

Brazilian High School Girls: What Drives Their Career Choices?

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Abstract—Women represent 30% of the workforce in technological areas. Those statistics are a challenge to gender equality, but pose as an opportunity to engage more people to the cause of bringing more girls to IT areas. This paper shows the results of a survey submitted to high school female students during a career event. Girls answered questions about their high school preferences, their career choices, and what made them choose the area. Results show math is a well-liked subject in High School but girls choose careers in Human or Biological fields. According to them, they lack mathematical skills and vocation to aspire a career in IT.

I. INTRODUCTION

Women represent only 30% of the workforce in technological areas, according to diversity reports from 11 of the world's largest tech companies[4]. Women low representativeness in exact areas begins at an early age, in fundamental and high school activities. On the other hand, this low number reflects on individuals, at a more personal level, and in society as a whole. In a personal level, women think they don't have the chance to succeed acting in these areas, and in the social level, we neglect 50% of the potential workforce [3].

Blickenstaff released a study about the many motives that push away women from STEM areas. The author judge motives some without merit, others dangerous and some really complex. However, it gives us a question if it isn't the scientific properly the responsible for the exclusion. At the end, some changes are proposed in the education of sciences to help the problem[2]. One strategy to increase this number is to develop programs and activities for girls in middle and high school[1].

In this context, we can identify several projects to young girls. The GETSMART Project (Get Everyone to Study Math and Related Technologies) is a project developed at Tampa University, Florida, that brings together women from IT areas – like leader in industry, researchers, recently graduated – and students in undergraduate courses and high school, aiming at creating a collaborative and support network, as well as an incentive to girls pursue STEM careers (Science, Technology, Engineering, and Math)[6].

In Manaus, Capital of Amazon State, in Brazil, was born the Cunhantã Digital Movement. The project aims at engaging women from the Amazon Region in STEM and promoting the interaction among professionals and students. It holds the support of the "Meninas Digitais" and the Women in Information Technology (WIT), an event promoted by the Brazilian Computer Society. The idea is to foment the gender discussion in schools, in the Academia, and in the IT market.

We intend to contribute to create an equality environment for women and a collective consciousness to undermine prejudice and taboos, such as the one that women have no place in technological areas. Project activities include mini-courses and workshops, training of women's teams for computer marathons and hackathons[5], data gathering and generation of scientific papers, lectures to high school and undergraduate students, and technical discussions with IT professional, among other things. Cunhantã is the Tupi-Guarani word for girl. [9], [10].

This paper presents the results of a survey done with High School female students in an event specific to discuss careers. We review several case studies in the areas of Information and Communication Technology for Development (ICT4D), mobile learning and tablet computer in education. The research aimed at finding out what attracts or led away girls from exact, STEM and IT areas in general. The paper is structured as following: in Section II we briefly describe Brazilian initiatives to support girls in IT areas. Section III presents demographic data about Manaus high school population and the Northern Student's Fair. In Section IV we describe our research methodology and in Sections V,VI,VII we present the survey results group by nature of the data. Section VIII closes the paper. This section provides in-depth analysis, discuss limitations and indicates future directions.

II. GENDER EQUALITY PROJECTS IN BRAZIL

The Brazilian Computer Society (Sociedade Brasileira de Computação - SBC) has a Project called "Meninas Digitais" (Digital Girls) to support institutions all over Brazil to develop projects to engage young girls in STEM areas[11], [8], [12]. We highlight the following programs:

- Emfli@s - Armações em Bits: Project developed in the Informatics Academic Department (Departamento Acadêmico de Informática - DAINF) of the Technological Federal University of Paraná (Universidade Tecnológica Federal do Paraná (UTFPR)) which aims at increase the number of girls in their computing courses: B.E. in Computer Engineering and Bachelor in Information Systems. Recently, the project was extended to another UTFPR Campus in Campo Mourão, and now works together with the Women in Free Software (Mulheres em Software Livre - MSL) initiative developed in the Academic Department of Computing (Departamento Acadêmico de Computação - DACOM). Their activities involve undergraduate students from their Bachelor in Computer Science and Technical Informatic course.

