

Differences by Gender in Work Expectations for CS Students in Costa Rica

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ABSTRACT

At the Escuela de Computación e Informática, Universidad de Costa Rica, female students are a minority and their numbers are diminishing. This mirrors tendencies reported at universities in other western countries. The explanation for this phenomenon is possibly multifactorial, and in this paper we explore one of the possible factors: the role of work-related perceptions for career choice, and the confirmation or rejection of common stereotypes after entry to the workforce. We found that there are gender-based differences in those perceptions even at the undergraduate level. The differences accentuate after exposure to real workplace experiences, albeit not in the same directions for men and women, unfortunately not necessarily for the better.

Keywords

Computer Science, work expectations, gender differences

INTRODUCTION

For several years, many researchers, especially in western countries, have reported low women participation in Computer Science programs at their universities. Examples of some of these studies were cited in our previous work [6]. Some authors have detected a phenomenon, called "the shrinking pipeline", which is even more worrying. The percentage of female population is actually declining [2,5]. This phenomenon was first reported in Costa Rica in [3] and confirmed in [6].

In [6], we gathered evidence that in our institution, the Escuela de Ciencias de la Computación e Informática (ECCI) at the Universidad de Costa Rica (UCR), (a) women have significantly lower participation in undergraduate and graduate programs,

(b) the relative frequency of women in our undergraduate program is declining, and (c) women are much more efficient at graduating and at getting admitted to the graduate program. Based on the available data, we confirmed that the differences between the female and male populations were not due to any hypothetical feminine deficiencies but due to gender issues.

The difference in female and male participation in the information technology (IT) area is not only present within the academic world. The IT industry has detected significant differences in the composition of their workforce, both internationally and locally. McKinney et. al [9] reported that in 2006 only 26% of the professionals working in the information technology field in the United States were women. This is consistent with the declining trend in female participation highlighted by Summer, who reported that the rate of women in the U.S. labor market fell from 41% in 1996 to 34% in 2002 [10]. In Costa Rica, the Chamber of Software Producers, Caprosoft, (now called CAMTIC), reported a drastic imbalance in the sex composition of the Costa Rican IT professional workforce. They surveyed 97 companies in the information technology (IT) industry as part of a program to support the competitiveness of the software development industry in our country [8]. The percentage of men in large and medium companies was 82.3%; in small companies, it went up to 86.3%; and in micro-enterprises, 92.6% of the employees were men [8]. CAMTIC has made public its concern over this situation in many industry-academia meetings.

We investigated in [7] whether there were gender differences in some of the motivating or inhibiting factors to enter our CS program. The purpose was to identify some of the causes of the participation imbalance. We found such differences in the undergraduate and graduate populations. The results reflected that gender differences exist

(a) in the motivations for joining our undergraduate CS program. First-year undergraduate women gave more importance to external influences, such as opinions from teachers and parents. Male un-



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dergraduates reflected greater confidence on their ability to be successful in the field than women.

(b) in the perception about the skills needed to study CS. Women tend to identify more talents and skills required to be successful in CS than men. Significant changes emerged when undergraduate and graduate populations were compared. As a result of their academic and workplace experiences, female and male graduate students changed their perceptions about the skills and abilities needed to study CS in different ways.

After confirming that male and female students have different motivating and inhibiting factors to study CS, we considered important to analyze whether there are gender differences in expectations for recruitment and employment benefits, to try to motivate more women to study CS. In this paper we present some results regarding labor expectations among undergraduate and graduate CS students at our university.

McKinney et al. [9], based on a survey of 815 professionals in the United States, found that IT professionals report similar satisfaction levels with their professional career, so the profession in itself is not women-hostile. Flórez-Estrada [4] is not as optimistic. She studied the work environment of three Costa Rican big IT companies, making a detailed analysis of the performance, job description and coping strategies of women in a working environment dominated by men. We believe that many of the problems identified could be avoided getting more female students to enter the field.

Understanding the work expectations of both sexes might help determine actions to attract a larger proportion of women to the field. The low participation of women has implications: it leaves women out of an area with growing demand, professional prestige, and good wages; deprives the industry of a qualified workforce; and impoverishes the field given the loss of the different perspectives that women could give.

Our research hypotheses are: (1) there are gender differences in labor expectations as motivation to pursue CS as field of study, and (2) these differences are accentuated with the entry into the job market.

METHODOLOGY

To investigate hiring expectations, we surveyed two populations: incoming CS undergraduate and current CS graduate students. Both populations are different and have different knowledge of the discipline. Incoming undergraduates do not really know what CS is and what kind of job scenes will they face after graduation, apart from stereotypes gleaned from hearsay and media notions. Their perceptions reflect the social notion about CS. On the other hand, graduate students in our country are already practicing professionals, so they not only know what the discipline is from their undergraduate coursework, but also from their

work experience (in the surveyed population, the average has slightly over two years of work experience).

