GENDER DIFFERENCES AS INFLUENCE FACTORS TO CHOOSE COMPUTER SCIENCE AS A PROFESSIONAL CAREER OPTION

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ABSTRACT

Gender roles influence in choosing a Computer Science oriented career remains a problem since the emergence of the Information Age. In general, women are underrepresented fun in Science, Technology, Engineering and Mathematics fields. The objective of this work is to conduct a study based on current state of gender differences as factors influencing pursuit of careers related to Computer Science. The research work was developed with students enrolled in Secondary Compulsory Education and High School, using a questionnaire as data colleting instrument. The analysis of the results shows that, in general, the situation is still worrisome. Female students show much less interest in careers related to computer science due mainly to the work of their teachers and a distorted perception of their abilities.

1.INTRODUCTION

The influence of gender roles when choosing a career The oriented to Computer Science is a problem since the emergence of the Information Age [1]. In general, the proportion of women participating in Science, Technology. Engineering and Mathematics (STEM) is very low. There are Spanish universities in which the percentages remain stagnant since the 90's of the last century. In Alicante, the representation of students in STEM careers is 30%, dropping this value below 15% in Informatics [2].

In addition to issues related to gender equity, women's lack of participation in Information Technology contributes to an additional problem: lack of diversity in some professional contexts. Studies show that, for example, when it's necessary. In numerous studies, researchers try to identify key points that affect female participation in Information Technology field. In general, it is possible to highlight two types of fundamental factors to justify this low representation [5]: (a) environmental and cultural factors and (b) intrinsic motivational factors.

Environmental and cultural factors include family support. received education, and stereotypes associated to Informatics. [6, 7]. First, families exert an influence that can, without explicit intention, be part of obstacles through certain messages and beliefs [8]. Second, the commonly used pedagogy in Computer Science classes is another factor that influences abandonment and loss of interest in careers related to the field [9]. Experiences in the learning environment affect professional decisions and there is evidence that introductory Computer Science courses are a good

initiative to attract future female students [10]. Finally, Computer Science is linked to stereotypes that produce negative attitudes in women toward themselves, which encourages them to stay out of the technical fields [11, 12]. In addition, girls also show negative stereotypes about their own abilities, making them believe that they are not suitable in Computer Science field [13].

On the other hand, intrinsic motivational factors allude to one's personality, personal interests and especially to the "self-efficacy" construct. [14]. This can be defined as "a person's belief about his/her ability to successfully conduct a task [15]. In general, girls tend to have very low self efficacy and perceive that they do not have a natural ability in traditionally associated with men fields, such as STEM careers [16].

Due to this situation. the main objective of this work is to conduct an investigation based on the aforementioned works The ultimate goal is to contribute to the promotion of gender equality in the opportunities offered in Computer Science and Information Technology field.

2.METHODS

Following the methodology set out in previous studies [12, 4], our work is conducted using an adapted questionnaire from the research carried out by Ibáñez [12]. This data collection instrument was used for the assessment of gender differences in the following variables:

1. Socio-demographics, with questions regarding their sex, age, course and profession of parents.

2. Social support and encouragement:

a) 7 items that measure how important are different aspects of their environment when deciding what career to choose. For this, an 1 to 4 scale (from "No importance" to "Very important) is used to denote the relevance of each aspect:

b) 1 question regarding whether someone has recommended them to study some Computer Science related subject.

c) 1 question regarding if they think they would receive support from their environment if they decide to study some Computer Science related subject.

3. Perception of Computer Science career:

a) 1 question to check if they have considered to study some Computer Science related subject in the future;

b) 1 open response question in which they can indicate reasons why they would study some Computer Science related subject, as well as reasons why they would not.

c) 2 items with a 1 to 5 scale (from "completely disagree" to "completely agree") to indicate statements agreement level related with Computer Science.

d) 2 items with a 1 to 5 scale (from "nothing" to "a lot") to indicate how much they enjoy using computer and how much utility they perceive in Technology and Computer Science subjects.

4. Personal preferences and interests towards future profession, with 14 items with an 1 to 5 scale (from "nothing" to "a lot) to reflect

how much they would like to choose a Computer Science related profession.

lot") about how much their teachers influence their motivation towards subjects as well as how interesting are their classes.

b) 2 open response questions in which they can indicate positive and negative aspects about their classes.

In order to carry out this work, students enrolled in Secondary Education last last courses and High School participated in the investigation. A total of 47 students, from a rural public school have participated in this study: 24 boys and 23 girls.

3.RESULTS

Data analysis focuses on assessing differences in responses depending on gender variable. On one hand, a comparison of the average values achieved in each item is performed using the t-test for independent samples (except those with open response). This test had been applied to each item to verify if there is a statistical difference between the responses of boys and girls. On the other hand, a qualitative treatment of the open response questions is carried out by grouping the answers in categories according to their content.

The results obtained are presented below. They are organized based on the analysed variables described in the previous section.

A. Social support and encouragement

With regard to social environment received support, all students have expressed that they would feel supported if they decide to

study some Computer Science related career. Table I shows the results obtained with reference to the influence that the different environmental variables have on their vocational decisions.

For both sexes, the main determinant when choosing what to do is their own personal preferences, reaching an average value close to the maximum of the scale (very important). The next most relevant factors on the list are: their parent's opinion, their teacher's opinion and the school guidance. reaching an average value that reaches the middle scale value. Finally, their friend's opinion and what they decide to do, as well as what their parents have done, are positioned as they would study Computer Science or not. Regarding the first aspect, Figure 1 shows the answers obtained.