- Android Smart Girls: Project created by the IEEE WIE Unicamp of the State University of Campinas (Universidade Estadual de Campinas), to present to high school girls programming logic and algorithms in a fun and pleasure way. They aim at developing apps for smartphones using the MIT App Inventor tool.
- Girl Geek Dinners Brazil: This project has a really interesting approach once it promotes events to gather women who are interested or work with technology. They share experiences, personal and technical, related to IT areas. The meetings include short talks, panel discussions, experience reports, and most important they encourage networking and are really fun.
- Encoding Women: The project encourages women to expose their works in computing as a factual prove of their capacity of building a strong and impacting application and as a tool against prejudice. They provide technical support in form of lectures and study groups to women who want to develop or improve programming skills. They share experiences and build a support group where one help another.
- Delete seu Preconceito Delete Your Prejudice, in English translation, is an project with great impact, that shows that, in the 21st Century, the prejudice is latent in our society, in academic, work and social environments. The project first act was to capture in camera the mark of prejudice. Several girls and women, students and professionals, posed with a small poster with a sentence that they had already heard. The project became viral and contributed greatly to bring the subject to light.

III. NORTHERN STUDENT'S FAIR

The Northern Student's Fair (FNE - Feira Norte do Estudante) is an event realized annually since 2010, focused on high school students, that reached its 7th edition in 2016. During the three days, it attends a public of about 30 thousand people. In the event, students contact Higher Education Institutions, know their infrastructure and their courses. They meet professors and students from these institutions and can access professionals from several areas. The FNE presents vocational and technical lectures aiming at clarifying doubts and presenting new perspectives to the young students.

According to IBGE census, in 2012 in Manaus the number of teenagers in high school was 97.791, being 85.687 from state network, 1.937 from the federal network and 10.167 from the private network. Those numbers are divided into 103 state schools, 4 federal schools, and 51 private schools. All the federal schools are technical schools[7].

In the 2016 edition of FNE, the "Cunhantã Digital" Project gave a lecture about Influential Women in Science, that had several positive feedback from the audience, especially from young girls. The project also had an exhibition stand to talk with the students that visit the fair. The visitors met professors and students from Computer Science and Information Systems. The stand is shown in Figure 1.

They had the opportunity to know projects developed from undergraduate girls in International Competitions and learned



Fig. 1: UFAM students in the Cunhantã Digital during 2016 FNE

more about logical games and reasoning, as shown in Figure 2.

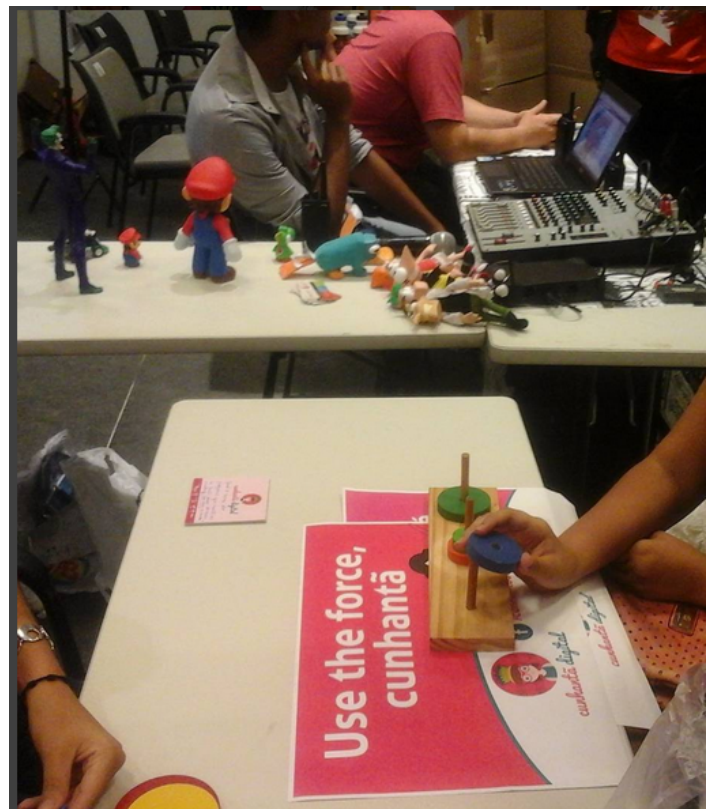


Fig. 2: FNE visitor playing Tower of Hanoi

In the same opportunity we surveyed high school girls about their favorite subjects, their career choices and the motives behind those choices, and about their perception of several skills like computer programming and teamwork. The results are shown in the following sections. The data was

collected personally by a form answered anonymously.

