

# Undergraduate women in Computing: where did they come from, how are they and where they are going?

Rosiane de Freitas  
 Instituto de Computação  
 Universidade Federal do Amazonas  
 Manaus-AM, Brasil  
 Email: rosiane@icomp.ufam.edu.br

Fabíola Nakamura  
 Instituto de Computação  
 Universidade Federal do Amazonas  
 Manaus-AM, Brasil  
 Email: fabiola@icomp.ufam.edu.br

Tanara Lauschner  
 Instituto de Computação  
 Universidade Federal do Amazonas  
 Manaus-AM, Brasil  
 Email: tanara@icomp.ufam.edu.br

Taynah Santos  
 Instituto de Computação  
 Universidade Federal do Amazonas  
 Manaus-AM, Brasil  
 Email: tmas@icomp.ufam.edu.br

Ana Lúcia Machado  
 Instituto de Computação  
 Universidade Federal do Amazonas  
 Manaus-AM, Brasil  
 Email: analuciamachado@icomp.ufam.edu.br

Ludymila Lobo  
 Tribunal Regional do Trabalho - TRT-AM  
 Manaus-AM, Brasil  
 Email: lobo.ludymila@gmail.com

**Abstract**—This work shows some data about women in Computing in Brazil and in Federal University of Amazonas in order to check if there are any improvement done recently when related to a more equal environment in the Technology area. It also directly analyses the impact of a program created in Federal University of Amazonas, to reduce gender gap in IT field and promote empowerment to women. In this study we have included data collected with an online survey of alumni, recent graduated and current student of Computing courses of our university.

## I. INTRODUCTION

Women are minority in IT area, and that seems to be the reality of many countries (if not even all of them) around the world. The statistics shows that women represents around 18% of all graduates in Computer Science. [9] The most impressive data is that, in the beginning of Computing courses, the proportion of women were significantly higher, even because they have participated in the creation of Computing [6]. As can be seen in literature, many universities can evidence this argument with numbers. In Brazil, although women make up the majority of university students [8], the female participation in Computing courses is low [7]. In one of Rio de Janeiro's most famous university, UFF (Universidade Federal Fluminense), the percentage of female students in computing has decreased over the years, from the 80s to the present day, where it represents a difference of 20% less. More than 3,000 student were admitted to this university in a Computing area since the opening of the course, however, of this total, only 16% were women.[6]

A case study carried out at Unicamp, another important Brazilian university, shows that there are no real differences in learning capacity related to gender. In fact, female students of courses considered masculine have a coefficient of income better than male students of the same courses [10]. In addition to observing the low female participation in computer courses, [7] in her work also shows that women in the area are concentrated in areas that have in common the human factor, such as Artificial Intelligence, Human-Computer Interaction and Computers in Education. In areas with technological

components they tend to drift apart, such as networks and hardware.

In response to this problem, the program "Meninas Digitais" [5] was created, with the aim of promoting the area of Computing to arouse the interest of female high school students. The project "Cunhantã Digital" [4] is a regional part of the program and this article is part of his research. One of the activities of the project, the SciTech Girls [2], is related to the stimulation of female participation in programming competitions as a way to attract women to the Computing area [1].

For our analyzes, we have focused in Federal University of Amazonas, located in Amazonas state, where women are 49.53% [3]). Those analysis will be presented in the following sections, with specific approaches: Section 1 will focus on our freshman women student in undergraduate and graduate courses; Section 2 will analyze our student performance with indicators such as dropout rate; Section 2 will present data about our alumni, in order to identify difficulties that they had along the course. Follows, we present some future work, and finally, the conclusion.

## II. WHO ARE OUR STUDENTS?

This section presents some data collected with online questionnaires about the students in our University, for a initial study of our gender gap reduction program that was implemented.

### A. Admission's statistics in our University

In order to compare the data about women and men proportions in IT related courses with the literature and our university, we have collected data about admission's statistics. Checking the information along the time, it is possible to observe that men were always the majority since the course started in our University. Although, there is a slightly difference between the courses: Information Systems usually have more women when compared to Computer Science.

**B. Information about freshman female students in undergraduate courses**

In this subsection, it will be presented some data collected with freshman student of Federal University of Amazonas in undergraduate courses.

The data was collected through the web, with direct and indirect questions, in the Google Forms tool. Of the total of 26 students enrolled in Computer Science, Information's Systems and Computer Engineering courses contacted via e-mail, 19 answered the survey, which was available for about one week.

