How Cultural Messages Through Experiences Influence Occupational Pursuit of Muslim Female Computer Science Students

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Work in Progress: How cultural messages through experiences influence occupational pursuit of Muslim female computer science students

Abstract

Women are underrepresented in the field of computer science in the United States. However, this is not a new problem as female participation in computer science (CS) has been experiencing a steady decline over the last three decades. Current reporting on women's participation in this field has been published as steadying around 13-17%, depending on the data source. Although, there are varying levels of participation in other countries, particularly in Muslim majority countries. For example, women in Bahrain, Morocco, Palestine, Oman, Saudi Arabia, Iran, and Tunisia earned more than half of the total number of science degrees in their respective nations. This stark contrast between the United States and these other countries has prompted an exploration into the factors that contribute to women's participation in computer science.

This study focuses on understanding how cultural environment can affect the participation of women in CS, specifically with respect to individual, household, community, country, and global influences on occupational pursuit. The research question guiding this study is: what cultural factors influence Muslim women's occupational pursuit of computer science? This qualitative study explores, through semi-structured interviews, the experiences and influences of Muslim female students currently pursuing graduate degrees in CS. Leveraging snowball sampling, this research study seeks to better understand Muslim women's pathways to and through computer science. This study will also provide further insight as to how and why certain experiences or cultural influences impact women's choice of computer science.

Through thematic analysis leveraging NVivo12, the preliminary findings suggest that micro- and macro-cultural environmental factors are different for Muslim women students across different cultural groups as well as the influence these variables have on their participation and achievement in CS. Our findings suggest that cultural background may influence women in different ways. Understanding the pathways of Muslim women, given their high representation in computer science in their home nations, might provide insight into different ways to engage more women (Muslim or otherwise) in CS in the United States. This study provides a counter-narrative to underrepresentation of women in this field by presenting the pathways of those achieving or exceeding parity in science, technology, engineering and mathematics (STEM) fields outside of the United States.

1. Introduction

Computer science has been identified as one of the STEM fields most in demand. Computer science has been identified as a powerful educational tool for critical thinking, problem solving, and creativity [1]. There are studies exploring why participation of female students in the field of computer science in the United States is so low [1],[2]. In 2017, women in the United States accounted for less than 18 percent of the total degrees being pursued in engineering and computer science. However, according to the data from UNESCO in Muslim majority countries, female students account for more than 39 percent of the STEM degrees being pursued [3]. Gender disparities and perceptions of CS as a heavily male-dominated field in the United States are cultural factors identified as having negative effects on the participation of women[4]. Each culture has its own unique beliefs, constructs, and dynamics that shape it, as well as the cultural factors. These

factors, include micro- and macro-level social communities like home and school that influence students' educational paths.

The rest of this paper highlights influences of the educational and cultural factors on students. First, the literature review for this study. Second, introduction of the framework that shapes this study. Third, the methods applied in this study. Finally, the preliminary results and the discussion.

2. Literature Review

Cultural factors and the culmination of family, school, peers, and technology telecommunications have an influence on students' identities [5],[6]. Culture is the intersection of language, religion and the core values and norms of a community [7]. Different pipelines exist for different cultures. In each pipeline there are the core values, norms, interests, and beliefs of that particular culture. One cultural value is the separation of genders; in Muslim nations, gender roles are separated, and potential career choices have been identified for individuals based on these cultural influences [8],[9],[10]. One example, is the concern in Muslim majority countries about the work environment that women will take part in and the restrictive codes for women's behavior [9], [13]. And although there are no strict rules prohibiting women from working outside, Muslim women and their families typically prefer an indoor job environment versus outdoor [11], [15].

A study from Siann & Clark [11] found that parents and daughters in Muslim countries believed women must be educated because they cannot work in hard labor. For Muslim women, majoring in CS gives them the opportunity to work from home without the need to go to an outside work environment, allowing them to allocate more time meeting their responsibilities in the family, being respectful to cultural expectations, and not worry about their hijabs [9]. Culture can also influence beliefs about gender differences that lead to variations between female and male career choices [5]. In almost all of the Muslim majority countries, schools segregate by gender from the first grade up to college and university levels. For example, Saudi Arabia is one of the Muslim majority countries that has a high percentage of women participation in the CS field. According to a study, the education system in Saudi Arabia has wide-ranging features including single sex education system, gender-specific educational policy, and precise curriculum during each level of education[8]. Thus, in gender-specific education, female students believe there are differences between them and male students[5][12]. Finally, when choosing undergraduate studies, the Muslim female students try to responsibly meet the prospects of their families and culture by choosing subjects they were encouraged in during their primary to high school education [13].