IV. RESEARCH METHODOLOGY

To understand the problem of the reduced enrollment of female students in courses of exact and technological areas, we surveyed 195 high school female students, between 14 and 20 years old, during the 2016 FNE. Our purpose was to investigate the interest in IT areas and the motivations to follow or not the area.

Below we present the questions submitted to the girls. They were divided into 3 sections. In the first section we asked the following questions:

- Age
- High School Year
- Favorite Subject Area in School
 - 1) Arts, Sports and Extracurricular Activities;
 - 2) Biology and Genetics;
 - 3) Exact Areas; and
 - 4) Human Areas and Languages.
- Undergraduate Area of Choice
 - 1) Agricultural Sciences;
 - 2) Biology and Healthy Sciences;
 - 3) Exact Sciences; and
 - 4) Human Sciences.

In the second section, we asked the girls to classified a group of skills into: [1] Very Interesting; [2] Quite Interesting; [3] Slight Interesting; and [4] Uninteresting. The general question was "What do you think about..":

- Writing Texts (papers)?
- Handling Data and Solving Problems?
- Computer Programming?
- Owning Your Own Business?
- Researching and Writing Reports?
- Designing Planes, Buildings, and Machines?
- Teamwork?
- Being Able to Communicate Well?
- Speaking in Public?

In the third and last section of the survey, we asked about the reasons that would make them choose or not an IT career. They could choose up to 2 options.

The first question was "What reasons could make you choose an IT career? The options were:

- Job Market;
- Salary;
- Opportunity to work with new technologies;
- Opportunity to create apps;
- Vocation;
- To have math and problem solving skills;

- Influence of family and friends;
- Others.

The second question was "What reasons could make you NOT choose an IT career? The options were:

- Job Market;
- Salary;
- Lack of Vocation;
- Lack of math and problem solving skills;
- Influence of family and friends;
- Others.

V. WHAT I WANT TO BE WHEN I GROW UP?

Our research reached girls from 14 to 20 years old. The age's distribution of the interviewed is shown in Figure 3.

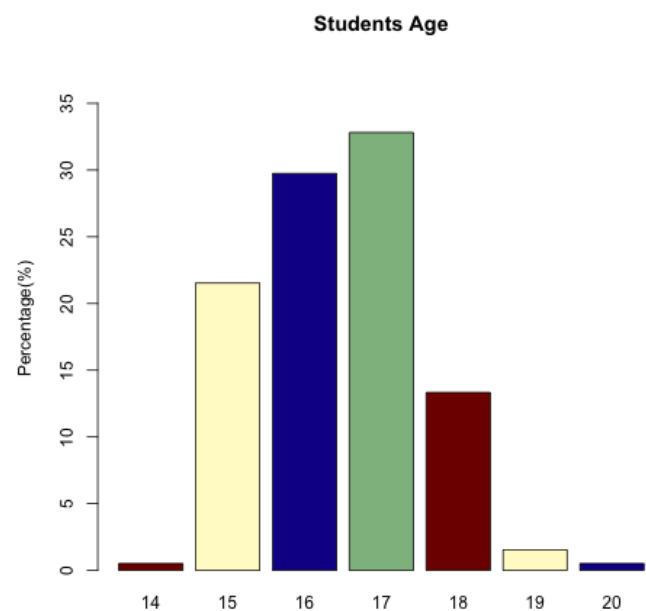


Fig. 3: Students Age

In Brazil, High School is 3 (three) years long. The distribution of the High School students for each year is shown in Figure 4.

One of the goals of the research was to investigate if the lack of interest in exact areas reflects on favorite subjects in high school. We formulated the following question: "In high school, your favorite subjects are from what field?". The options for the answers were: a) ASE - Art, Sports and Extracurricular Activities, b) BIO - Biology and Genetics, c) HS - Human Sciences and Languages and d) EXA - Exact Sciences. The results are shown in figure 5, when we can find a balance between biology, human and exact areas.

