Gender Gap in Computer Science Does Not Exist in One Former Soviet Republic: Results of a Study

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ABSTRACT

It is well known that women's involvement in the field of Computer Science is very low in the USA. This is viewed as a significant problem and has become a great concern to educators and professionals in the CS field. Although the low participation rate of women is an issue in many countries around the world, the truth is that it is not a universal problem: there are countries, such as countries of the former Soviet Union, that have well represented female populations in Computer Science. The Soviet society, culture and educational system in many ways are quite different than America's. It is important and helpful to explore these differences with the intention to identify factors in the Soviet system/culture that may contribute to attracting women to Computer Science.

In 2005 we started an international investigation of the issue of women in CS in two different societies/cultures – American and Soviet. Our research is intended to bring a better understanding of the social perceptions and influences that make this issue a problem in the United States, and will contribute to designing better strategies in efforts of mitigating the low participation of women in the field of Computer Science. In this paper we present the results of an extensive study in one former Soviet republic, the Republic of Armenia.

Categories and Subject Descriptors

K.3.2 [**Computers and Education**]: Computer and Information Science Education – *computer science education*

General Terms

Human Factors

Keywords

Women in Computer Science, Women in Engineering, Gender Gap in Computer Science, Gender Gap in Engineering.

1. INTRODUCTION

It is no secret that women in the United States avoid Computer Science as a career choice. This has been the case for decades, and regardless of all efforts, it is still a big problem not only in the USA, but in many other countries as well. There have been numerous studies researching the lackluster involvement of women in Computer Science. A large number of studies have been undertaken to determine the reasons for women to avoid Computer Science, and many attempts have been made to attract more women into CS programs, but the issue still remains as a significant problem (see literature review in [6]).

However, there are countries, such as former republics of Soviet Union, where the problem as such did not, and still does not exist. For example, in the Computer Science department of Yerevan State University, Republic of Armenia, throughout all of the 1980-s and 90-s (for almost 2 decades) the percentage of women never fell below 75% (this is not a typo) – and this is in Armenia, a country with a traditionally male dominating culture. The situation was not much different in other Soviet republics, which makes us believe that in the Soviet society/culture there could be factors that positively affected women and attracted them to Computer Science field.

As mentioned above, there have been many studies on the issue of women in CS field. Most of them have concentrated on one particular country (see e.g. [1,5]). Few studies have performed comparative analysis of women's involvement in Computer Science in different countries (see e.g. [2-4]), but we couldn't find studies extensively involving republics of the former Soviet Union as a group of interest. Perhaps it is safe to say that there are no studies comparing and contrasting the issue in the United States versus countries of the former Soviet Union. This motivated us to start an international investigation of the issue involving former Soviet republics and the USA; we planned to investigate the factors that attract women to Computer Science in Soviet countries, and find out whether these factors work in the USA, and if they don't, find the reason why. On the other hand, we wanted to find out whether well known negative factors that affect women in the USA (see [6]) exist in those countries, and if they do, why they don't influence women as much as in our country. Having answers to these questions would give a better understanding of the problem in our country and would contribute to designing more effective solution strategies in attracting young girls to Computer Science and keeping them in the field. The

Engineering Information Foundation (EIF) in the USA became the sponsor of this project.

The first of two stages of our project has been completed. We thoroughly investigated the issue in the Republic of Armenia – one of the major Computer Science centers in the former Soviet Union. We conducted an extensive series of surveys and interviews in Armenia, and analyzed collected data and information. In this paper we present some of the results and findings of our investigation.

In the second stage of our project we plan to conduct a similar investigation in the USA and make some conclusions and suggestions towards reversing the trend of declining enrollments of women in the field of Computer Science.

2. OUTLINE OF OUR INVESTIGATION

The investigation in Armenia was carried out in the form of surveys and interviews.

a) *Surveys:* we developed 3 different 23-question surveys for 3 different groups of population:
1. university students majoring in Computer Science
2. university students majoring in a field other than CS
3. university graduate professionals working in different fields

All 3 surveys shared a subset of questions, which allowed us to determine the public opinion on certain matters. Student surveys were conducted at Yerevan State University (YSU) – the oldest university in Armenia (was founded in 1919), with one of the largest Computer Science programs in the country (867 majors in graduate and undergraduate programs together). Until 1990s the Computer Science program at YSU was the only one in the country (counting 1,200 majors).

