ABSTRACT

Title of Document: APPROACHING GENDER PARITY: WOMEN IN COMPUTER SCIENCE AT AFGHANISTAN'S KABUL UNIVERSITY

Jandelyn Plane, PhD, 2010

Directed By: Dr. Steven Selden
Department of Education Policy and Leadership

This study explores the representation of women in computer science at the tertiary level through data collected about undergraduate computer science education at Kabul University in Afghanistan. Previous studies have theorized reasons for underrepresentation of women in computer science, and while many of these reasons are indeed present in Afghanistan, they appear to hinder advancement to degree to a lesser extent.

Women comprise at least 36% of each graduating class from KU's Computer Science Department; however, in 2007 women were 25% of the university population. In the US, women comprise over 50% of university populations while only graduating on average 25% women in undergraduate computer science programs. Representation of women in computer science in the US is 50% below the university rate, but at KU, it is 50% above the university rate.

This mixed methods study of KU was conducted in the following three stages: setting up focus groups with women computer science students, distributing surveys to all students in the CS department, and conducting a series of 22 individual interviews with fourth year CS students. The analysis of the data collected and its comparison to

literature on university/department retention in Science, Technology, Engineering and Mathematics gender representation and on women's education in underdeveloped Islamic countries illuminates KU's uncharacteristic representation of women in its Computer Science Department.

The retention of women in STEM through the education pipeline has several characteristics in Afghanistan that differ from countries often studied in available literature. Few Afghan students have computers in their home and few have training beyond secretarial applications before considering studying CS at university. University students in Afghanistan are selected based on placement exams and are then assigned to an area of study, and financially supported throughout their academic career, resulting in a low attrition rate from the program.

Gender and STEM literature identifies parental encouragement, stereotypes and employment perceptions as influential characteristics. Afghan women in computer science received significant parental encouragement even from parents with no computer background. They do not seem to be influenced by any negative "geek" stereotypes, but they do perceive limitations when considering employment after graduation.

APPROACHING GENDER PARITY:
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AFGHANISTAN'S KABUL UNIVERSITY

By

Jandelyn Plane

Dissertation submitted to The Faculty of the Graduate School of the
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Advisory Committee:
Professor Steven Selden, Chair
Professor Dianne O'Leary
Professor John Grayzel
Associate Professor Sharon Fries-Britt
Professor James Greenberg

ProQuest LLC
789 East Eisenhower Parkway
P.O. Box 1346
Ann Arbor, MI 48106-1346

Dedication

This is dedicated to my family:
my parents, Jack and Carol Hazlewood
my husband, Mike
and my children, Angelisa and Jonathan

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List of Abbreviations and New Vocabulary

CRA	Computing Research Association
CS	Computer Science
Kankoor	University Entrance Exam in Afghanistan
Kuttab	School for education of young children in the Islamic system of education
KU	Kabul University in Afghanistan
Madrassa	School for older children in the Islamic system of education
NSF	National Science Foundation
STEM	Science, Technology, Engineering and Mathematics
US	United States of America
USAID	United States Agency for International Development

Chapter 1. Introduction

1.1 Background

The lack of representation of women in computer science in many countries has been well documented and persistent; it has been most extensively studied in the countries of the Western World (Gurer & Camp, 2002; Binkerd & Moore, 2002; Beyer, Rynes, Chevez, Hay, & Perrault, 2003). While countries exist that are not experiencing a gender gap in computer science, there are only a small number of countries where women are not underrepresented (Galpin, 2002; Gurer, et al., 2002). A considerable amount of research has been done attempting to understand why few women go into this field in most countries (Gurer & Camp, 2002; Barker, Garvin-Doxas, & Jackson, 2002; Bernstein, 1991), and many recruitment and retention programs have been created in an attempt to reverse the trend (Fisher, Margolis, & Miller, 1997).

The lack of women in computer science has been referred to by different names depending on the lens through which it is viewed. Scholars often refer to the problem of the "shrinking pipeline" (Astin & Astin, 1992; Beyer, Rynes, Chevez, Hay, & Perrault, 2003) when they want to emphasize that many girls are interested in studying computing at a young age; nonetheless the percentage of women receiving bachelor's degrees in Computer Science is small, and the percentage of women earning PhD degrees is even significantly smaller. Other researchers focus on the issue of the "gender digital divide" (United Nations Development Project: UNDP, 2004; Huyer & Sikoska, 2003) to emphasize the fact that women do not have access to the same jobs, income or influence

in technology because of their lack of representation. The distinction between the two perspectives is only in emphasis. While the first is a question of retaining those who are interested in the field through different levels of education, the second stresses a woman's place in and influence on both the economic and technological spheres of society.

The literature also puts forth many possible explanations regarding the phenomena of the underrepresentation of women in computer science (Gurer & Camp, 2002). These explanations can be conceptually divided into three areas: societal/disciplinary, departmental, or individual/personal characteristics (Cohoon J. M., 2001; Binkerd & Moore, 2002). For example, the research often presents an explanation based on commonalities and generalities found within societies, among computer science departments, and among women studying computer science. These generalities are studied as possible characteristics that can explain success or failure even though not all of the characteristics apply to every individual (Adams, Jensen, Lester, Olson, & Tennant, 2005; Cohoon, 2001).

Kabul University (KU) currently offers a bachelor's degree in computer science. Because they are just emerging from several decades of war, the development of computer science education in Afghanistan has progressed differently from the countries more often used for studies concerning educational equity issues. Unlike most universities in the United States, KU has a higher percentage of women in its Computer Science Department than it has in the university as a whole. The university has approximately 25% women, and the Computer Science Department includes approximately 36% women. This study will explore the relevant societal, departmental,

and individual characteristics influencing the representation of women in computer science at KU.

The purpose of this study is to understand the societal, departmental and individual characteristics present in Afghanistan in an attempt to shed light on the gender digital divide, its pipeline, and future technological development issues. Afghanistan is a country that has not been studied in-depth regarding women's status in the Western typically "male" fields such as computer science. The study will focus on the Computer Science Department at Kabul University in order to determine which of the explanations put forth as causes of the underrepresentation of women in computer science are also present there. By studying a society, a department and a group of students that have several significant differences from those often studied, we may be able to have a deeper understanding of the phenomenon worldwide.

Cohoon (2001) posited, "Women succeed as computer scientists in certain times and settings" (p. 108). Finding ways to help more women succeed will encourage gender parity. Understanding the characteristics of women who select this area "will eventually allow us to identify a profile of women who pursue careers in computer science" (Beyer, Rynes, Perrault, Hay, & Haller, 2003, p. 49). The results of this study will further our understanding of which societal, departmental and personal characteristics can be altered or compensated for in order to encourage more women to study computer science in the US as well as in other countries. The goal is to understand which of those conditions are favorable to the underrepresented populations to allow change in the educational environment to provide the best opportunities possible. Gurer and Camp (2002) argue "It is imperative that we encourage and retain more women in computer science" (p. 121),

and this study seeks to understand the conditions that encourage women to pursue degrees in computer science in order to make that happen.