In other question, "In which area you intend to undergraduate?", the options to the answer were a) Agricultural Sciences,

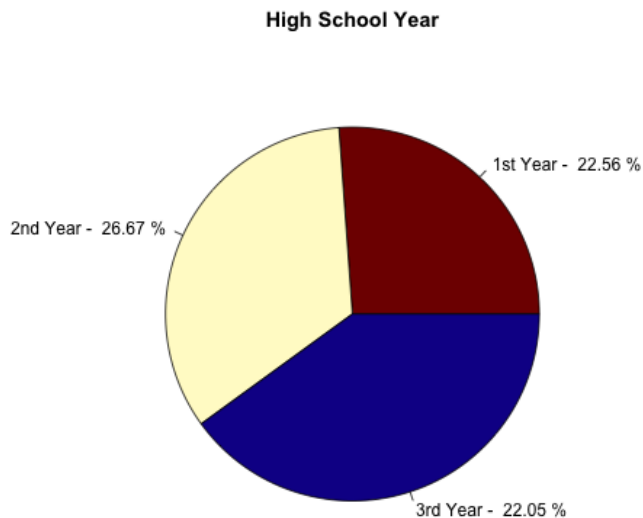


Fig. 4: High School Year

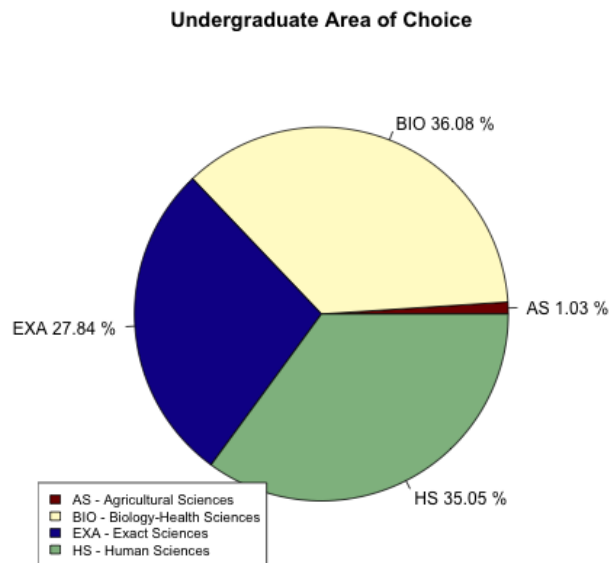


Fig. 6: Favorite Subject in High School

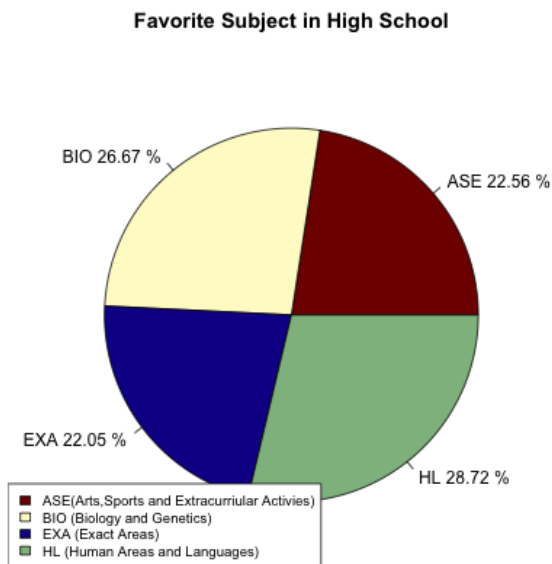


Fig. 5: Favorite Subject in High School

b) Exact Sciences, c) Human Sciences and d) Biological and Health Sciences. The results are showed in Figure 6. Comparing the two graphics we can see that, even if exact sciences figure as preferred among the subjects in high school when it's time to choose the graduation that option stays behind biological and health areas and human areas.

VI. STUDENTS PERCEPTION OF SKILLS

As stated in Section IV the second part of the survey, gave the students a series of skills for them to test based on the scale: [1] Very Interesting; [2] Quite Interesting; [3] Slight Interesting; and [4] Uninteresting.

According to 59.49% of the students, being able to write texts (papers) is Very Important, as shown in Figure 7. Only 4.1% find the task Uninteresting.

To handle data and solve problems is "Very Important" to 45.64% of interviewed and "Uninteresting" to 10.77%. We show these results in Figure 8. Given the importance of data/information nowadays and the prospect of becoming even more important in near future, this can be a subject to explore and bring to the attention of high school students, regardless of gender, once it can open several opportunities, career-wise.

A pleasant surprise was the results about computer programming. Among the interview, at least 72.16% will not choose an IT career, given their choices are Agricultural Sciences, Biology and Healthy Sciences, and Human Sciences. However, 66.15% find the computer programming "Very Interesting", which means that they are aware of prize those skills. The results are shown in Figure 9.