1) In Brazil, students have to take an exam to apply for a course in University. They can chose more than one option of area. Every course has a limited number of students. They will compete for their second option only if not approved at the first option. Our first question was whether a Computing related course was their first option or not. The results pointed on figure 1 shows that for the majority of interviewers, a Computer related course was the first option for the majority of them.

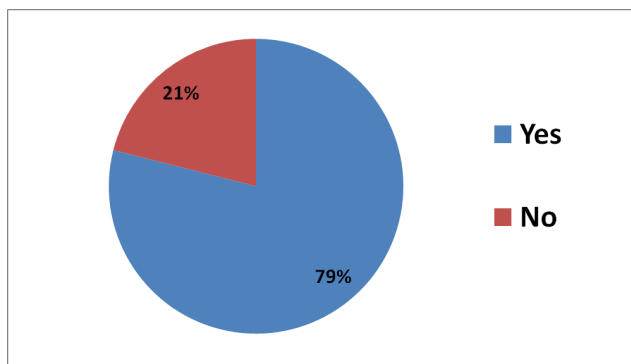


Fig. 1: Results for the question "Was a Computing course your first option on admission exam to university?"

2) In order to check whether they have started a Computing course immediately after taking the admission exam or if they have transferred from other option of course, we have asked if they have already transferred from other courses. We can see in 2 that only 5% of the students have transferred from other courses to a Computing course.

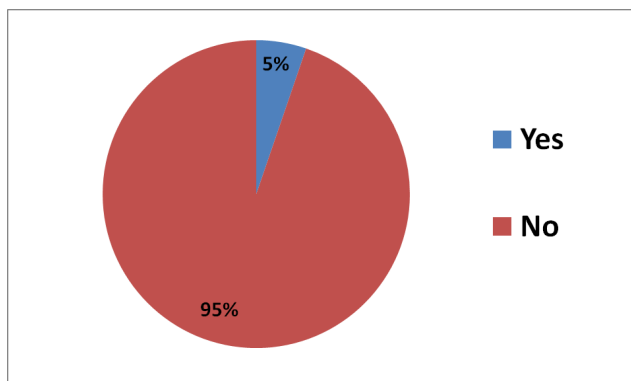


Fig. 2: Results for the question "transferecia"

3) We also asked about how many of them had taken a technical course before starting university. A considerable amount of them (62%) had studied in technical schools, as we can see in 3.

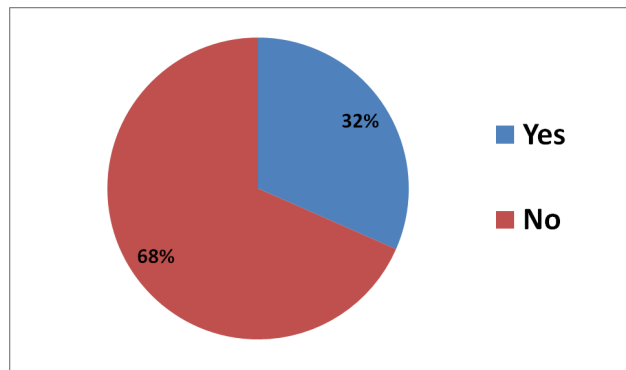


Fig. 3: Results for question "Have you studied in a Technical school in Informatics area before starting undergraduate studies?"

**III. OUR STUDENT'S PERFORMANCE ALONG THE COURSES**

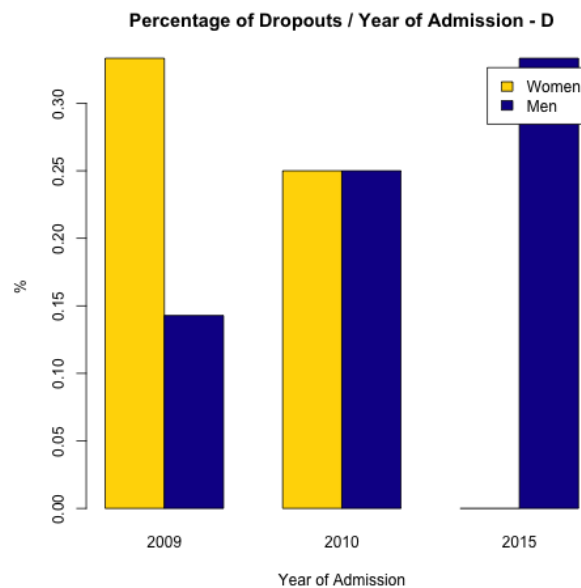


Fig. 4: ...