In juxtaposition to these Muslim majority countries, there are often discussion about gender equality in the United States. However, there exists an unconscious bias in Western countries that a male is better than a female in math-related topics [14] and teachers' biases have a negative impact on female students' math ability [15]. As a result, female students are not compelled to pursue STEM fields. School, the second most important environment next to the family atmosphere helps students advance their identities based on their cultural beliefs, making friends, and developing new skills. In another word, school has a crucial role in establishment of students' confidence in society.

One of the most important factors that has been identified as having an important impact on shaping students' identities and academic success is the family [16]. Family is the safe environment in which students can raise their self-awareness[17]. Likewise, parents' educational expectations from their children has been recognized as having influence on students' education outcomes [18]. However, a research study stated that the expectations of the parents from children

varied by the children's gender identities [19]. In western countries, parents' and teachers' biased perceptions about the female students' math ability have been identified as having a negative influence on female students' self-efficacy [20]. Families expectations and attitudes have noticeable impression on their children [21],[22]. The factors discussed above helped us to frame our research questions as well as our theoretical framework and methods for this study.

3. Theoretical Framework

The framework guiding this study is from Erez and Gati (2004) micro and macro level cultural influences analysis. This framework led us to focus on how different layers of culture influence women's educational path. According to the literature, there are five levels of culture starting from individual to global culture nested in each other (Figure 1) [23]. Scholars used this framework to define the micro level as the individual and macro level as global culture, they defined the relationships between the two layers through the top-down and /or bottom up approach[23][24].

Figure1- Top-down-bottom-up process across levels of culture, Erez and Gati (2004)[23]
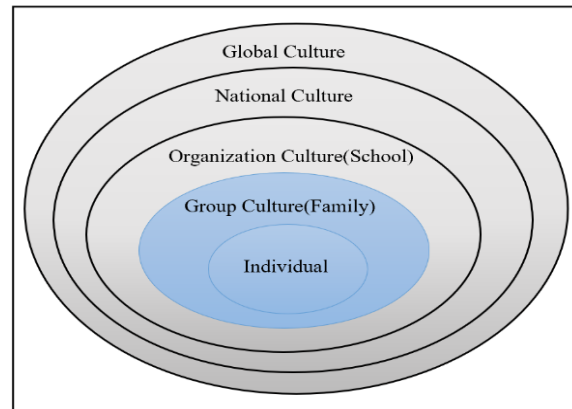

Figure 2- Levels of culture,
Blue: Micro_level;   Gray: Macro_level

In this study we take a closer look at the layers between the individual and global culture, the layers which our analysis showed have the most important role on Muslim female students' educational decisions. Considering family as a group on the micro level, school as an organization and society as a national culture on the macro level. We will study the importance of each layer and its effect on female students who came from Muslim majority countries. We should remember that each layer has its own dynamics as well as the congruence with other levels.

First, starting from the home environment and analyzing the support that female students get from their family (group culture). Second, evaluating the class setting (organizational culture). Third investigating the school environment and lastly investigating the country's implications on students (national culture) (Figure 2). In order to answer the research question "What cultural factors influence Muslim women's occupational pursuit of computer science?"

4. Methods

This qualitative pilot study utilizes a case study approach through a small sample of people's experiences. Employing purposive sampling, four graduate Muslim female participants were solicited from a large public university in Florida. All the participants were Ph.D. students majoring in computer science and have been in the program for at least one year. Three out of four

students passed their qualification exams, two of them have also defended their proposals. The fourth student was in her second year of the Ph.D. program and was taking courses to meet the requirements of the department for taking the qualifying exam next year.

A semi-structured interview protocol with open-ended questions approved by the IRB was prepared to understand the students' backgrounds, experiences, and pathways through the CS major. Examples include: Do you see yourself as a CS person? Why? How have you come to know about CS? Each participant was interviewed face-to-face for an hour. The interviews were tape recorded and additional field notes were gathered by the interviewer during the interview. In order to analyze the data, the recorded interviews were transcribed verbatim.

Thematic analysis is one method used to investigate qualitative data in a research study [25]. For more structured analysis we used NVivo12. First, we uploaded the data to the NVivo environment and second, we specified nodes for the interviews. Nodes included CS major, family impact, cultural influences, first programming class, friends and peers, priorities, and support or encouragement. Our goal was to understand Muslim female stories in order to better understand their pathways to CS leveraging deductive coding.