Research and write technical reports are "Very Important" to 44.62% of the interviewed. It is an interesting result given that this kind of activity is little explored during school. In Brazilian schools, experimental activities and scientific reports are not explored appropriately even though they could contribute to engagement students in activities. The results are shown in Figure 10.

To own a business is "Very Interesting" to 83.59% of the students. It is by far one of the highest results in all the

How interesting is to write papers?

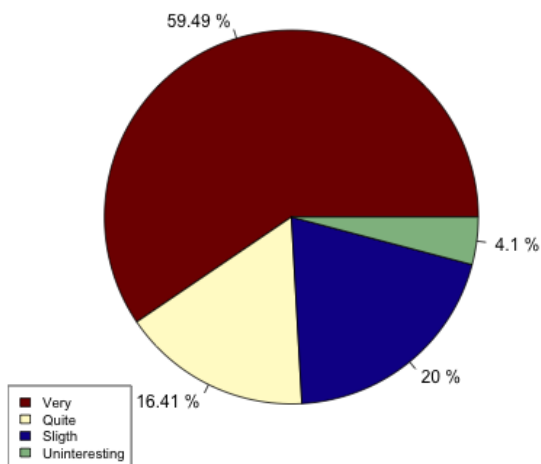


Fig. 7: Opinion about Writing Skills

How interesting is to programm computers?

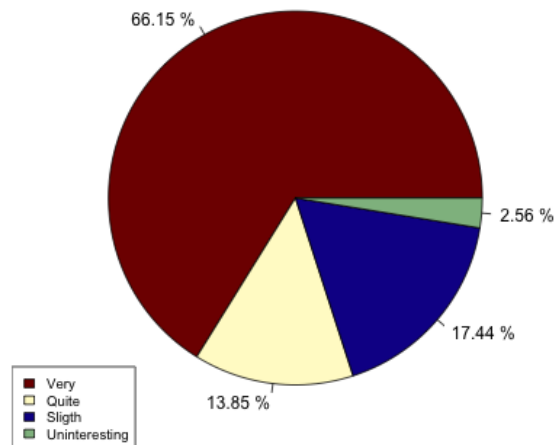


Fig. 9: Opinion about Computer Programming

How interesting is to handle data and solve problems?

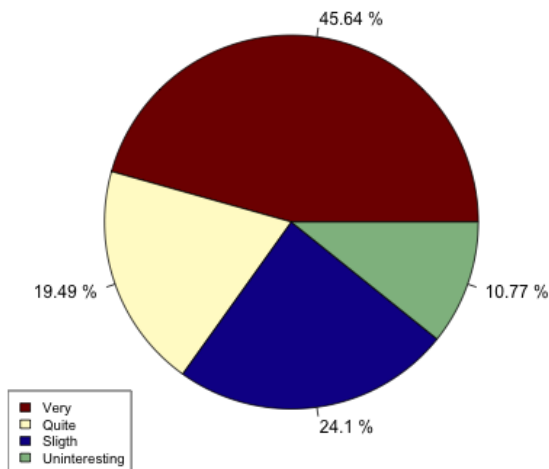


Fig. 8: Opinion about Handling Data and Solving Problems

How interesting is to do research and wirtte scientific reports?

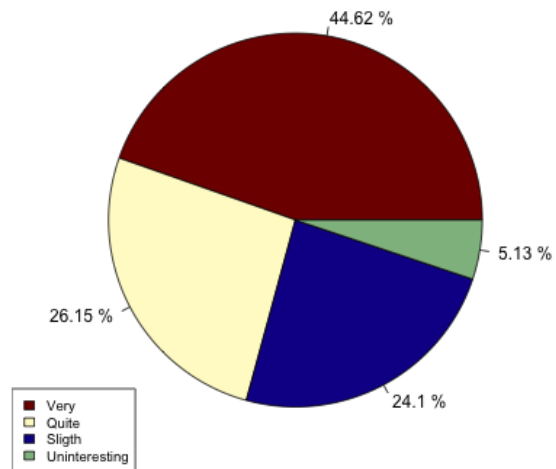


Fig. 10: Opinion about Research and Technical Reports

questions. It also shows a profile that 20 or 30 years ago was not very popular among young people, when individuals right after College wanted to find a job that could give them a good paycheck and stability. We believe that companies such as Facebook, Twitter, Uber, make the young people today believe that is possible to achieve great success being young. That

result also opens new opportunities to IT careers given that most of the theses companies success is due technological innovation. The Figure 11 shows the results. We can see that no one choose the option "Uninteresting".