**IV. WHERE ARE OUR STUDENTS GOING AFTER GRADUATING?**

**A. General information about alumni**

In this section, we present the results of a questionnaire made with alumni in our University, with an online survey. With this questions, we are trying to understand more about the difficult they had along the course. At total, 41 alumni answered our questions. Following, it is presented the questions in our survey, the results obtained and a short analysis of it.

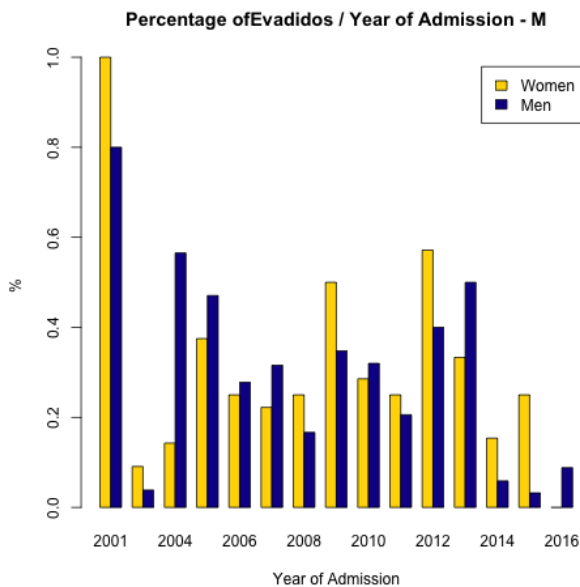


Fig. 5: ...

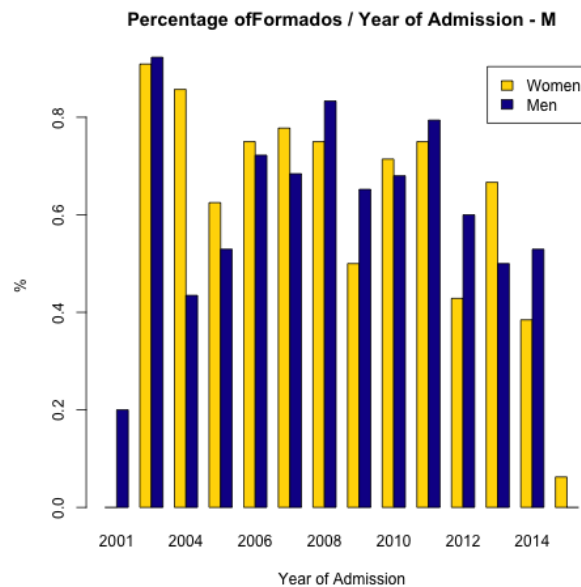


Fig. 7: ...

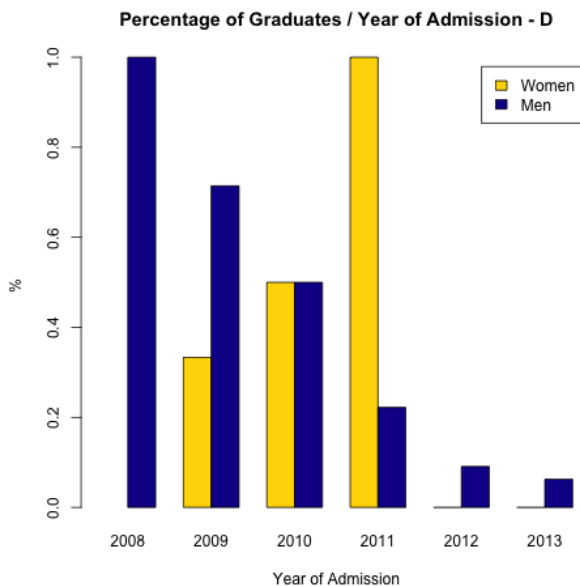


Fig. 6: ...

