discussion

In this section, results will be presented on several findings of the study. Findings will be related to demographic distribution of the sample, perceptions about IT professionals, salary expected by students once they graduate, and factors that influence their career choice.

4.1 Sample and Demographic Data

The research sample (n) was 517, of which 41.2% are women and 58.8% men; 95.9% of the participants are full-time students (enrolled in 12 credits or more) and 3.1% are part-time students (enrolled in less than 12 credits). Most participants has no work, corresponding to 62.1%. One sub-population (IT related programs) was composed of 228 participants (44.1% of total sample), while the other sub-population (IT non-related) was composed of 289 participants (55.9% of total sample).

As mentioned above, each of these sub-population is separated into two groups (male and female). Therefore, these four strata were identified as Group 1, Group 2, Group 3 and Group 4. Sample for each group is presented on
**Table 1**. Group 1 corresponds to male students in IT related fields (n = 183), group 2 programs is for female students in IT related fields (n = 45), group 3 corresponds to male students in programs not related to IT (n = 121) and group 4 corresponds to female students in programs not related to IT (n = 168).

Table 1: Sample distribution by Sub-population

	IT related fields (n = 228)		Non IT fields (n = 289)	
	Group 1	Group 2	Group 3	Group 4
Frequency	183	45	121	168
Sub-population percent	80.3	19.7	41.9	58.1
Total Sample percent	35.40	8.70	23.40	32.50

Source: Designed by the investigator

So, the distribution of each group is proportional to the population, as the stratified sample requires. The average age is 21 and the standard deviation (σ) is 4.97. Minimum age is 17 and maximum is 62. As shown in **Graph 2**, most participants are between 18 and 21 years.
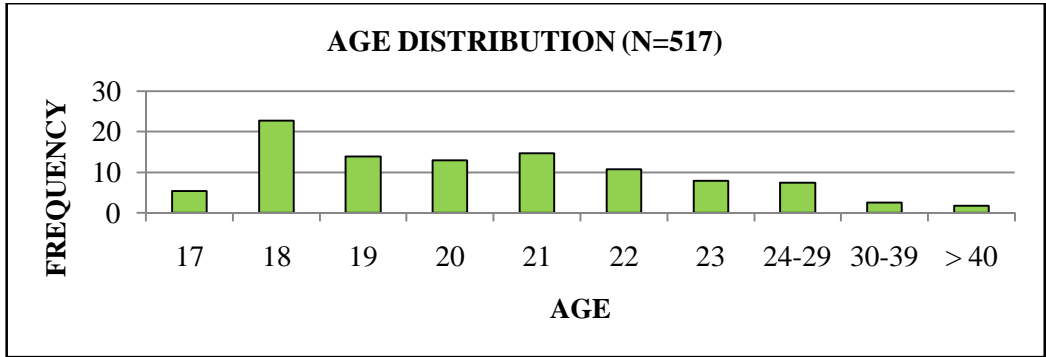
Graph 2 - Age Distribution of the Sample

4.2 Perceptions

Findings suggest that there is no statistically significant difference by gender in the perception of the IT field orientation to computers. This finding was similar in the three performed analysis, students in IT programs, students in programs not related to IT and students in general. Students, in general, do not perceive the IT field as male-oriented, which contrasts with the ideas presented by Dorpenyo (2011), Beede et. a. (2011), Etzkowitz & Ranga (2011), Blickenstaff (2005) and Anasi (2012).
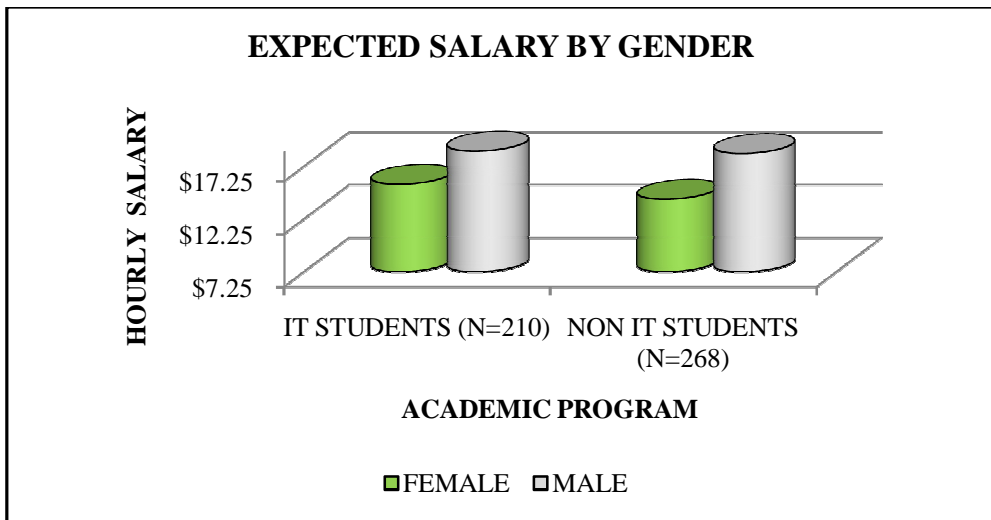
However, this research results does not suggest that these students perceive the field as feminine or oriented to women. Another finding of the study is a weak, but statistically significant, correlation at 99% confidence (R = -0.302), which may suggest that students who have a greater attitude towards the field of IT (more positive), receive a lesser degree of limitations and / or barriers in this field.   In addition, groups of men and women in both sub-populations consider the importance of a model in a similar way.