We surveyed 538 individuals total: 466 students (240 males and 226 females) and 72 university graduate professionals between ages 25 and 76. The group of CS majors included 254 students. The group of non-CS majors included 212 students majoring in Math, Business, Law, Management, International Relations and Medical fields (almost equal number of students within each major). The group of professionals included computer scientists/programmers, mathematicians, chemists, MD's, lawyers, historians, journalists, and university professors in different disciplines.

b) *Interviews*: we interviewed 85 individuals – 14 CS professors, 12 non-CS professors, 7 university staff members, 5 owners of CS related businesses, and 47 parents of university students including 3 journalists and 13 high school teachers.

In further sections we present some findings of this investigation. All statements, speculations and observations are based on data and information collected via surveys and interviews. For clarity, the percentages are rounded to the closest integer.

3. EDUCATION IN ARMENIA

Armenia is one of the republics of the former Soviet Union; it is a small, yet modern country with 3.2 million population, several millennium old history and a very rich culture. Armenia has a highly educated population; it is considered by many to be one of the most intellectual republics of the former Soviet Union. According to the Council of Europe reports, the literacy rate in Armenia is 100%; about 20% of the whole population, including children and elderly, has a university degree. According to the latest statistical data of the Government of Armenia, 0.1% of the population holds a scientific degree – Ph.D. or higher (countries of former Soviet block still offer a scientific degree higher than Ph.D.). The official language in the country is Armenian, but almost everyone speaks Russian as a second language, and many speak a third language, usually English (students are taught 3 languages by the time they finish high school).

Armenian society values education very highly. Although historically Armenians have always had great respect towards knowledge, during the Soviet era they've come to see higher education as a necessity on their path to success. In the Soviet system the entire economy was state owned and people got paid approximately the same amount in different fields and professions. Consequently, the measure of personal success was not one's wealth, but their profession, position, achievements and status; and usually one could not go far without higher education. Pursuing a scientific degree was one way to be successful and achieve a high status in the society; this explains the surprisingly high number of those having a Ph.D. or a higher scientific degree in the country. With the end of the Soviet rule and prospering of the private sector, higher education is still considered the "must have" tool in Armenia, and applying to a university is an expected step from a high school graduate.

Through our surveys of university students and interviews with the general population we were able to detect few specifics in Armenian mentality that in our opinion contribute to the success of the CS program among women.

One of the interesting observations we made through our investigation is that Armenians are very realistic and reasonable in almost all aspects of their lives, including the planning of their future. When choosing a major, young people (both males and females) most often take a realistic look at their abilities and their chances at succeeding in a particular field. Following an "empty dream" (i.e. a dream that doesn't have good odds of coming true) is not encouraged. Thus, young people choose a major not just because they like it, but more often because they believe they will be good at it. There is no cultural emphasis on having a job that one loves; instead, there is a determination to have a profession that will guarantee a good living.

When it comes to plans for the future, our survey showed that 88% of surveyed university students (with equal distribution of males and females) want to make a serious career; as a matter of fact 71% plan to make a serious career in the field of their major. The surprising piece of information was that only 2.79% of surveyed students (13 out of 466) answered *no* to the question "Would you work if you could afford not to". It is worth mentioning that only 1.77% of females (4 out of 226) gave that answer. Our interview responses support and explain these results: the prevailing sentiment is that in Armenia people have a tendency to look down to those who don't work. The stated rationale is that if you work, you stay current and up-to-date not only in your area/profession, but also in your view of world and life. At the workplace there is a lot of social interaction among employees; they discuss the latest news, politics, cultural events, etc. One who doesn't work is usually considered out of touch and uninformed, and not interesting to socialize and interact with. This mentality, more typical to the Soviet society, hasn't changed

with the transformation of Armenia to a capitalistic economic system.

The above-mentioned data and observations bring us to conclusion that in Armenia young people are determined to get higher education and join the workforce, and when planning for their future, they set a realistic and doable path for themselves. This goes for men and women alike, which we believe is a factor that has a lot to do with women not avoiding Computer Science in Armenia.

4. WOMEN AND COMPUTER SCIENCE

Computer Science is one of the most popular majors for young people in today's Armenia; it is considered to be an interesting field that provides a secure and comfortable future. Our survey of 212 students majoring in fields other than CS showed that 37% of students (31% of women and 48% of men) considered Computer Science when applying to the university.