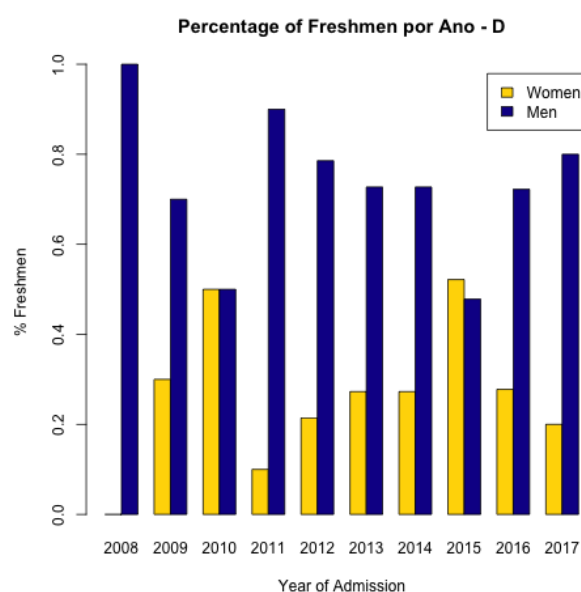


Fig. 8: ...

1) In Federal University of Amazonas, currently have three courses related to Computing: Computer Science, Computer Engineer and Information Systems. But previously, the courses had different names (such as Data Processing). We have made a survey to check the distribution of courses that our alumni have finished. The results are presented in Figure 11

2) We have also asked about the year of graduating of the interviewed alumni, just to take a look at their background before taking a look at the next questions. See 12.

3) In order to check about their involvement with the

research area, we consulted their participation on scientific initiation projects and other related projects along the course. The result on 13 shows that 29 (or 82%) has participated on projects with scholarship.

4) Performing other functions along undergraduate course can influence the available time that student has to develop activities related to their course. In this question we are checking how many of the alumni have exclusive dedication along the course. 14 shows that that 48% was exclusively dedicated to the course.

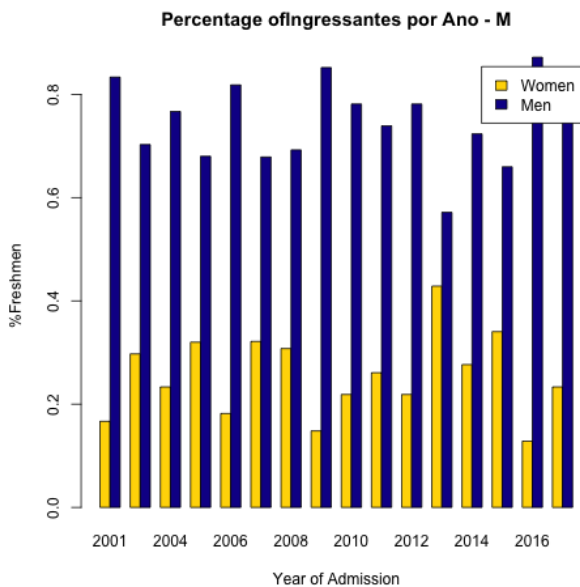


Fig. 9: ...

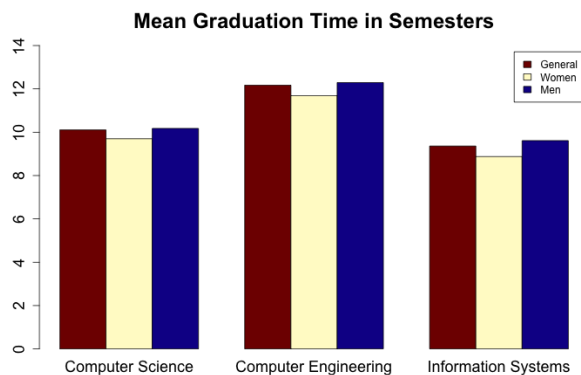


Fig. 10: ...

5) In this question, we verify alumni's opinion on whether working along undergraduate course has positive, negative or neutral effects. 15 shows that 46% thinks that it made more difficult to finish their course while participating of other professional activities .

6) In order to verify which professional area that our alumni are working on, we have asked about their current job position. 16 shows that most of them are working directly with programming, a considerable amount (22%) is working in the research field.

7) We also have checked whether the alumni are still working in IT field nowadays. 17 shows that 95% of the interviewed alumni are still in Computing related areas.

8) Also, we checked if they already have any professional experience in the area, and 18 shows that the majority of them (55%) have not had any professional experience yet.