1.2 Statement of the Problem

1.2.1 Importance of Understanding the Underrepresentation of Women

Several arguments are common for why it is important to close the gender digital divide at all educational levels of computer science. Two of the primary arguments revolve around the issues of power. These arguments of power concentrate on the financial gain and on the control of the future development of the science. Some arguments are made at the level of the individual while others concentrate on the benefits to the society as a whole.

The individual financial argument is that the salary awarded, positions available, and employment flexibility of the traditionally male fields such as computer science have major benefits over the positions that are more traditionally held by women. These positions allow men to earn higher salaries and advance in ways that positions traditionally reserved for women do not.

The futuristic argument is based on the fact that technology is developing and changing at a rapid pace. The jobs that are more traditionally feminine seldom involve technical policy or design decisions that will determine what new technologies are developed or how they are applied. Without equal representation of all members of the society in the design of technology, it will be much more difficult to ensure that the technologies developed have the maximum benefit for all and have the appropriate design for use by all. Without the input of women into the design, creation, application and funding of technologies not all viewpoints can be considered (Borg, 2002; Cohoon J. M., 2003; Lazowska, 1999; Margolis & Fisher, 2002). Cohoon (2003) believes that "Without

diversity, we limit the set of life experiences that are applied, and as a result, we pay an opportunity cost – a cost in products not built, in designs not considered, in constraints not understood and in processes not invented" (p. 673).

Focusing on this problem from the financial sector is especially relevant because of the growing need for workers in the computing fields worldwide. Just referring to the conditions in the US, Camp (1997) points out that "there is a critical shortage in computer science and, although women are more than half of the population, they are a significantly underrepresented percentage of the population earning computer science degrees" (p. 104). The increase in the technological base of almost every discipline indicates that more people trained in computer science will be needed all through the foreseeable future (Camp, 1997). The rate of growth over the past several years is quantified by Stockard, Kassen and Akbari (2004): "According to the *Monthly Labor Review*, computer occupations are expected to add nearly two million jobs between 2000 and 2010, which is a 75 percent increase" (p. 103). Similarly, in terms of the recent growth in number of workers needed, "the U.S. Department of Labor projects that between 2000 and 2010 an additional 1.6 million workers with degrees in information technology will be needed" (Beyer, Rynes, Perrault, Hay, & Haller, 2003, p. 49). According to Margolis and Fisher (2002), there is a shortfall of 900,000 skilled workers causing 40% of the planned software development projects to be canceled with loses of billions of dollars. It will be difficult to meet this demand with the same quality of students without the increased representation of both women and minorities (Cohoon J. M., 2001). The importance to society of the representation of all people in the technological development is emphasized by Borg (2002):

> People's political, social, economic, and personal lives will be affected dramatically and more than we now imagine, for in a global knowledge economy, those without knowledge and access to technology will be left behind. Exactly which technologies are created and what they are used for depend on who has the ability to influence them. At the moment, it is white, prosperous, technologically educated men who make most of the decisions about the nature of technology, and this defines how technology affects the entire world population. That needs to change. (p. 13)

Although these statistics were applicable to the US, the worldwide reliance on computers and computing technology appears to be continually increasing; the digital divide and the shrinking pipeline threaten to eliminate some portions of the population from some of its benefits. Both the individuals and the society as a whole can benefit if we can understand the reasons for the underrepresentation of women in computer science and if we can do something to reduce it in the countries where it does already exist and prevent it from happening in the countries where it does not exist.

1.2.2 Historical and Contemporary Status of Women in CS in the US

Women's participation in computer science education in the US increased for a period in the 1980's; however, it has been declining since. This trend is not consistent with mathematics, engineering or any other discipline; it is consistent with computer science education in most other countries. It is true that "women's representation in many science, mathematics, and engineering disciplines historically has been low in the United States," (Cohoon J. M., 2003, p. 668), however these other fields are currently improving gender parity worldwide while computer science is not. According to Cohoon (2001, 2003), women earned 13-14% of the Computer Science bachelor's degrees in the US during the 1970-1971 school year. This percentage rose steadily to 37% for the 1984-

1985 school year, although the percentage then dropped 10 percentage points over the subsequent 13 years to below 30% by the year 2000 (Cohoon, 2001; Cohoon, 2003). In 2001, they earned 28% of the bachelor's degrees in computer science (DePalma, 2001). Women are particularly underrepresented in the most prestigious research institutions: only one out of five computer science students were women in 2002 (Margolis & Fisher, 2002). This 20% from 2002 has also dropped to where "women accounted for only 12 percent of undergraduate degrees in computer science and engineering in the United States and Canada granted in 2006-7 by PhD-granting institution" (Stross, 2008, p. 1).