5. Preliminary Results

There were four important themes which emerged during the first round of analysis: family role, educational foundation, unspoken rules, and expectations.
Each theme will be described with interviewee quotes as evidence in order to better understand the students' experiences.

5.1 Micro Influences: Family role

The students described their interest in the CS field as beginning during middle school or high school by playing computer games or from other family members in the CS field.

"One of my cousins. She was studying computer science at the college when I was at high school and we were so close together. So she was kind of my motivation to choose the computer science and because I love math, when she was at the college I saw that all the courses or materials mostly related to the math. That motivates me to choose computer science at the college […] Mostly she was my motivation" (Participant 3).

"…I remember when I was nine or 10 years old my father bought a computer for our family, and I was really excited about it. And I usually used to play games with it. …It was rallies, race, car races and stuff like that. So, it was my first experience, and I think that it was the moment that I thought that I really love computer science" (Participant 4).

5.2 Macro Influences: Educational foundation

All the students interviewed described a strong background in math and English courses during their education.

"My math was always the best score in the class and my English was good. I think both of them were really good" (Participant 1).

"I was at the top of the class for the math and English during high school. I ranked first in math during my first grade in high school in the whole city that I was living back in my country." (Participant 3)

5.2.2 Macro Influences: Unspoken Rules

Students spoke about the cultural unspoken rules and the difficulties they had in communicating with their male colleagues during the time they were undergrads at university in their home countries.

> "[…] the tradition in my society, girls are mostly friends with the girls. So, I had most of my friends my girls ... most of my friends were girl but, it was better to be in a group that has some boys in it because when the both gender mix, the competition is better and also the collaboration […]" (Participant 1).

> "As our major was computer science the number of girls and boys were almost equal, or maybe we had more girls than boys. But for other majors such as electrical or mechanical engineering most of them were boys. […] in my country you rarely can speak with your classmates who are male because it's not really good to speak with boys […] my classmates that I've told you they have a good programming skills were all boys. And when I used to ask my questions then on campus, for example, it wasn't really good. So, anybody thought, "Okay. They started backbiting you. He's her boyfriend." Or it's not good, "Why this girl is speaking with a boy?" […] And these traditional and religious things that made anybody think not good talking to boys" (Participant 4)

5.3 Micro and Macro Influences: Expectations

Considering family role as a micro level influence, and unspoken rules in the society as the macro influences, we concluded the interviewees experienced both levels of cultural influences while deciding on their majors.

Cultural beliefs and values of families had a significant influence on student's decisions choosing CS. All of the interviewees mentioned they chose CS over other engineering topics describing limitations of other engineering over CS; they described either doubts of their families (micro) or they mentioned future job environment concerns (macro).

> "… My family asked me to choose some engineering majors because I was in a math major to which, after the graduation, I also can find a good environment to work on. Because I also was interested in electrical engineering but my family thought that electrical engineering, the workplace for electrical engineers are mostly male dominant and it's not a good place for a female to work with them. This one affect my decision for CS" (Participant 3).

> "As I've told you, I didn't choose electrical or mechanical engineering. … as I said it's not suggested to do these majors for girls because after you are graduated then in the job environment, they prefer to hire man rather than women. And in my country, some of the religion or traditional things doesn't let you to be higher in these environments" (Participant 4).

6. Conclusion

Our preliminary results show that there are different factors influencing the student's decision to choose CS. Most important factors identified as cultural factors and family impact. All the Muslim female students mentioned they chose CS because they believed it is a more feminine field compared to other fields like electrical and mechanical engineering. They believed CS is a feminine field because it is an indoor job which does not require field work, and there is no need to work far from home. Though, in the US the femininity border is different and students believe math related fields are masculine. To conclude, we understand there is also feminine and masculine

type of fields in Muslim majority countries as well as United States. However, the borders of femininity and masculinity are different for Muslim and non- Muslim female students.

For the next steps we would like to interview students who are coming from different Muslim majority counties. We would also like to understand the importance of social media, role models and supreme leaders on students' choice of major.

7. Acknowledgement

References

[1]   A. Nager and R. D. Atkinson, "ISSUES REGIONS PUBLICATIONS EVENTS NEWS ROOM ABOUT The Case for Improving U.S. Computer Science Education," 2016.

[2]   C. Thomas, "Encouraging the Participation of Female Students in Stem Fields," *Science (80-.).*, pp. 1–72, 2009.

[3]   "UIS Statistics." [Online]. Available: http://data.uis.unesco.org/. [Accessed: 30-Jan-2019].