To obtain and compare the perceptions of both populations, the majority of the population of incoming undergraduate CS students was surveyed in February, 2007 during the first orientation meeting. Of a total of 179 students admitted for 2007 (149 men and 30 women) 130 students completed a valid survey (106 men and 24 women), i.e. 72.6% of the total population (71.1% of male students and 80% of the female students). Surveys with answers that did not comply with the instructions (for example out-of-range options, or unanswered questions) were discarded. Interestingly, the percentage of women admitted was only a 16.8%, but 18.5% replied the questionnaire correctly. This reflects an interesting aspect we found consistently: women were more responsible and careful than men in their responses.

Graduate students were surveyed during class registration for the first semester (March-July) of 2007. Of a total of 183 active students (148 men and 35 women), 147 students completed correctly the survey (114 men and 33 women). In this case, the 80.3% of the active population were polled (77% of the male students and 94.3% of the female students). From the population that answered the survey without errors, 22.4% were women and 78.6% were men.

It is important to emphasize that the results of this article are based on the quasi-totality of both populations for 2007. The disparity in participation between men and women studying Computer Sciences causes inevitably the difference in sizes of the categories of analysis.

In this article we will discuss only those survey questions that allow us to characterize expectations for recruitment of CS students. The instrument was based on previous research projects inside our department, and is part of an ongoing investigation process.

PRESENTATION AND ANALYSIS OF RESULTS

The information is analyzed on three categories: (1) relative differences by sex among incoming undergraduate CS student, (2) relative differences by sex among graduate CS students, and (3) changes of perception between graduate and undergraduate members of the same sex.

For the relative differences by sex between male and female students, for graduates and undergraduates, we will focus on the most significant differences. They are highlighted in orange (strongest), green (intermediate), and yellow (weakest). We believe these differences could reflect trends in the populations, in particular the orange ones. The categories that are not highlighted are answers that we considered to be non-different. Negative values of relative differences indicate that the male population gives more importance to the particular aspect. Conversely, positive values of relative difference indicate that the female population gives the issue more importance. For ease of presentation, we use the words "more ♂" and "more ♀" in these cases.

For changes in perception between undergraduates and graduates, "♂" represents men and "♀" women, and "↓"

represents a decrease and "↑" an increase of the relative importance of a specific issue, as a product of exposure to the CS curriculum and work experience in the population of the respective sex. The strength of the effect is symbolized with a higher number of arrows. For example, "↓↓" represents a larger diminishing effect than "↓".

Three questions from the survey are analyzed: employment expectations after graduation, general type of position sought after graduation, and finally, specific job positions of interest. Results in each of them are analyzed to see if gender differences are present.

Employment expectations after graduation

Results to the question: "Do you think your graduation will have an impact on your future employment?" are tabulated in Table 1. The analysis concerns gender differences for the undergraduate and graduate populations, and the differences in perception among individuals of the same sex but with different levels of exposure to the career are presented below.

- **Relative differences by sex among incoming undergraduate CS students:** There are no

significant differences in the perception of job prospects between men and women, except in the criteria of "obtaining better salaries", to which men attribute greater importance. In general, new students are similarly interested in the same positive aspects of Computer Science, with emphasis on the perspective of finding a job in a field they like and find interesting, with women being slightly less interested in the possible high income, which is the second most important factor for both populations. Both groups consider that receiving good salaries, working on something they like, and having good working conditions are the most important aspects, in that order.

- **Relative differences by sex among graduate CS students:** For graduate students, the situation varies dramatically. The order of factor importance varies by sex and there are significant differences in three categories (instead of just one). Indeed,

Table 1. Employment expectations after graduation for incoming undergraduate and active graduate students, by sex. The "Difference" column for each, undergraduate and graduate populations shows the distinction between the percentage of men and women who considered the point as important. The column "Changes in perception" evaluates the perception variation between undergraduate and graduate students for the same issue, by sex. Downward arrows represent decreases between undergraduate and graduate importance perceptions for the aspect, while upward arrows signify an increase in the importance of the subject for graduate over undergraduate students. The number of arrows reflect the strength of the tendency.