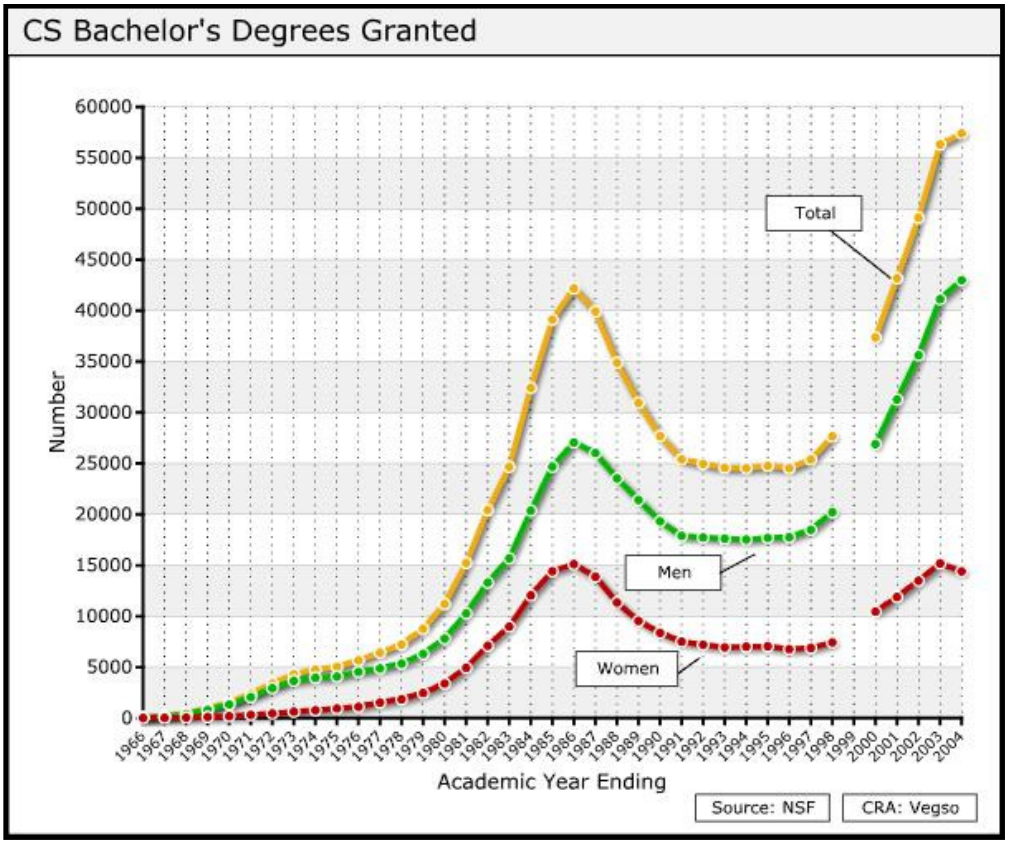


Figure 1-1: U.S. CS Degrees Awarded (CRA) 1966-2004; Gender Comparison

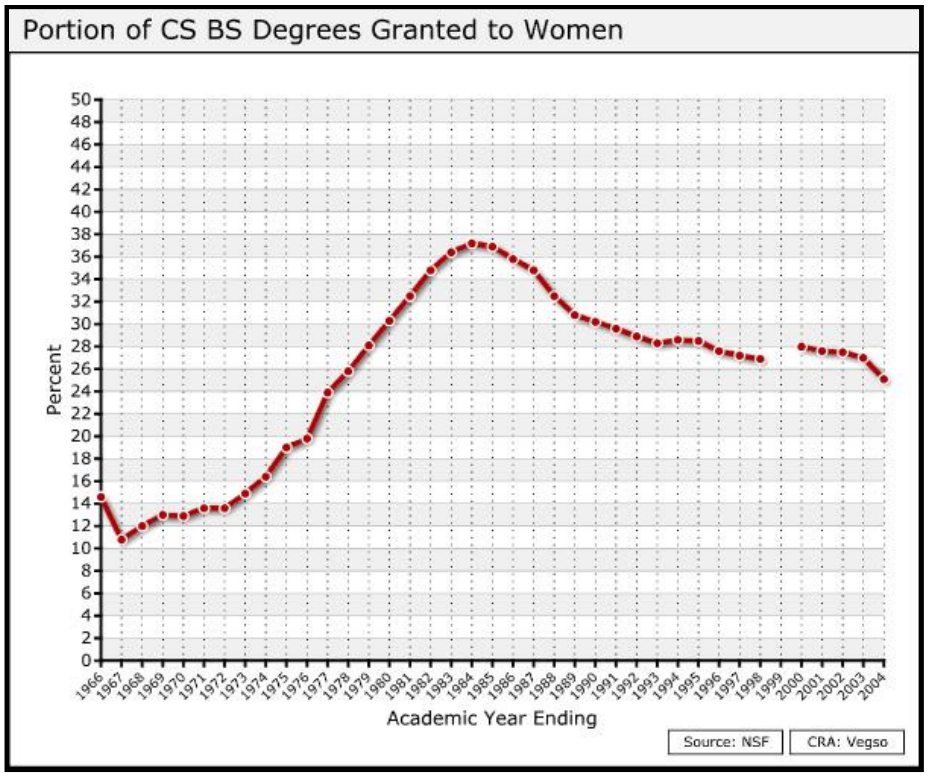


Figure 1-2:U.S. CS Bachelor's Degrees (CRA) 1966-2004; Percentage Women

Figure 1-1 and Figure 1-2 are based on statistics collected by the Computing Research Association (CRA). These figures show the number of computer science degrees disaggregated by gender and the percentage of the total degrees that were awarded to women from 1966 to 2004 - the last year for which data is available (Computing Research Association, 2007). These graphs are based on data from the National Science Foundation (NSF), where the year number indicates the date in June and includes the preceding year. In both of these graphs, the data for the year ending in June of 1999 is blank because that data for that year was not available. The first graph compares the number of total degrees, the number of men earning degrees and the number of women earning degrees. The rise in number of degrees through the 1980's is obvious as well as the increase in recent years. The number of women earning degrees, in most cases, parallels the number of men in direction of trend, but not in rate. As the

number of men increased, the number of women also increased but at a slower rate, and as the number of men decreased, the number of women also decreased but at a faster rate. This is true except for the period from 2003 to 2004 when the number of men increased, even while the number of women decreased. The second of these graphs shows the percentage of the overall computer science degrees that were awarded to women. The persistent decrease in percentage of women earning bachelor's degrees in computer science since the 1980's implies that the recruitment and retention programs designed to improve the gender representation in computer science have not been sufficient to improve the level of participation. The percentage of women has returned to where it was at the end of the 1970's.

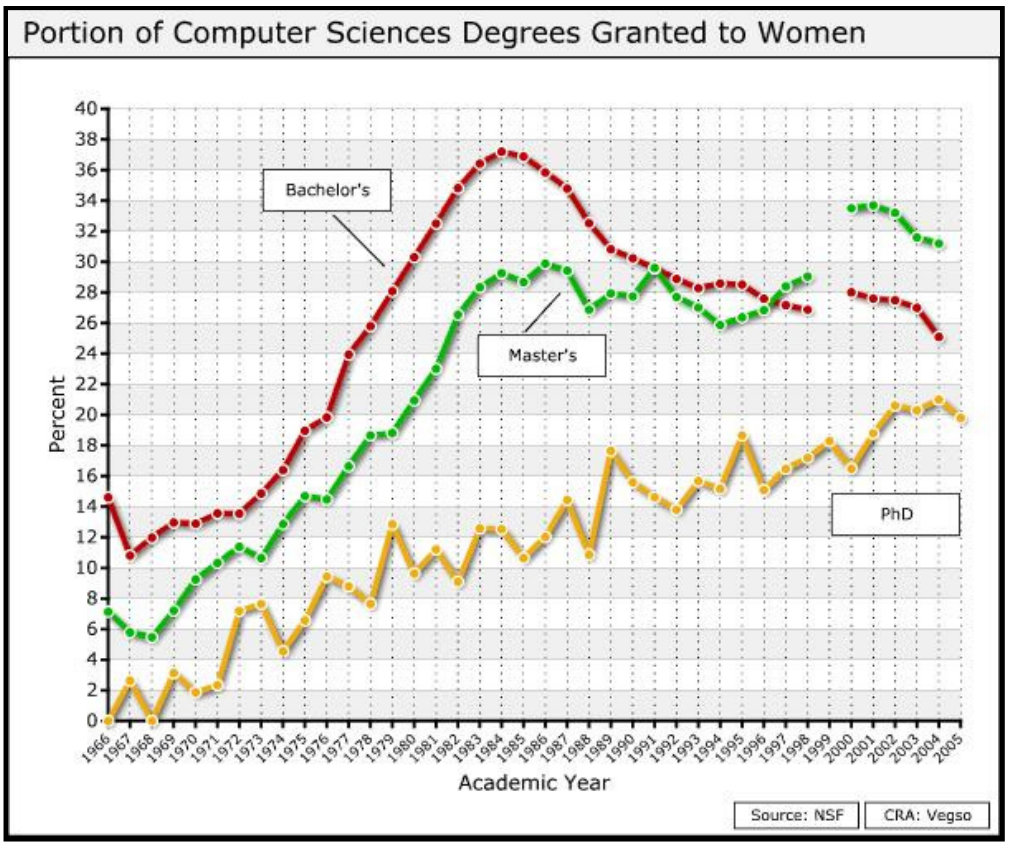


Figure 1-3: Portion of Computer Science Degrees Granted to Women

Figure 1-3, above, shows that until the mid-1980's, there was a steady increase in the percentage of women earning degrees in computer science. Since that time, the percentage of graduate degrees awarded to women has remained on an overall upward trend, although the percentage of bachelor's degrees earned by women has been declining. This information is also based on data collected by the NSF (Computing Research Association, 2007). The percentage of PhD degrees awarded to women is still significantly smaller than the percentage of bachelor's degrees awarded to women, however the percentage for PhD degrees has been on an overall increase for the past two decades while the percentage of bachelor's degrees awarded to women has been on a decrease.