As mentioned in the Introduction, throughout 1980's and 90's the female population in the Computer Science department at YSU never fell below 75%. Today this number has declined, it has been around 60% at the beginning of the new millennium, and it continued to decline to 44% in last few years. However, during our interviews we discovered that the decrease of female population in the CS program is not due to dropping interest of women with this major, but its growing popularity with men. In the past the job market for CS graduates mainly consisted of scientific-research institutions – Armenia being one of the major centers of the Computer Science field in the USSR had a large number of such institutions. During the last few years the import of computer related foreign businesses have made CS a very desirable field, and has started to attract a larger number of young men than in the past, thus creating stiffer competition for women attempting to get into this major.

The decrease of female population in the CS program gave a boost to the number of women getting into the Math major: during the last few years the percent of women in the Math department at YSU has been consistently growing – it is over 60% right now. In our interviews we got an explanation to this phenomenon: women who can't get into CS program pick the closest related field, which in Armenia is considered Math, with the intention of taking Computer Science courses and joining the CS workforce after graduation.

One of the attractions for women in choosing a career in Computer Science is the wide range of employment opportunities. In addition to the still widely functioning scientific-research institutions, there are many CS related businesses and companies functioning in Armenia that are looking to hire devoted, hard working, energetic and smart professionals. Our interviews with some of these company owners led to one interesting observation: although employers considered male professionals more creative and innovative, they preferred to hire females. The reason, they explained, is that females are loyal, dedicated and less ambitious – they are happy where they are and don't like to change their job; while with men it is a very different story – once they get trained and become accomplished at what they do, they start looking for another, better paying job.

4.1 Choosing Computer Science as a Major

To find out what are the primary motivations for young people (both men and women) to choose CS as a major and what are their feelings about the field, we surveyed 254 undergrad CS students in different years of education (28% were freshmen, 27% were sophomores, 29% were juniors, and 16% were seniors). Below we present some results.

Our survey shows that the motives for choosing CS as a major are the same for both genders. The answers to the multiple choice question regarding the main influencing factor in the student's choice of CS field are as follows:

- 51% of females and 53% of males said they were interested in computers and Computer Science
- 39% of females and 37% of males thought that CS would provide well paid jobs
- 7% of females and 6% of males followed parents' and/or teacher's advice
- The rest of students had a variety of other factors to point out.

When analyzing the results of our survey, we made the following observation: when deciding for a major, CS was the first choice for 85% of questioned (84% of women and 85% men). After being in the program for some time, 91% still believed they have chosen the right major. The explanation of this we contend is in the fact that people in Armenia are reasonable and practical; they lack glamorized and unrealistic expectations in life, which keeps them from frequent disappointments. They don't encourage the "try and fail until you succeed" approach and they don't give up when things get difficult. Young people choose their major when applying to the university and they stick with it trying to make the most out of it; changing a major although possible, is almost never practiced. The same mentality is observed when it comes to marriage – Armenians typically marry in their early or mid twenties, start a family and stay committed to it through good and bad times, which is one of the reasons the divorce rate is so low in Armenia (it is less than 10%).

One conclusion we made when analyzing the results of our surveys and interviews is that young men and women in Armenia have similar motivations and influences when choosing a major.

4.2 Computer Science vs. Engineering

To gain additional insight into the general public's mind-set about the CS field and its suitability for women, we included a set of questions in all our surveys toward that end. Although we allowed 5 different answers for these questions ("strong yes", "strong no", "weak yes", "weak no", and "not sure"), for simplicity we will group the answers into 3 categories – "yes", "no" and "not sure". Below we present some results of our surveys of 538 people (289 females and 249 males).

Before developing our surveys, we had anecdotal data to believe that Computer Science in former Soviet countries is not thought of as an engineering field, but rather a mathematical field. Thus we decided to include questions in our surveys that would test this opinion. The results came out as expected; 83% of surveyed think of CS as a mathematical field; this opinion is almost equally shared among females and males (82% of women and 85% of men).

In our surveys we included 3 questions to test the general public's opinions on the suitability of the following 3 fields – CS, Math, and Engineering – for women. The following three charts represent responses to these questions; each chart represents the responses regarding one field, and contains 3 segments for all, female, and male responses respectively. It is readily apparent that (i) the majority of women (79%) think CS is suitable for women, while only half of men (49%) think so, (ii) CS is considered more suitable (65%) for women than Math (59%) and Engineering (41%), (iii) out of 3 mentioned fields Engineering is by far the least popular choice for women (only 52% of women and 28% of men think it is suitable for women).