Employment expectation upon graduation	Undergraduate students					Changes in perception	Graduate students				
	Men		Women		Difference		Men		Women		Difference
	n	%	n	%			%	n	%	n	
Having a better salary	50	46,3%	8	33,3%	13,0% more ♂	♂↓ ♀↑↑	47	41,2%	14	42,4%	1,2%
Getting a more interesting job and/or a job position in something they like more	79	73,2%	18	75,0%	1,8%	♂↓↓ ♀↓↓↓	58	50,9%	16	48,5%	-2,4%
Getting a promotion and more responsibilities (*)	na	na	na	na	na		44	38,6%	16	48,5%	9,9% more ♀
Getting a job position with better working conditions: more schedule flexibility, more stability, etc.	38	35,2%	8	33,3%	-1,9%	♀↓↓	36	31,6%	7	21,2%	-10,4% more ♂
Not expecting any impact, and studying only because they like it	19	17,6%	4	16,7%	0,9%	♂↑ ♀↓	28	24,6%	4	12,1%	-12,4% more ♂
Other	4	3,7%	0	9,0%	-3,7%		9	7,9%	3	9,1%	1,2%

(*) Note "to get a promotion and more responsibilities" makes no sense for the majority of incoming undergraduate students who still have no work, thus this category was not included in the instrument that they responded.

getting a good salary is now a category in which there are no differences. The most significant criteria for men (mentioned by more than 30% of them) are (in that order): working on something interesting, having a good salary, getting a promotion, and having good working conditions. On the other hand, the most significant criteria for women (mentioned by more than 30% of them) are (in that order): working on something interesting, getting a promotion (both with the same level of importance) and getting a better salary. This latter aspect, getting a better salary, is something that graduate women care far more than graduate men (our insight, based on incomplete data from a few employers, is that their salaries might be lower than those of men in similar positions, but more research is needed to confirm or reject this). It is interesting to note that working conditions are more important for men than for women once they are working (an outcome rather puzzling). Moreover, a significantly higher percentage of men than of women believe that graduating from the Masters program is not going to have any impact on their future employment, and that they study it just because they like it.

- **Changes in perception between undergraduate and graduate students by sex:** The most interesting change is that the category "Getting a more interesting job and/or a job position in something they like more" is the one which importance decreased the most in both populations. The second most important aspect is

that graduate women are more concerned with earning a higher salary than undergraduates, and at the same time, they care less than undergraduates about getting better working conditions.

Type of position sought after graduation

The results to the question: "What type of position would you be interested in the most after you graduate?" were tabulated in Table 2 and are discussed below.

- **Relative differences by sex among incoming undergraduate CS students:** There are differences by sex in the three categories of type of positions. Incoming male students answered they would prefer a managerial position, followed closely by a technical position, while incoming female students prefer technical much more than management positions. More women than men are interested in academic posts (although in both sexes, they represent a weak minority).
- **Relative differences by sex among graduate CS students:** The situation for the graduate student population is totally different. In this group, women are inclined to seek management positions, while men are focused on technical posts. More men than women (by a 15% difference) prefer a technical job, while many more women than men are seeking a managerial position (for a 24% difference).
- **Changes in perception between undergraduate and graduate students by sex:** The preference between technical and managerial positions is dramatically reversed between women and men as

Table 2. Type of position preferred by incoming undergraduate students and active graduate students, by sex. The "Difference" column for each, undergraduate and graduate populations shows the distinction between the percentage of men and women who considered the point as important. The column "Changes in perception" evaluates the perception variation between undergraduate and graduate students for the same issue, by sex. Downward arrows represent decreases between undergraduate and graduate importance perceptions for the aspect, while upward arrows signify an increase in the importance of the subject for graduate over undergraduate students. The number of arrows reflect the strength of the tendency.

Preferred type of position	Undergraduate students					Changes in perception	Graduate students				
	Men		Women		Difference		Men		Women		Difference
	n	%	n	%	%		n	%	n	%	%
Tecnical	49	45,4%	14	58,3%	12,9% more ♀	♀↓↓↓	52	45,6%	10	30,3%	-15,3% more ♂
Administrative	51	47,2%	10	41,7%	-5,5% more ♂	♂↑ ♀↑↑↑	59	51,8%	25	75,8%	24,0% more ♀
Academic (+)	2	1,8%	3	12,5%	10,7% more ♀		na	na	na	na	na

(+) Unfortunately this category did not exist in the instrument that was answered by graduate students.

they enter the workforce. Although incoming students do not have a clear understanding about the real differences in the types of position, the drastic increment in the interest of women in managerial positions may be due to their desire to have better salaries or may reflect the "glass ceiling" effect, in which women tend not to be selected for some positions such as project managers, as indicated by some studies in the United States (for example, [1] or [11]).

Specific job positions of interest

Table 3 presents the results of asking the students to be more specific about the posts they were interested in occupying. Technical positions are marked in yellow and administrative positions are marked in blue.