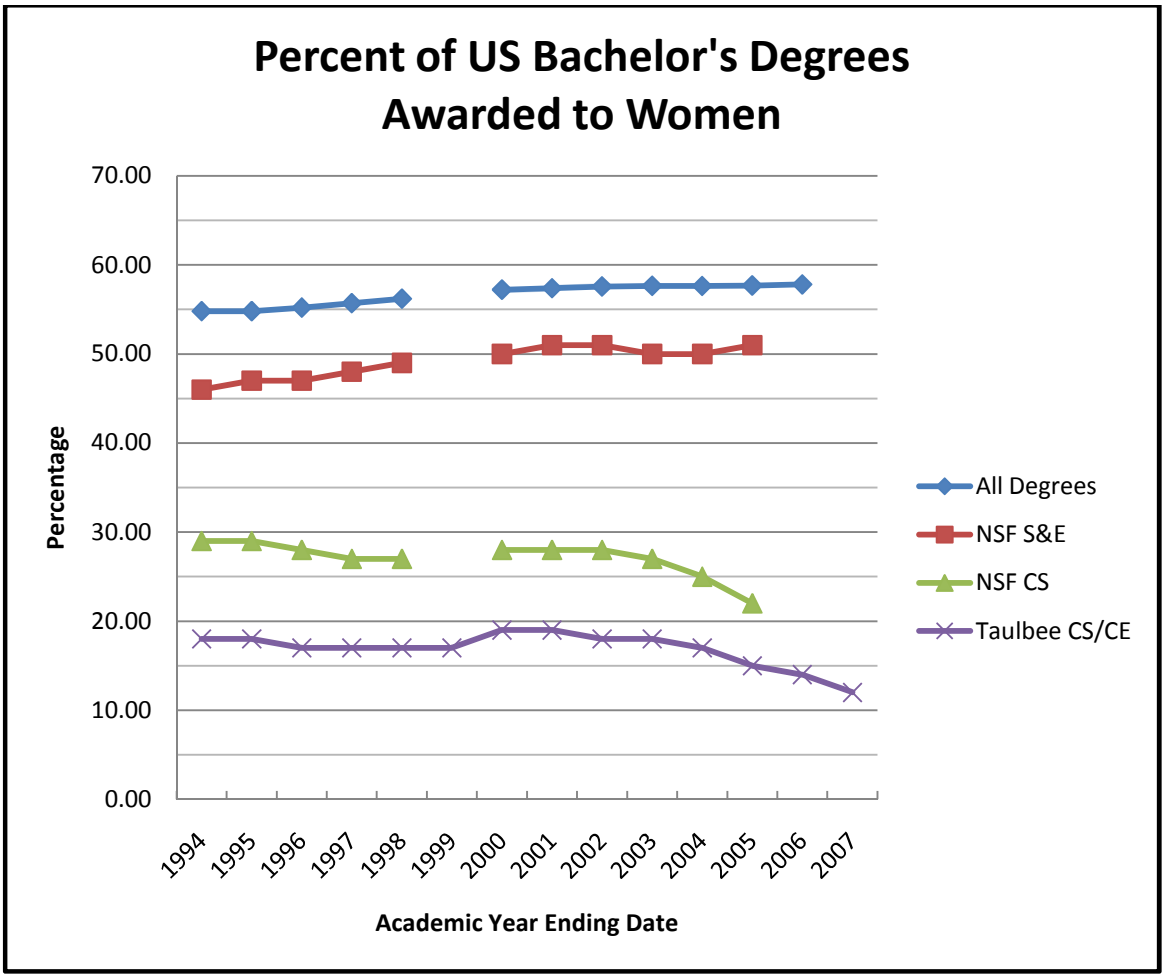


Figure 1-4: Comparison of Taulbee Reports of Percentages

Figure 1-4[1] compares the NSF data for bachelor's degrees from the most recent years of the previous graphs (shown on this graph as the NSF CS line) with other data about the percentage of bachelor's degrees awarded to women. The top line of the graph shows the overall percentage of bachelor's degrees awarded to women, the second line shows the percentage of bachelor's degrees earned by women that were in science and engineering (S&E), and the bottom line shows the data collected from the Taulbee survey about the percentage of bachelor's degrees in computer science and computer engineering that

[1] Based on data from http://nsf.gov/statistics/ and http://www.cra.org/statistics/ and http://www.societyofwomenengineers.org/SWE/ProgDev/stat/earnbach_graph.html

were awarded to women. The NSF science and engineering (S&E) line shows that the aggregated S&E degrees reached gender parity by the year 2000 though the number is still below the percentage of bachelor's degrees awarded to women across all fields. The aggregated percentage in S&E has remained about 50% for the last several years. The Taulbee shows data aggregated across only computer science and engineering but including only data collected from schools offering a PhD degree – since those are the only schools that submit Taulbee surveys. The fact that the Taulbee data is much lower across the whole width of the graph shows that women who do earn computer science/engineering bachelor's degrees are often receiving them from institutions that do not have PhD programs. This graph begins with the academic year ending in June 1994 because that was the first year the Taulbee survey collected data about the undergraduate students at its participating institutions. Again, the 1999 CRA data was not available through NSF.

The numbers in computer science cannot be explained by comparison to other academic trends of the same period. Women increased their representation in undergraduate degrees overall between 1970 and 2000 according to Cohoon (2001) "women's proportion of all bachelor's degrees rose steadily from 46% to 56% during this period... women's proportion of the non-CS scientific and technical disciplines rose during this period" (p. 108). The percentage of all bachelor's degrees continued to increase to 57.8% by 2006 (National Science Foundation, 2008). The decrease in computer science percentage during the period from the mid-1980's to the present is not even consistent when just compared with the most closely related fields; the percentages of women represented in other non-life sciences and engineering were also both

increasing (Camp, 1997). The numbers show that the trends in computer science enrollment affected the percentages for women in negative ways. In the periods of time shown in the graphs above, "[the number of degrees awarded to] women increased more slowly than men and decreased more rapidly than men" (Cohoon, 2001, p. 109). Even during the years of overall decline in computer science enrollment, the percentage of women did not improve because the number of women dropped faster than the number of men. This rate is explained with specific numbers by Beyer, et al (2003) "from 1986 to 1996, the number of men majoring in computer science dropped by 33%, whereas the number of women dropped by 55%" (Beyer, Rynes, Perrault, Hay, & Haller, 2003, p. 49). According to Hill (1997) "bachelor's degrees awarded in mathematics and computer science declined for both men and women from 1985 to 1995; in computer science, the percent decline in degrees to women was twice that of men" (p. 1).