The difference between sexes is very clear. The responses provided by boys are spread across the entire range of options. On the contrary, the answers chosen by girls are centered on those with an explicit negative nature. Most girls clearly indicate that they will never engage in something related to Computer science. Another large percentage of girls states that it can be among their options, but they don't find it interesting.

On the other hand, there are also differences in the reasons they present to justify their choice. That is, the reasons why they might consider studying Computer Science or not. Figures 2 and 3 show the obtained answers in open response questions grouped according to their content.

On the one hand, in regard to the reasons to study Computer Science:

1. A large part of the students, both boys and girls, see in Computer Science positive aspects related to their usefulness in the labour market. They express this through phrases such as: "It is very present in all jobs". "It's the future". "It has very good professional opportunities" or "I find it very useful":

2. There is a similar percentage of boys and girls who indicate that Computer Science seems interesting or curious;

3. The main difference between boys and girls in the positive reasons they provide are in the enjoyment they find in Computer Science. Almost 30% of the boys have indicated that: "I like the computer", "I like Technology or "I am good in Informatics". compared to a little less than 5% of the girls. In addition, a large number of girls (30%) do not indicate any reason to study Computer Science.

On the other hand, regarding the reasons why not study computer science.

Finally, Table II shows the analysis of the answers to the questions with a scale referring to the interest in Computer Science and the perceived usefulness of the related subjects. Although there are statistical differences in three of the analysed variables, the most significant fact is that girls show a much lower interest towards Computer Science.

C. Personal preferences

Table III contains the analysis of the answers for the items dedicated to personal preferences. In these answers, they reflect how much they would like to work in a profession with certain characteristics.

According to the results, we can highlight the following:

1. Girls value more than boys working in a profession that enhances their social facet, either by helping others or by being connected to other people at work.

2. Girls value jobs in which they can learn new things or be able to deal with challenges, while boys show more interest in jobs where they can make their own decisions.

3. Girls are also more interested in jobs that enable them to reconcile their family and working lives.

4. Boys show a much greater interest in professions that demanded tasks related to Computer Science(usage of computer and mathematics).

This is consistent with the gender stereotypes treated in numerous studies that analyse the different motivations and professional interests that students have [17, 14].

D. Computer science stereotypes

Table IV shows the analysis of the answers to the questions proposed to evaluate the

stereotypes that exist among young people about the Computer Science career.

Data shows very positive results. Although there are some statistical differences between the opinion of boys and girls.

All the obtained mean values show an important statistical difference, indicating that girls tend to believe that they are much worse than their classmates, especially in the subjects of Computer Science and Technology.

In addition, there are answers found throughout the questionnaire that also have to do with their self-concept. When it comes to pointing out negative aspects of the career and its classes, girls are the only ones who express that "they feel incapable" or "they are bad at it (See Figure 3 and Figure 5). This is in line with the results obtained by other studies which prove that boys have a better concept of themselves towards computers than girls [18, 19].

F. Perception of the educational work of their teachers This section contains the analysis of the items related to the work of the teacher in the classroom. Table VI shows the results for each question.

Based on these data, we can see that the interest of girls towards their subjects is more influenced by their teachers. In addition, girls find the Computer and Technology classes they attended much less motivating

The answers to open response questions about the positive and negative classes

aspects are grouped in Figure 4 and Figure 5.

A large part of students points out that the best of their classes are the practical, enjoyable parts in which they can carry out projects. In addition, a greater number of girls compared to boys find motivating to learn new or interesting issues.

The greatest differences among sexes are found in the answers regarding the negative aspects of their classes. Boys find theoretical classes boring and uninteresting, which is something that girls do not express. Girls indicate that their classes seem complicated. denoting their teacher activity as a career.

The only positive fact found in results has to do with stereotypes related to Information Technology career. Contrary to what has been indicated in other past studies [20]. the majority of students consider that the profession is also linked to social and creative facets, which shows that they have a fairly updated perception of work in the field of Information Technology.

Regarding personal preferences and the valuation of the Computer Science professions as an option to pursue, the results are consistent with gender stereotypes still present in society. Girls show, in general, less interest for technology- oriented careers.

The most alarming fact corresponds to the low perception of girls' self-efficacy in relation to Information and Technology field. Female students have a very pessimistic opinion about their own skills in these fields compared to boys. This is

consistent with gender stereotypes recorded in various studies and represents a barrier. This causes them to discard computer related studies and professions [21].

Teacher work also stands out for being a very relevant factor to influence students' motivation regarding the disciplines related to new technologies. In general, girls express that classes are boring, complicated or point teacher's pedagogical options as the worst aspect of the subjects.

Practical actions to minimize this problem should focus on promoting initiatives to bring girls closer to technical careers from the earliest years of schooling in order to become familiar with them and break with their prejudices. Similarly, if from an early age they had contact with Computer Science- related elements in their classes, such as simple programming languages, this would help improve their self-concept of skill in the technical fields. Publicizing and making successful women in the field visible as role models would also help not to doubt about their potential and not to underestimate themselves.

In addition, teaching work should focus on student motivation in classroom. A methodological redesign is needed, emphasizing the applications of Information Technology in girl interest issues, such as social aspects. Likewise, classes should include teamwork and collaboration, pedagogical approaches that have proven effective in learning [22].

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