The study also found that there is statistically significant difference in the importance of a role model, according to the presence of a model. The difference is present in both sub-populations and the whole student as a single sample.   Students who identified a role model in their academic development considered more important the presence of the role model. Other findings were related to the overall perception about IT professionals. In this regard, 76.7% of students think that IT professionals are intelligent, 93% of students think that women are able to develop useful software, 78% of students are comfortable working with the opposite sex, 79.7% believe that men and women have the same employment opportunities in IT courses and 79.8% believe that women have the same technical skills than men.

4.3 Expected Salary

Another finding is that students in IT programs perceive that IT professionals can expect to earn a high salary. When asked about what salary they expected to earn when they find a job after graduating from their undergraduate program, most of them were able to identify salaries above the current minimum hourly rate for the United States and Puerto Rico ($7.25 per hour). Other students were unable to identify their expected hourly rate. Considering only those students who identify hourly salary wage expected to earn in a job related to their academic career, there were differences by gender and also by sub-populations.
Graph 3 shows the expected salary by gender, on both sub-populations.

EXPECTED SALARY BY GENDER

HOURLY SALARY

$17.25

$12.25

$7.25

IT STUDENTS (N=210)   NON IT STUDENTS
(N=268)

ACADEMIC PROGRAM

☐FEMALE ☐MALE

Graph 3- Expected Salary by Gender

The starting salary expected by men in IT academic programs is $ 18.69 per hour, while women expect $ 15.55 per hour. Among students in programs not related to IT, the starting salary expectation for men is $ 18.47 while woman expect $ 14.13. As it is observed, women in IT academic programs expect to get 83% of the salary expected by men, showing a gap of 17%. That is, for every dollar of income expected by males, the woman expects to receive $ 0.83.   Among students in programs not related to IT, the gap is 23%. These findings with a sample of undergraduates Puerto Ricans match those presented by Schweitzer et. al. (2011).

4.4 Influences on Career Choice

Other findings of this research are related to factors that influence students to choose a career.   In this regard, students in IT related programs identified employment and salary expectations as the two options with highest influence in both genders. Among women, they identified greater influence by family members and parents. The support of family and parents is significant for females who choose a career in a field in which they will be minority, though may not be aware of gender inequality in the field. For students in programs not related to IT, the employment expectation and the information collected on Internet were the greatest influence on their decision. In this sub-population, it was also found that the salary expectation, advice from university professor and suggestions from parents and relatives were also identified by students.

5. Conclusions

In the total sample, 64% consider that the field is computer-oriented. Also, 95% of females in IT programs perceived it as computer-oriented field. This finding is consistent with those presented by Harrys, Crushman, Kruck & Anderson (2009) and Stoilescu & McDougall (2011). In contrast to previous research (Dorpenyo, 2011; Beede et al, 2011; Etzkowitz & Ranga, 2011; Blickenstaff, 2005), the sample of students in undergraduate programs in Puerto Rico did not identify the field of IT as men oriented. Specifically, 70% of females in IT programs and 60% of females in other programs disagreed with this approach, which contrasts with the findings presented by Martinez, Lugo and Rivera (2007).

The attitude presented leads to the conclusion that students who have a more positive attitude towards the field of IT, perceived a lower degree of limitations in this field. Regarding the expected salary, there are differences by gender between 17% and 23%. Results showed that females expect lower salaries than men, regardless of their academic careers.

If women's expected salary is lower, they may accept a job with a lower salary than men because that salary meets their expectations. Institutions should provide guidance and experiences so that women interested in technology, computer sciences, information systems and other related fields are confident and understand their opportunities to succeed.

Puerto Ricans students perceive that females can be software developers, may have the same employment opportunities as men in the field of IT, and they have the same technical skills than males. Also, students ignores the gender gap that exists among IT students and IT workplace and the group of participants that gave more importance to the presence of a role model in their college careers were females in IT programs. Based on these findings, there is no negative perception about female's capabilities related to technology. However, since gender gap still exists in IT programs, it may be important for academic institutions to provide role models so they can engage in providing guidance to young females, develop different opportunities for females in the IT field and involve in STEM workshops or associations. Institutions should continue to promote programs and prepare workshops directed to females in high school, so they can consider to pursue an IT related career.

Among the factors that most influence the decision of the students to choose a career in technology-related areas are: the interest in technology, the expectation of employment and salary expectation. Compared to their male counterparts, the women showed greater influence of family and parents in choosing a career in the IT field. Among the factors that most influence students in non-technology areas are: the expectation of employment, information collected online, salary expectation, university professor and suggestions from parents and family members. As final recommendation, institutions should update the information on each program they offer throughout their website, as students opt to seek information on the Internet before choosing one career among other. Information presented in the website must include employment opportunities after the student complete the studies and salary's expectation for the career.

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