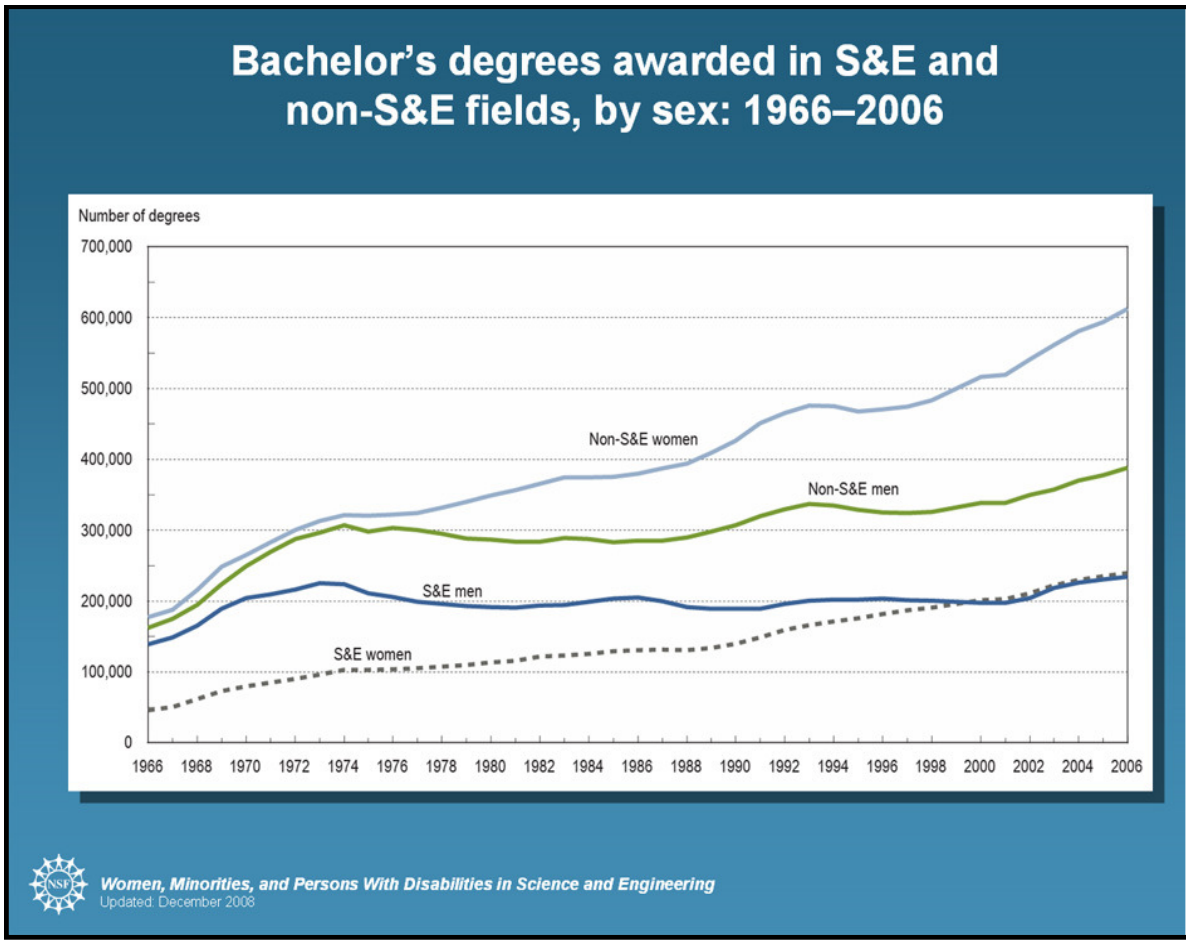


Figure 1-5: STEM Degrees Awarded as reported by http://www.nsf.gov/statistics/wmpd/slides/figc-1.jpg

Figure 1-5 compares numbers of degree granted comparing Science and Engineering (S&E) disaggregated by gender. The numbers of bachelor's degrees for men and women aggregated in the S&E and non-S&E is reported (National Science Foundation, 2006). In the non-S&E fields, degrees granted to women increase in quantity all across the width of the graph. In the non-S&E fields, the degrees granted to men are also on an overall increasing trend though not at the same rate as women. When aggregated, the number of S&E degrees granted to women has a constant increase even while the number of S&E degrees granted to men did not increase much at all. When comparing the S&E fields aggregated, it is obvious that gender parity was reached around

the year 2000 and remained relatively consistent. This gender parity is reached in the aggregated data because some of the larger fields of study, such as those needed for pre-medical studies, have as many – and in some case more – women graduates. Figure 1-6, below, disaggregates that data to show the percentage of bachelor's degrees granted to women in several individual fields within S&E. The high percentages in fields such as psychology explain the gender equity of S&E when the fields are aggregated. It is important to notice that computer science is the only field that has been on a steady decline for all of the years between 1985 and 2005.

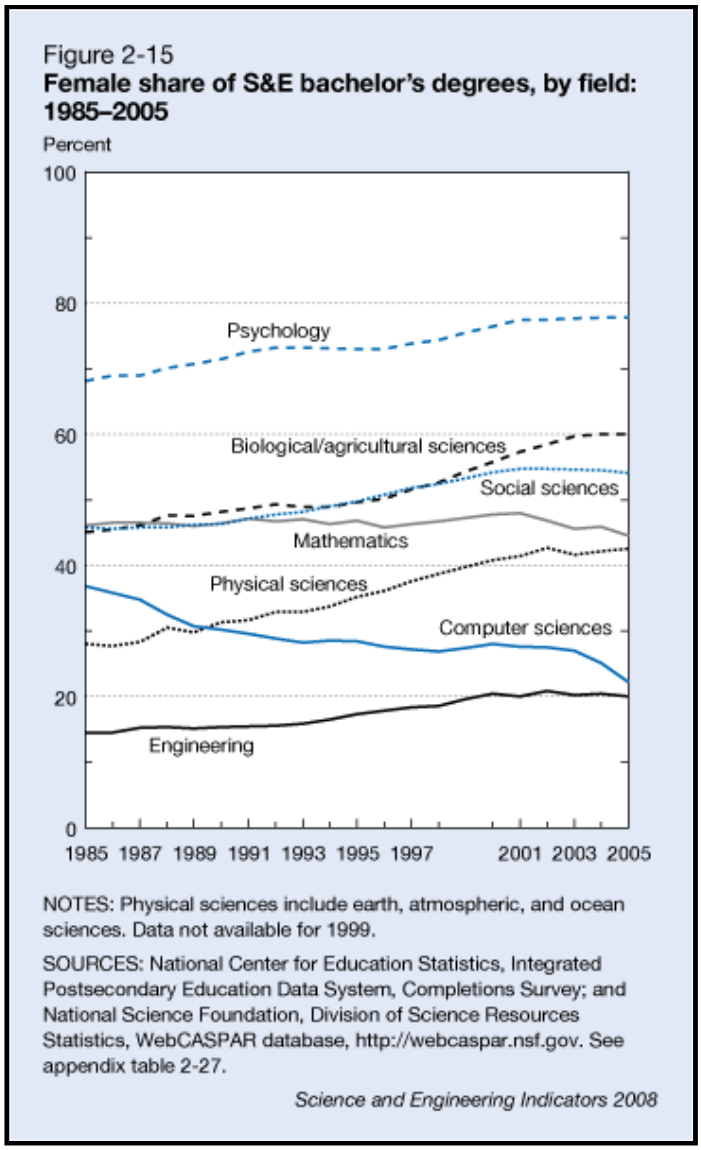


Figure 1-6: Disaggregated S&E Gender Data[2]