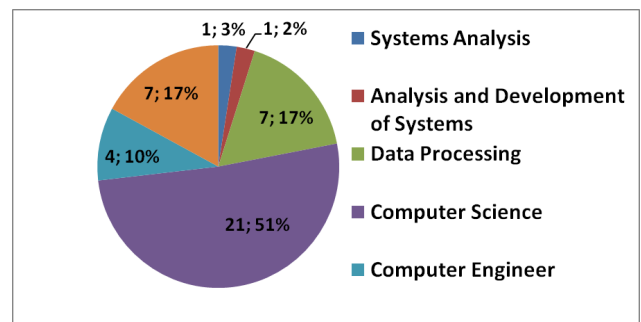


Fig. 11: Distribution of alumni's courses

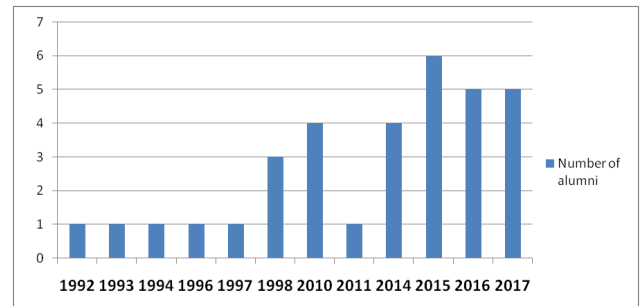


Fig. 12: Distribution of alumni's graduation year

9) Finally, we have asked about our alumni's specialization. 19 shows that 45% of them does not have any kind of specialization (masters degree, MBA and other post-graduate courses).

B. PPGI

V. DATA ABOUT OUR PROGRAM

As a way to measure how much can we reach with our program, we have made an analysis on data collected from a form answered by our Computing female students in order to identify the strengths and weakness of our program of incentive to women in IT, so that will allow us to take actions that can reach a higher number of people that will be impacted with our efforts on gender equality in IT field. The following graph represents the result of a questionnaire made with freshman women student admitted in the Federal University of Amazonas. It can be observed that our program did not reach half of the freshman, but at least 32% have already participated of one of our actions or heard about us on events or social media. Although, in the last year, we have participated of only one event dedicated to high school girls.

It was also asked whether they have already heard about any other program related to gender in IT field. The results on 27 shows that 84% of them have never heard about any actions of other programs.

VI. FUTURE WORK

Regarding our next steps, a survey will be conducted with women in the industry to verify qualitative information about the work environment, and thus, it will be made a plan of

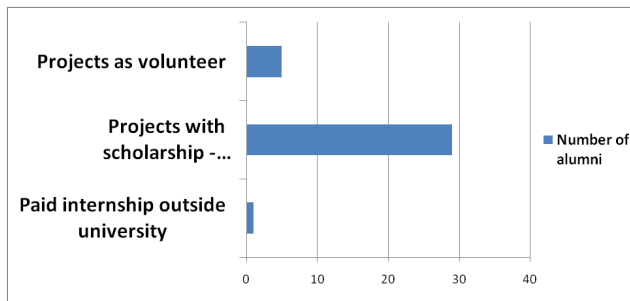


Fig. 13: Distribution of alumni's rate of participating on projects along undergraduate course

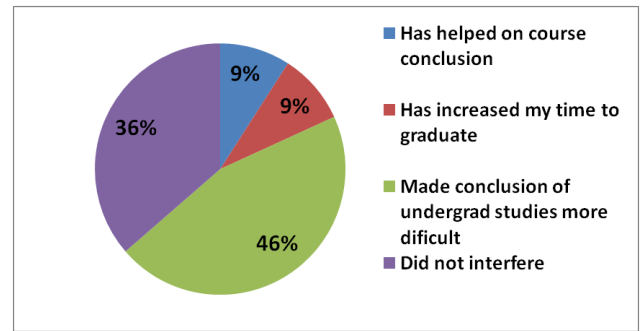


Fig. 15: Alumni's opinion on the effects of working along undergraduate course

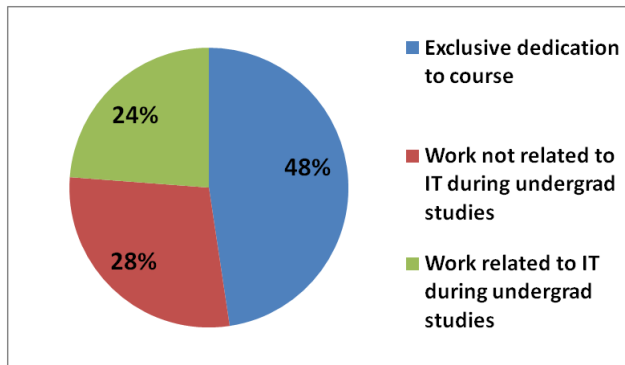


Fig. 14: Graphics showing whether alumni had exclusive dedication or not along the undergraduate course