Is CS suitable for women?

Is Math suitable for women?

Is Engineering suitable for women?
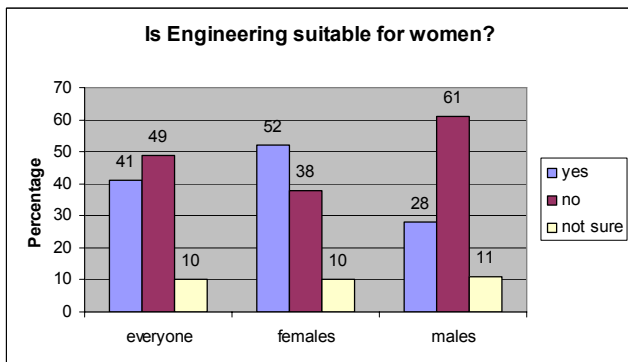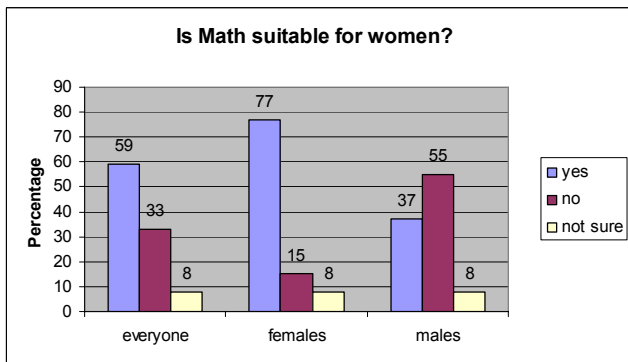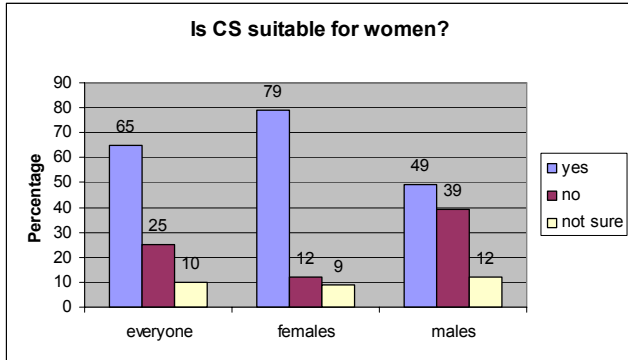
In our surveys we included questions on whether women in CS, Math and Engineering are less feminine/attractive/sexy. The percentages of people who find women in mentioned fields not any less attractive are as follows: for CS field – 74%, for Math – 68%, for Engineering – 59%. As with earlier questions, women's answers were much more favorable – 83% for CS, 79% for Math, and 71% for Engineering.

These survey results evoke a question: Does the fact that CS is more often considered as an engineering field in the USA play a role in its unpopularity with women?

4.3 Affect of Well Known Negative Factors

As mentioned earlier, the issue of low participation of women in Computer Science has been the topic of many studies in the USA; through this research a number of negative factors have been identified that influence young women and drive them away from CS field (see [6]). Some of these factors are believed to be the following:

a) CS is a male dominated field; girls are intimidated by the sheer number of men and feel isolated from their female peers.

b) In the CS field there are no role models for young women.

c) It is believed that women in the CS field (i) don't receive the same respect as men, (ii) don't have the same opportunities as men, and (iii) can't achieve the same successes as men.

To determine whether these factors have a negative influence in Armenia, we included a set of specific questions in all our surveys. Here are some results and observations.

a) In our two surveys intended for students we included a question testing if they would be bothered with low number of women in their classes. Interestingly, 70% of men responded that they would be bothered by that, while only 18% of women gave the same answer. Further interviews came to clarify this result: the sentiment is, we were told, that Armenian men love to be surrounded by attractive women – the more, the better – which explains why they would be bothered by lesser women in their classes. On the other hand men are very attentive and complementary to women around them. Women like that attention – the lower the number of women is, the more attention they get – which explains why they wouldn't be bothered by fewer women around them. Thus, we were led to believe that being in a male dominated field is not a concern for women in Armenia.

b) Another factor that is mentioned repeatedly in the USA is the absence of female role models in the CS field. In our interviews we learned that there are no such role models in Armenia either. Even more, the interviewees didn't see it as a factor at all, and didn't give any importance to having a role model when choosing a career.

c) When it comes to the unequal treatment of men and women in CS field, it is believed to be the case in Armenia as well; the following 3 charts represent the distribution of all participants (538 individuals) opinions on whether women in CS field receive the same respect and have the same opportunities as men, and whether they can achieve the same success as men. However, in the interviews we heard many say that the unequal treatment of women exists in many fields and professions, and is not specific to CS; women are used to it and are not discouraged by it.