Researchers have identified a link between too few women taking classes in high school that would lead to college programs in computer science, subsequently leading even fewer women to pursue a bachelor's degree. The statistics for those taking the Advanced Placement exam also show a decline in percentage over the last several years. According to the National Center for Women and Information Technology, "girls represented 56 percent of all Advanced Placement (AP) exam-takers in 2006. Yet

[2] Chart copied from http://www.cra.org/info/education/us/women.html

women students comprised fewer than 15 [weighted average over both the A and the AB exam versions] percent of all AP computer science exam-takers – the lowest representation of any AP discipline [based on data from the College Board]" (National Center for Women and Information Technology, 2008, p. 2). Even in cases where women are just as qualified, they are less likely to select any of the sciences as an area to study in college. In a study in 1995 involving 2,000 students, there were 280 men and 220 women in high school who had taken the courses that would allow them to select to enter directly into one of the sciences. In that year, 50% of the qualified men did elect to study a science, however only 16% of the women made that choice (Leeve, Dunigan, & Turner, 2002).

1.2.3 Status of Women in Computer Science Country Comparisons

Women's participation in computer science in other countries varies significantly and many have been less researched than the level of participation in the US. Some countries have reached gender parity or at least have the same representation in these fields as they do in university degrees as a whole. Two issues that make comparisons difficult is the inconsistent definition of computer sciences and the aggregated data that is often available.

When computer science statistics are combined with either information technology or with the mathematical fields, the data appears to give a much higher representation for women in the field. Combining it with information technology makes the numbers appear better because these are often the lower paying jobs that have less control over the development of computer technology in general. In addition, these are

the technological positions typically held by women even within the US. Combining it with mathematics and statistics is also misleading since these fields are also closer to gender parity than is computer science.

Figure 1-7, based on Galpin (Women in computing around the world, 2002) compares the percentage of degrees awarded to women in general to the percentage

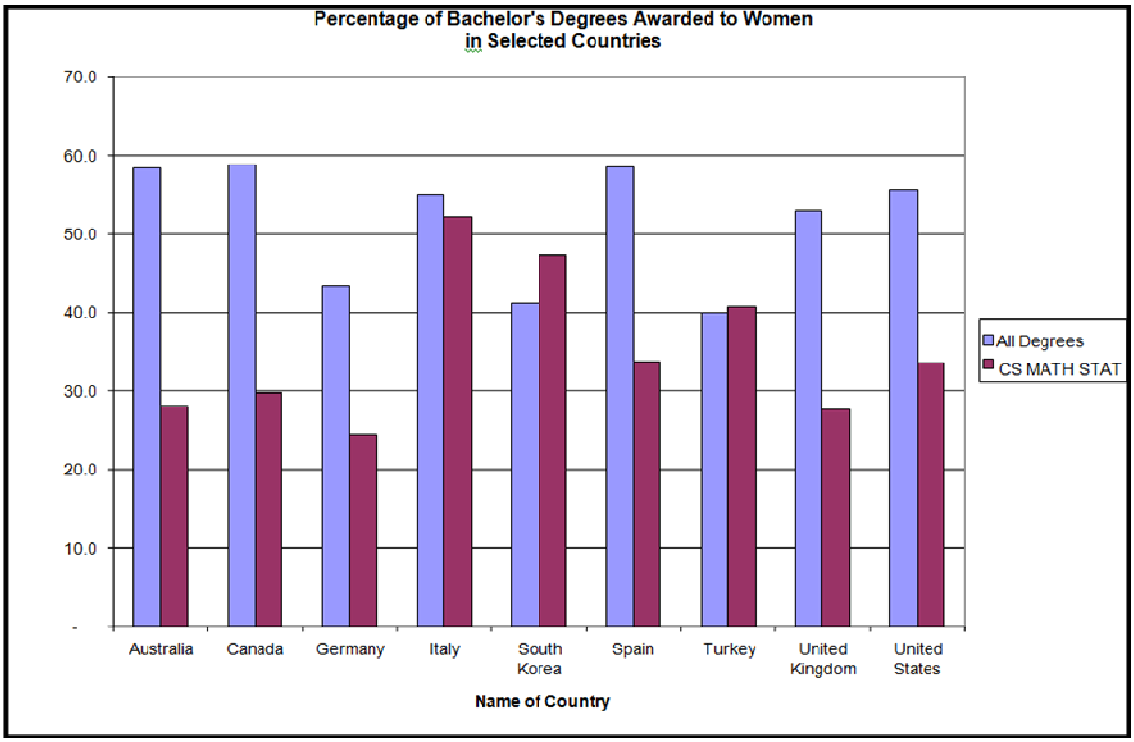


Figure 1-7: Country Comparison: Percentage Female

awarded to women in the aggregate computer science, mathematics and statistics fields. Some countries, most notably The United States, Australia, Canada and the United Kingdom, have a significantly higher percentage of degrees awarded to women in total than their percentage of these technical degrees which are awarded to women. Other countries, especially South Korea and Turkey have a higher percentage degrees awarded to women in these technical fields than their percentage of degrees awarded to women in

general. These countries, like Afghanistan, are not experiencing a problem with underrepresentation of women when the data is aggregated in this way.

Another country reporting no problems of underrepresentation is Malaysia (Othman & Latih, 2006). These researchers report the degree statistics and the result of a survey given to understand attitudes toward gender bias in the computer science/information technology fields. They determined that many of the characteristics identified as being limiting to women wishing to pursue a degree in computing technology do not exist at their universities. They conclude that the difference of these characteristics between Malaysian universities and the Western universities contributes to their achievement of gender parity.

One country that shows evidence of women dominating the field is Armenia where at one university the computer science population is 75% women:

> 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. (Gharibyan & Gunsaulus, 2006, p. 222)

The small numbers of countries that have sufficient women in computer science to achieve gender parity are the exception to the rule and these countries also often have a small number of computer science graduates compared to the larger countries that do not have gender parity. Because of these two factors, the worldwide representation of women in computer science remains quite low. By studying characteristics about these countries and attempting to understand the attitudes and motivations of the computer

science students in those countries we may be able improve the representation rates in the other countries.