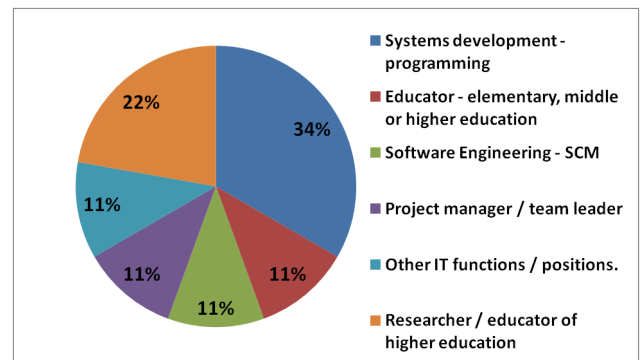


Fig. 16: Alumni's position on work nowadays

actions for the program according to the result obtained, aiming to provide a more welcoming corporate culture to women in environments almost always mostly occupied by the male audience. It is also intended to continue the statistical studies and to deepen them more, besides carrying out actions of mentoring within the university to accompany the students in the academic activities and in the participation of competitions. Another activity that could be done is to extend the public of our questionnaire and include a larger number of students and universities.

## VII. CONCLUSION

In this article, the data presented about women in IT in universities and in high school shows that there is a lot to be improved when related to attract and retain women in this field. The data presented in this article will also be useful to other studies related to IT and gender. Another point that could be observed, is that our program Cunhantã Digital is starting to get recognized, and for that, we are planning to invest more time on marketing and on event planning, so it will be possible to reach a larger number of women.

## REFERENCES

- [1] Rosiane de Freitas, Ludymila Lobo, Victoria Patricia Aires, Nadny Dantas, and Tayana Conte. Programming contests and mobile apps development as actions for attracting and retaining brazilian women in computing courses. In *In: LAWCC (VIII Latin American Women in Computing Congress)*, CLEI, 2016.
- [2] Rosiane de Freitas, Ludymila Lobo, and Tayana Conte. Projeto scitech-girls: desenvolvimento de aplicativos e participação em competições de programação científicas e tecnológicas. In *In: WIT - 10<sup>o</sup> Women in Information Technology*, CSBC, 2016.
- [3] Instituto Brasileiro de Geografia e Estatística. Ibge 2017. <http://www.ibge.gov.br/apps/populacao/projecao/>, 2017. Accessed: 2016-04-10.
- [4] Tanara Lauschner, Rosiane de Freitas, Fabíola Nakamura, and Ludymila Lobo. Cunhantã digital: programa de incentivo à participação de mulheres da região amazônica na computação e áreas ans. In *In: WIT - 10<sup>o</sup> Women in Information Technology*, CSBC, 2016.
- [5] Cristiano Maciel and Sílvia Amélia Bim. Programa meninas digitais - ações para divulgar a computação para meninas do ensino médio. *Computer on the Beach 2016*, pages 327–336, 2016.
- [6] Karina Mochetti, Luciana Salgado, Ana Valladares Zerbinato, Beatriz Lopes Souza, and Meirylene Rosa Emidio Avelino. Ciência da computação também é coisa de menina! In *In: WIT - 10<sup>o</sup> Women in Information Technology*, CSBC, 2016.
- [7] Fortes R. P. M., Monard, M. C. Uma visão da participação feminina nos cursos de ciência da computação no brasil. *LAWCC2013*, 2013.
- [8] Gilda Olinto. A inclusão das mulheres nas carreiras de ciência e tecnologia no brasil. *Inclusão Social*, 5(1), 2012.
- [9] Ana Elisa Schmidt, Hiryna Philipps de Britto, and Mozara Dias Koehler. Levantamento e análise dos dados da presença feminina discente no curso de bacharelado em sistemas de informação do instituto federal catarinense, campus camboriú. In *In: 10o WIT ( Women in Information Technology)*, CSBC, 2016.
- [10] Elza da Costa Cruz Vasconcellos, Sandra Negraes Brisolla, et al. Presença feminina no estudo e no trabalho da ciência na unicamp. *cadernos pagu*, 32:215–265, 2009.