In CS field do women receive the same respect as men?

In CS field do women have the same opportunities as men?

In CS field can women achieve the same success as men?
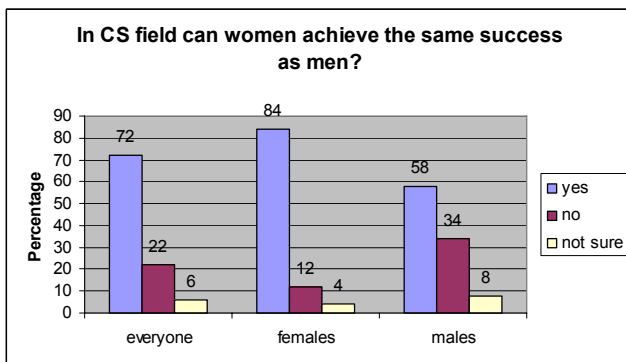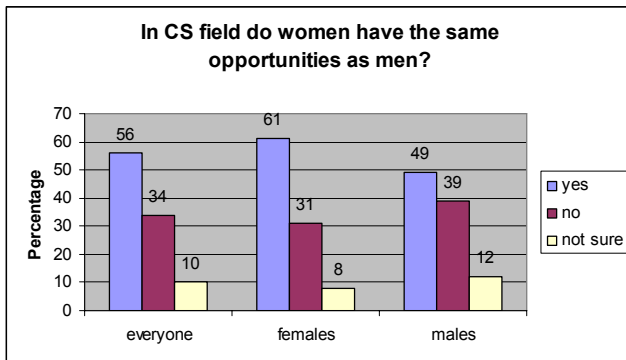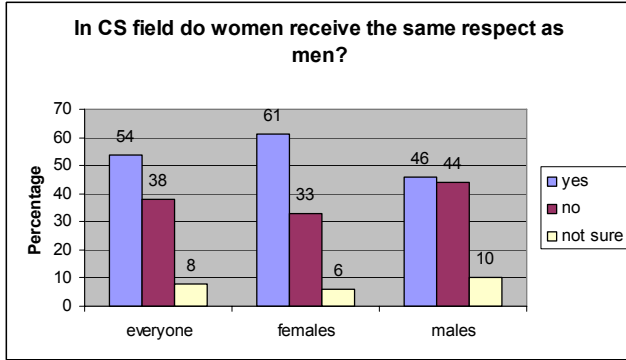
Thus, our observation is that despite the fact that some of the above mentioned negative factors do exist in Armenia, they don't seem to have a great influence on women and don't deter their career choice, since women still find CS an attractive and promising field and are eager to choose it for their major.

5. CONCLUSION

In our investigation we detected some factors that we believe should be credited for the large female population in CS field in Armenia. We also learned that some factors that are believed to be negative influences on women in the USA are not significant or decisive in Armenia. Here is the summary of our observations:

1. When choosing CS as a major, young men and women think and feel alike – they have similar motivations, goals, and influences.

2. Young people are very mature when planning their future:
   - They attempt to choose a field that will provide a comfortable and secure future; CS is considered as such.
   - They are determined to work even if they don't have to.
   - They choose a major based on a realistic evaluation of their own abilities, and they do not follow unreasonable dreams.
   - The choice of a major is mostly the student's own decision – there is very little parental or other outside influence.
3. Computer Science is considered a mathematical rather than an engineering field. Engineering is not much favored as a field suitable for women.
4. Male dominated fields are not intimidating to women.
5. Absence of female role models is not a concern for women.
6. The opinion that women are not perceived to be regarded as much as men exists in many fields and is not CS-specific. Besides, this opinion doesn't seem to have much effect on women.

The next step in our investigation is to conduct a similar study in the United States in the light of the aforementioned observations. Only after we accumulate data for the USA, can we make some final conclusions and work on productive solution strategies for the problem at hand.

6. ACKNOWLEDGMENTS

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