1.3 Justification for Selecting this Research Site

These theories and numbers are primarily based on evidence from cultures and countries that are to a certain extent similar to each other. These countries developed computing technology and the education of technical fields on similar paths and in similar time periods. The countries represented in most of the literature include predominantly English-speaking, Western countries: the United States, Canada, Great Britain and Australia. The research for this study was conducted in a country where the historical development and culture are significantly different from those that are typically studied.

Afghanistan was at war during most of the last three decades. This was the major period of development in the area of computer science, and the wars prevented Afghanistan from developing on the same timeline as these other countries. Even when KU first added the Computer Science Department, they did not have the resources to provide the equipment or access to outside sources they needed until recently.

Not only is Afghanistan different in how it developed technologically, it is also different from these countries in how it developed in terms of women's education and a women's role in society. Earlier in its history, women were educated and held similar positions in society to men. However, during the time of the Taliban rule, women were not permitted to be educated, to teach or to hold most types of employment. This transition back to the equitable education of women at the same time as the technological advancement is happening at an accelerated rate makes a unique interaction.

The theories researchers have derived to explain the numbers reported in the previous section will be described in the literature review section contained later in this paper. The information collected from Kabul University's Computer Science Department and its students with then be compared to the data just presented and the theories created to explain the data. This comparison will help us better to understand the relationship between societal, departmental and individual characteristics and the choice to study computer science at the bachelor's degree level.

1.4 Research Questions

This research uses several methods of data collection in an attempt to answer the following question and its sub-questions. All of the data collected during this study will refer to the computer science students at Kabul University in Afghanistan during the academic years March 2006-November 2006 and March 2007-November 2007.

What are the relevant societal, departmental, and individual characteristics that influence the representation of women in computer science at Kabul University?

a) What is the current nature of gender disparity in computer science education at the bachelor's degree level in Afghanistan?

b) What are the demographic characteristics of those students who select to study computer science and why did they select to study computer science?

c) What factors do students perceive as barriers and support structures to achieving complete gender parity in computer science higher education in Afghanistan?

d) How are these perceptions and characteristics different and how are they similar to the perceptions portrayed in the literature as developed based on the selection of countries studied?

1.5 Dissertation Organization

This dissertation will first review the three areas of literature that help to frame the discussion of the representation of women in computer science education in Afghanistan. The first of these areas (Chapter 2) summarizes what is known about the history and current status of education in Islamic countries ending with details of education of women in those countries and education in Afghanistan specifically. The second area for literature review (2.2) will provide an overview of the research concerning the representation of women in computer science and related Science Technology Engineering and Mathematics (STEM) fields. The final literature review (2.3) summarizes the retention theories that can be applied to the loss of women from the computer science pipeline.

Following the literature review sections, the methodology including the data collection and data analysis will be presented (Chapter 3). This chapter summarizes first what is known about the research site chosen followed by the structure of the research conducted. This is followed by an overview of the methodology with the specifics about the methods used for data analysis for each of the three stages.

The next chapter (Chapter 4) presents the results of the survey/questionnaire stage followed by the results of the interview. These results are then compared in more depth to the three sections of the literature review in the discussion chapter (Chapter 5). The implications and future research needed is presented in the final chapter (Chapter 6).

The appendices of the document contain sections that give more detail for each of these stages of data collection. These include the survey, the survey directions, the interview outlines, sample interviews and sample coding from those interviews.

Chapter 2. Review of Relevant Literature

2.1 Literature on History of Education in Muslim Countries

The fact that Afghan culture is strongly rooted in the faith and practice of Islam needs to be considered a factor in the decision-making processes especially of women when deciding about university attendance and about what to study when they arrive on campus. The Islamic teachings and the practices of Islam are part of the educational system as well as the beliefs concerning gender roles and acceptable behaviors. Because of this, the literature about the history of education in Islamic countries is reviewed here to assist in the understanding of the gender representation in computer science in Afghanistan. For the purpose of this review, Islamic countries are classified as those which have a majority Muslim population and who, like Afghanistan, are member states in the Organization of the Islamic Conference (OIC)[3]. The chapter starts with the broad overview of education in these countries followed by sections each relevant to this research including technology education, women's education and Afghanistan's education specifically.

2.1.1 Generalizations Across Islamic Countries

Islamic countries are by no means homogenous. Interpretations and expressions of the faith vary greatly between and within the cultures of countries that have a Muslim majority. Nonetheless, all Muslims agree on the centrality of the teachings of the Qur'an, which state that it is duty (*farz*) of all Muslims to be educated (Wardak, Zaman, & Nawabi, 2007; Boyle, 2007). Most will take that belief one step further to say that

[3] OIC is also referred to by the name "Organization of Islamic Countries" in some texts.

education is a "right guaranteed by the Qur'an and practiced by Islamic societies since the time of the Prophet" (Sonbol, 2006). According to Wardak, Zaman and Nawabi (2007):

> The study and transmission of religious knowledge (*'ilm*) have always been at the heart of Islamic tradition. Islam is a religion of the Book and of religious commentary, and most Muslims regard religious study as a form of worship in its own right. In principle, every Muslim is enjoined to acquire a basic knowledge of God's words and injunctions as revealed in the Qur'an, the canonical words and deeds of the Prophet Muhammad (*hadith*), and the "path" (*shari'a*) or the law God has provided as a guide for human conduct. (p. 72)

Education is also highly prized in developing countries (Zia, 2006) and in the Arab countries (Kirdar, 2006); these countries find it difficult to provide a quality education to all citizens. Zia (2006) attributes the emphasis on education to their need for progress when she states "the OIC nations, like other developing countries, are aware of the significance of an educated and skilled populace specifically to keep pace with the rapid developments in the developed world" (p. 23). Interplay of religious, cultural, financial and societal issues make the availability of education inconsistent in the individual countries of the OIC. This inconsistency is further intensified within selected geographic areas and between selected groups in those countries.

The educational system in Islam began with the teachings of the Prophet in the mosques. As a result, the early literacy education developed and continued in the mosques. The Qur'an presents the importance of knowledge ('ilm) through 750 references - the third most used term in the Qur'an (Boyle, 2007). The Qur'an distinguishes two types of 'ilm - that which is revealed from God and that which is gained through reason. Since the first is presented as the more important of the two, the

Muslim education system began by centering its earliest education content on the words of the Qur'an - the revealed knowledge.

Schools associated with mosques began to develop in the first century of the Muslim era[4] (Wardak, Zaman, & Nawabi, 2007; Kadi, Education in Islam - Myths and truths, 2007). The schools are known as *kuttab*[5], which means place of writing, or Qur'anic schools (Kadi, 2007). These schools provided the religious education for anyone who could attend, and the local Muslim leaders (*mu'allim*) served as teachers. The individual teachers chose the content as well as the criteria for completion, though central to that content was always the Qur'an. The student often continued to receive instruction at the kuttab for five or more years (Kadi, Education in Islam - Myths and truths, 2007) mainly receiving one-on-one instruction from the teacher or the older students (Boyle, 2007). When a student completed the requirements and the teacher determined they were ready, the student was given a certificate and encouraged to search out a new teacher and a new place to learn.