The question about Designing Planes, Buildings, and Machines had the highest rate regarding the "Uninteresting"

How interesting is to own your business?

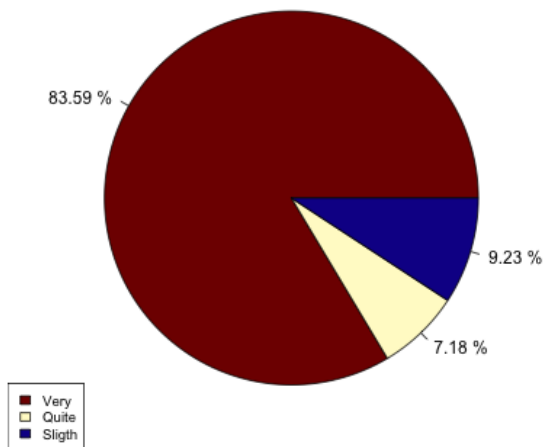


Fig. 11: Opinion about Owning a Business

option, 15.9%, and the lowest in "Very Interesting", 42.56%, once it survey a specific subject. Still, the girls can perceive its importance, as shown in Figure 12.

How interesting is to to design planes, buildings and machines?

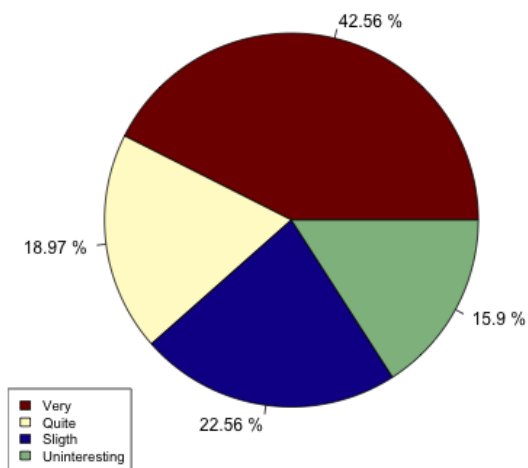


Fig. 12: Opinion about Designing

Another characteristic of this age group is the possibility of exposing their opinion in social media. This characteristic is

observed in Figure 13. According to 60% of the girls, Public Speaking Skills are "Very Interesting".

How interesting is to speak in public?

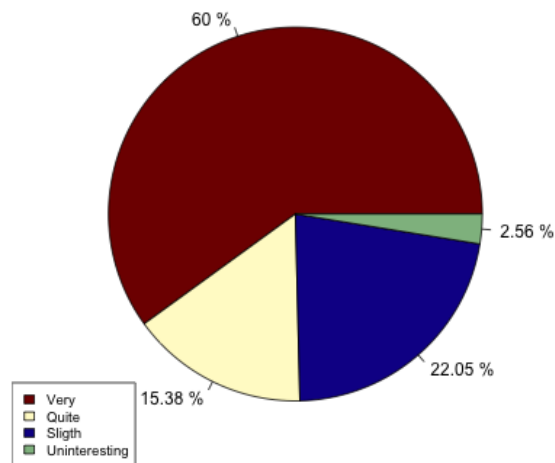


Fig. 13: Opinion about Speaking in Public

A further really interesting result is the one about "Being Able to Communicate Well". This question had the highest result regarding the "Very Interesting" option. This is another great insight into this generation, that realize that the ability to organize the ideas, present them in an effective way and discuss them is an essential skill. The results are shown in Figure 14.

At last, teamwork is also a "Very Interesting" matter according to 69.74% of the interviewed. The ability to work in a team is a requirement, regardless the career choice.

VII. IT OR NOT IT

Deeper in the the subject, the students answered "What reasons could make you choose an IT career?" and "What reasons could make you NOT choose an IT career?".

The results are showed in figure 16. The opportunity to work with new technologies and the job market are the factors most chosen to respond why to choose a technological area.

The lack of vocation and math abilities push them away from the area. This led us to the following conclusion: girls appreciate exacts areas, as shown earlier but they believe they do not have abilities to the area like we show in Figure 17.

VIII. FINAL REMARKS

The data and results presented in this work will be of great relevance in the analysis of points of improvement and strategic choices for future actions of the Cunhantã Digital Movement. We discovered that while girls appreciate the exact

How interesting is to be able to communicate?