- **Relative differences by sex among incoming undergraduate CS students:** Taking into account that first

year incoming undergraduate students do not have a clear vision of each post, we can see that there are sex differences in terms of the specific jobs they would like to hold, although the differences are relatively small (between 5 and 10%). The favorite positions for women (arbitrarily defined as those with more than 30% references) were: analyst / programmer (54%), systems administrator (46%), Data Base (DB) administrator (42%) and project manager or department head (38% each). For men, the favorites were: analyst / programmer (60%), systems administrator (46%), network manager (40%) and department head (34%). As it can be seen, preferences toward administrative and technical positions are similar. Among the favorites, there are significant differences for analyst - programmer and network manager (slightly favored by men), and DB administrator and project manager (favored by women). From the not-so-popular categories, more

Table 3. Specific positions of interest for incoming undergraduate and graduate students, by sex. The “Difference” column for each, undergraduate and graduate populations shows the distinction between the percentage of men and women who considered the point as important. The column “Changes in perception” evaluates the perception variation between undergraduate and graduate students for the same issue, by sex. Downward arrows represent decreases between undergraduate and graduate importance perceptions for the aspect, while upward arrows signify an increase in the importance of the subject for graduate over undergraduate students. The number of arrows reflect the strength of the tendency.

Specific preferred positions	Undergraduate students					Changes in perception	Graduate students				
	Men		Women		Difference %		Men		Women		Difference %
	n	%	n	%			n	%	n	%	
Project manager	30	27,8%	9	37,5%	9,7% more ♀	♂↑↑↑ ♀↑↑↑↑	53	46,5%	26	78,8%	32,3% more ♀
Analyst-programmer	64	59,3%	13	54,2%	-5,1% more ♂	♂↓ ♀↓↓↓	36	31,6%	7	21,2%	-10,4% more ♂
Department head	37	34,3%	9	37,5%	3,2%	♀↑	40	35,1%	14	42,4%	7,3% more ♀
Professor	8	7,4%	3	12,5%	5,1% more ♀	♂↑ ♀↑	16	14,0%	7	21,2%	7,2% more ♀
Systems administrator	50	46,3%	11	45,8%	-0,5%	♂↓ ♀↓	24	21,1%	8	24,2%	3,2%
Network manager	43	39,8%	7	29,2%	10,6% more ♂	♂↓ ♀↓	22	9,3%	3	9,1%	-10,2% more ♂
Data Base administrator	31	28,7%	10	41,7%	13,0% more ♀	♂↓ ♀↓	17	14,9%	11	33,3%	18,4% more ♀
Researcher	16	14,8%	5	20,8%	6,0% more ♀	♂↑↑ ♀↓	33	28,9%	4	12,1%	-16,8% more ♂
Auditor or Quality control manager	10	9,3%	4	16,7%	7,4% more ♀	♀↑	13	11,4%	9	27,3%	15,9% more ♀
Other	3	2,8%	0	0,0%	-2,8%		6	5,3%	0	0,0%	-5,3%

women than men prefer to be researchers, teachers or auditors, while in the other categories there is no difference.

- **Relative differences by sex among graduate CS students:** As can be seen in Table 2, in regard to general position types, student preferences changesignificantly with time and experience, partly because: (1) graduate students do understand better the characteristics and responsibilities of the different job descriptions, and (2) there is a gender difference in technical and administrative work, with men leaning towards technical positions, but women choosing increasingly administrative or managerial positions. The three favorite positions for graduate female students are project management (with an incredible 79%), department head (42%) and BD administrator (33%).

CONCLUSIONS

We analyzed the perceptions of a group of graduate and undergraduate CS students in regard to the impact their respective plan of studies was going to have on their future employment. We also studied their preferred type of work, and the position they aspire to occupy, to determine if there were gender differences in those perceptions. The first hypothesis, about differences by sex on work preferences was widely confirmed. On all questions analyzed, there were significant differences between women and men.

Our second hypothesis, with respect to changes in work-related motivations with the entry into the workforce provided also positive evidence. Women show an important change towards managerial and administrative positions, while men continue with their preference to work in technical positions. Women start their undergraduate studies with an expectation similar to that of men of working in technical positions, and in [6] we show that women have no difficulties graduating, that is, they are successful in the technical aspects of the field. This drastic change towards management/administration must have causes different to personal taste and capacity. Extrapolating from the experience of other researches, we argue that it might have to do with the difficulty of obtaining coveted positions because of gender bias [1,4,11].

This work opens several questions with respect to the insertion of women in the IT workforce. The next step must be a qualitative and/or quantitative research about the situation of women in public and private companies in the country. It would be interesting to know also the situation in other Latin American countries.

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