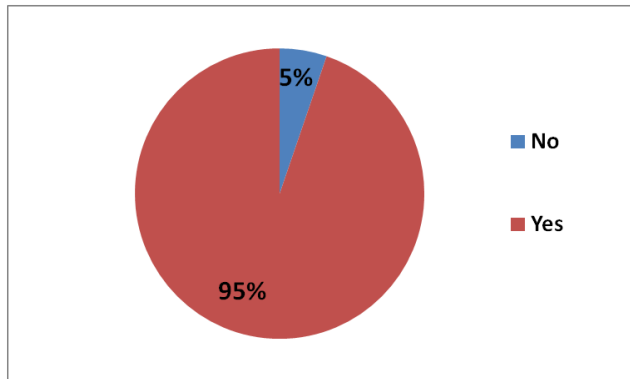


Fig. 17: Proportion of alumni that still are in IT field

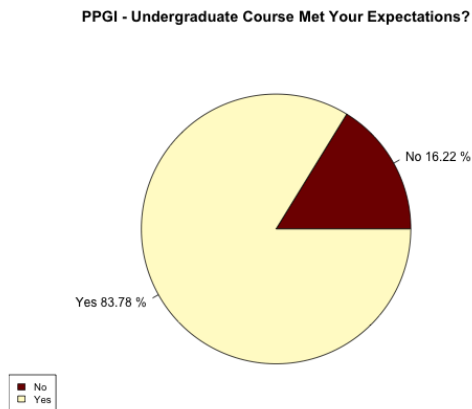


Fig. 20: ...

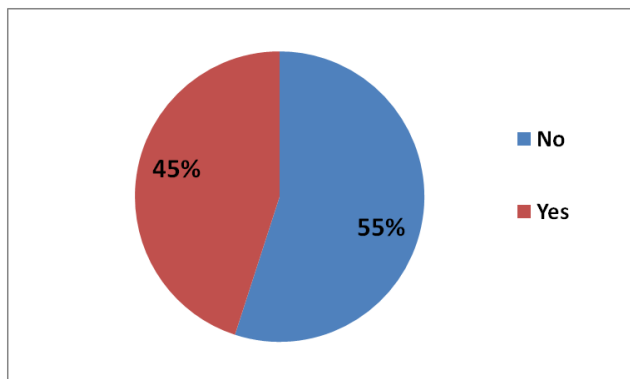


Fig. 18: Whether alumni had professional experience in IT

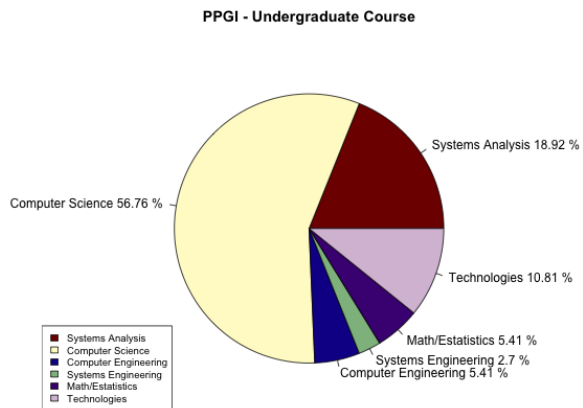


Fig. 21: ...