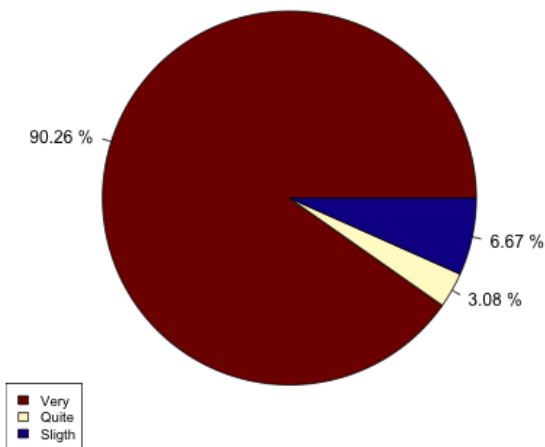


Fig. 14: Opinion about Communication Skills

How interesting is teamwork?

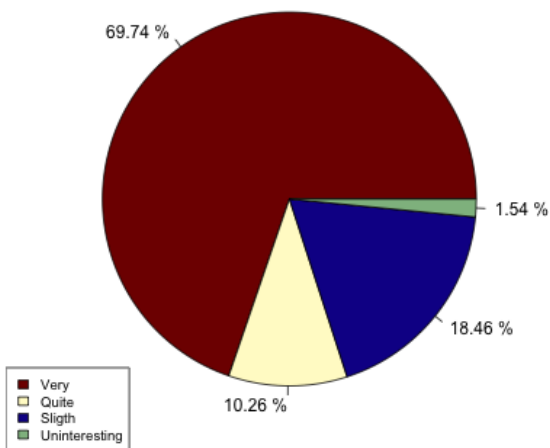


Fig. 15: Opinion about Teamwork

areas during the High School; they do not feel able to choose an undergraduate course in technology. One future work will be to investigate what factors lead them to feel not sufficiently prepared or not to think that they have the vocation for this area.

It is also worth noting the negative influence of family

Reasons To Choose IT

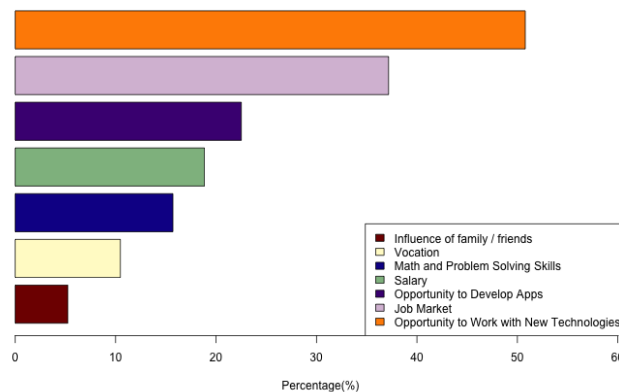


Fig. 16: Reasons To Choose an IT Area

Reasons Not To Choose IT

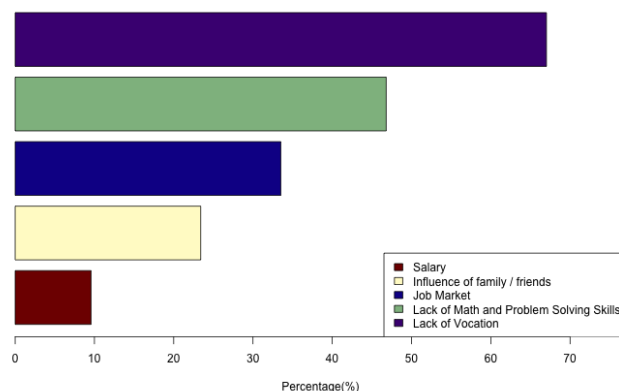


Fig. 17: Reasons Not To Choose an IT Area

and friends, which underscores the importance of actions that demystify the image that IT careers are mainly male. A future task is to hold lectures with parents of students, seeking to understand better what a computing professional does and what they can conquer in this career. We believe so, with this information, the parents probably will no longer play a negative role in the influence of their daughters' choices.

The participation of the Cunhantã Digital in the FNE was extremely positive, not only because it has made many girls who never considered choosing the area of technology to, at least, know what the professional in this area does. But also to encourage the involvement of computer science and information systems students who have convincingly tried high school girls that they have made a right choice and that the girls should of the same. The Cunhantã Digital will repeat and expand this type of action.

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