[4]   R. Varma, "Why so few women enroll in computing? Gender and ethnic differences in students' perception," *Comput. Sci. Educ.*, vol. 20, no. 4, pp. 301–316, 2010.

[5]   S. J. Correll, "Gender and the Career Choice Process: The Role of Biased Self-Assessments," *Am. J. Sociol.*, vol. 106, no. 6, pp. 1691–1730, 2001.

[6]   I. Hutchby, J. Moran-Ellis, and J. Moran-Ellis, *Children, Technology and Culture*. Routledge, 2013.

[7]   A. Bandura, *Social foundations of thought and action : a social cognitive theory*. Prentice-Hall, 1986.

[8]   N. EL-SANABARY, "Female Education in Saudi Arabia and the Reproduction of Gender Division," *Gend. Educ.*, vol. 6, no. 2, pp. 141–150, Jan. 1994.

[9]   M. AlMunajjed, *Women in Saudi Arabia Today*. London: Palgrave Macmillan UK, 1997.

[10]   Anthony H. Cordesman, *Saudi Arabia Enters the Twenty-first Century: The political, foreign policy Econimic, and Energy Dimensions Anthony H. Cordesman*. 2003.

[11]   G. Siann, "Muslim Women in the Workplace," *J. Work. Learn.*, 1992.

[12]   A. M. El-Sherbeeny and H. D. Alsharari, "Assessing engineering disciplines with expected success for females in Saudi Arabia," *ASEE Annu. Conf. Expo. Conf. Proc.*, vol. 2018–June, no. since 2010, 2018.

[13]   S. M. Chance and B. Williams, "Preliminary findings of a phenomenological study of middle eastern women's experiences studying engineering in Ireland," *ASEE Annu. Conf. Expo. Conf. Proc.*, vol. 2018–June, pp. 2009–2012, 2018.

[14]   S. Lindsay, A. Taylor, B. Woodward, and M. Milligan, "A MALE THING: WHY COLLEGE WOMEN ARE NOT CHOOSING STEM MAJORS," 2016.

[15]   Lavy, "ON THE ORIGINS OF GENDER HUMAN CAPITAL GAPS: SHORT AND LONG TERM CONSEQUENCES OF TEACHERS' STEREOTYPICAL BIASES," 2015.

[16]   V. I. Eichelsheim, M. Deković, K. L. Buist, and W. L. Cook, "The Social Relations Model in Family Studies: A Systematic Review," *J. Marriage Fam.*, vol. 71, no. 4, pp. 1052–1069, Nov. 2009.

[17]   D. K. Yee and C. Flanagan, "Family Environments and Self-Consciousness in Early Adolescence," *J. Early Adolesc.*, vol. 5, no. 1, pp. 59–68, Mar. 1985.

[18]   P. E. Davis-Kean, "The Influence of Parent Education and Family Income on Child Achievement: The Indirect Role of Parental Expectations and the Home Environment.," *J. Fam. Psychol.*, vol. 19, no. 2, pp. 294–304, 2005.

[19]   S. S. Boocock, *An introduction to the sociology of learning*. Houghton Mifflin, 1972.

[20]   E. A. Gunderson, G. Ramirez, S. C. Levine, and S. L. Beilock, "The Role of Parents and Teachers in the Development of Gender-Related Math Attitudes," *Sex Roles*, vol. 66, no. 3–4, pp. 153–166, 2012.

[21]   Y. Yamamoto and S. D. Holloway, "Parental Expectations and Children's Academic Performance in Sociocultural Context," *Educ. Psychol. Rev.*, vol. 22, no. 3, pp. 189–214, Sep. 2010.

[22]   P. E. Davis-Kean, "The Influence of Parent Education and Family Income on Child Achievement: The Indirect Role of Parental Expectations and the Home Environment.," *J. Fam. Psychol.*, vol. 19, no. 2, pp. 294–304, 2005.

[23]   M. Erez and E. Gati, "A Dynamic, Multi-Level Model of Culture: From the Micro Level of the Individual to the Macro Level of a Global Culture," *Appl. Psychol.*, vol. 53, no. 4, pp. 583–598, Oct. 2004.

[24]   N. SPIERINGS, *WOMEN'S EMPLOYMENT IN MUSLIM COUNTRIES*, FIRST. HAMPSHIRE: PALGRAVE MACMILLAN, 2015.

[25]   V. Braun and V. Clarke, "Thematic analysis.," in *APA handbook of research methods in psychology, Vol 2: Research designs: Quantitative, qualitative, neuropsychological, and biological.*, Washington: American Psychological Association, pp. 57–71.