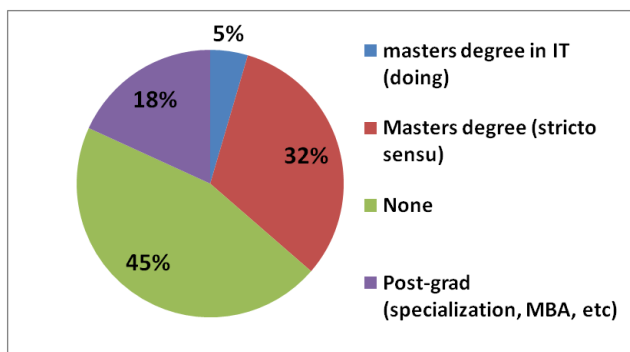


Fig. 19: Specialization of alumni

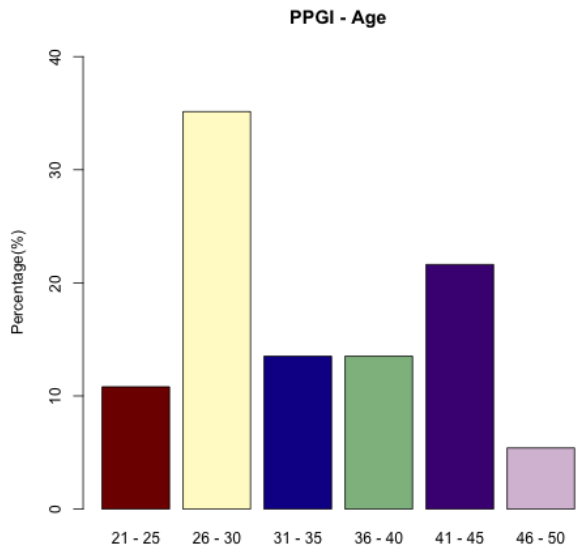


Fig. 22: ...

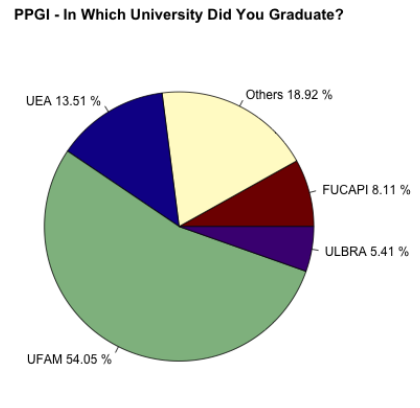


Fig. 25: ...

**PPGI - Did You Attend a Computing Technical Course Before University?**

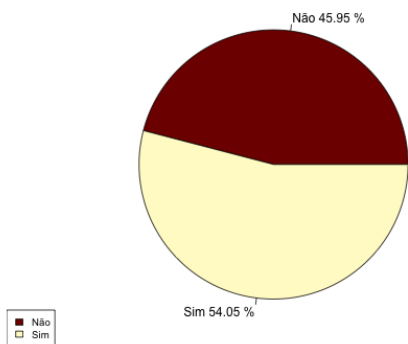


Fig. 23: ...

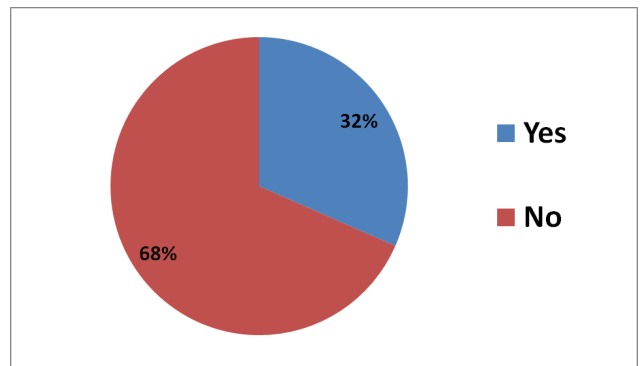


Fig. 26: Freshman women student that already knew our Program

**PPGI - Reasons To Choose IT**

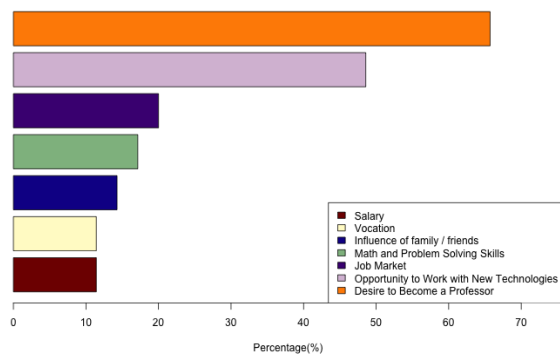


Fig. 24: ...

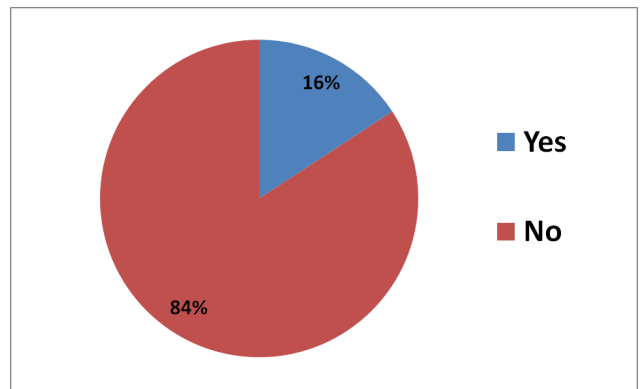


Fig. 27: Freshman women student that already knew another Program