In the kuttab, students start as early as age 3, though students could attend at any age and enrollment was often not continuous through years and grades (Boyle, 2007; Sonbol, 2006). A negotiated amount in tuition per student was paid to the teacher for his salary. Since this cost was negotiated individually for each child, the kuttab education was available even to those who were quite poor (Zia, 2006; Kadi, Education in Islam - Myths and truths, 2007). These schools have a much less formal structure both in the content of the curriculum and in the level of learning available or expected. The curriculum of these schools always centered on the religious knowledge, although a few

[4] This corresponds to 7th century CE (Common Era).
[5] The *kuttab* is sometimes called a *maktab* (Kadi, Education in Islam - Myths and truths, 2007).

also included more secular topics such as science and logic (Kadi, Education in Islam - Myths and truths, 2007). Many of these schools tended to emphasize memorization and recitation of the Qur'an in Arabic even in countries where the students did not learn the language. Emphasis on this method of teaching allowed students to develop excellent memorization skills although they did not expand the student's higher order skills such as analysis or logical reasoning. Zia (2006) takes a negative stance on the adjustability of the kuttab curriculum when she states that "over the years, generally speaking, Qur'anic schools, for various reasons, did not expand their teaching or curriculum and were therefore not deemed competent to provide an education more suited to contemporary societal needs" (Zia, 2006, p. 33). Some other researchers disagree with Zia's evaluation and say that the kuttabs have expanded to include other subjects, other methods of instruction and even variations of times in order to continue to provide religious instruction (Wardak, Zaman, & Nawabi, 2007; Hefner, Introduction: The culture, politics and future of Muslim education, 2007). The mosques themselves were also a significant center of learning. Study circles there provided the local scholar a way to share with people of all ages in a less formal method.

Madrasas[6] were created to provide further education to students who completed the Qur'anic schools. The system of madrasa institutions was more structured in both curriculum and expectations through coordination within a network of schools. This coordination is not comprehensive and there is still significant variation among the networks (Kadi, 2007; Berkey, 2007). The individual schools began to develop into

[6] "The word 'madrasa' is an Arabic word meaning school." (Wardak, Zaman, & Nawabi, 2007, p. 28) There are many other spellings: "Madrassa", "Madrassah", "Medrassah." These are often made plural by adding an 's' such as in "Madrssas" or by a change in the word as in "Madaris".

organized sets by the 10th century and were a major influence on the formation of the university systems in Europe (Kadi, 2007; Zia, 2006).

Madrasas were often built and endowed by the wealthiest members of the community. This endowment allowed the madrasa to provide salaried positions to the faculty and staff and to provide a stipend to the students. Endowments and stipends to students allowed many students without financial means to attend the madrasa as long as the families could allow them to leave the home for full-time concentration on their studies. The madrasa administrative structure was quite elaborate with many specialized employees. The madrasa was often endowed with shops, mills and lands to maintain income to provide salaries as well as living accommodations and stipends for the students.

The madrasas provided education of religious training "in addition to some 'foreign' sciences such as medicine and astronomy" (Kadi, 2007). The size and resources of the madrasa as well as the content of the curriculum depended on the wealth and control of its endower. The control of the content by the endower was often important because many used education "as a vehicle for development of the denominational doctrine" (Zia, 2006, p. 32). The style of instruction was based significantly in memorization, though branched into "probing of the student's understanding and ability to solve difficult problems" (Kadi, Education in Islam - Myths and truths, 2007).

The globalization and the colonization of many of these countries created a second educational system running in parallel with the traditional educational system of Islam (Zia, 2006; Shaw, 2006; Kadi, Education in Islam - Myths and truths, 2007; Boyle,

2007; Metcalf, 2009). The conflict of this new educational system taking the place of the religious system is expanded by Boyle (2007):

> This archetypal model is growing less and less common across the Islamic world, as more and more children attend public schools and thus study a wider variety of subjects ... Public schooling is commonly perceived by parents, teachers and students themselves as offering more options for economic advancement through university enrollment or employment. Indeed, many traditional Islamic schools have closed as their student population has diminished." (p. 177)

Most countries currently have the Western style education available as well as the kuttab/madrasa system (Belhachmi, 2008). This bifurcated system causes tension by their attempt to coexist with their significant differences, the societal judgment of right and wrong, and the battle for funding especially in the poorest countries. "Most Muslim states that gained independence from imperialist hold have parallel systems in most social institutions, composing a mix of the traditional and the secular. ... That these parallel systems of education have created considerable sociological, political and economic (and perhaps psychological) impact on the populace in these countries is quite obvious" (Zia, 2006, p. 33).

If the differences were just in the method of presentation and in the exact content, these systems could easily exist in parallel, both allowing students to reach some end goal. However, the differences are much more deeply rooted in the educational philosophy. Boyle (2007) suggests that they are also incompatible because "the approach to knowledge acquisition in Islamic schools contrasts with that associated with Western educational systems. While Islamic education has a narrower initial focus and broadens over time, Western education begins with a broad focus and moves toward narrower specialization" (p. 179).

In the opinion of some people, modernization and changing from the traditional is a dangerous move away from their commitment to follow the teachings of The Prophet. In their opinion, any modernization is associated with "westernization" and is considered evil (Shaw, 2006). The globalization forces that brought the parallel systems have caused an additional division in the social structure. A split has been formed between those who were educated in the Western style and those who were educated in the religious system. These two groups often have goals and solutions to the country's problems that are diametrically opposed.

The tension between these groups is increased because they are not only fighting for control of the government, but they are also fighting for any funding that is available for education. The fundamentalists who believe that the Western style education will lead people away from the path of Islam want to make sure that there is no state funding supporting schools that are not strictly religious in nature. Others believe that the style of education and its content needs to be in alignment with other countries in order to allow their country to progress in an international arena. The 'Western' educational system is seen by many as a better route to better economic opportunities and the kuttab and madrasa system is available for those who cannot afford a Western education (Zia, 2006).

Shaw sees finding a balance in this education debate as one or the primary goals in helping these countries to develop when stating "the really big issues, then, are, first, finding a balance between Western cultural pressures in education and defending the great Muslim traditions; and secondly, all that links education and development" (Shaw, 2006, p. 53).

2.1.2 Technology Education

The influx of and the creation of technology education programs in Muslim countries has created more separation between these different educational systems and more extreme polarization in the views of the people. These conflicts are most obvious in less developed countries. Computer and cell-phone based technologies continue to spread throughout society making changes both directly and indirectly to the beliefs and practices in that society. These new global technologies and the information they carry through their existence are not culturally neutral and increase the divergence of views toward the correctness of development (Shaw, 2006).

Those who embrace the Western form of development and globalization as the method of progress accept and welcome these technologies, while those who see that definition of progress as detrimental to the path the country should follow want to eliminate the effects of the technology. The struggle for control of the educational system is one place this dichotomy creates discord as expounded by Zia:

> The development of Information Communication Technologies (ICT's) has led to the radical transformation of educational institutions, their structures and processes. Technological innovations and changes in production techniques have impacted on state policies for the acquisition, transmission and application of knowledge and skills. A greater role of corporations in the development of human resources is perceived. (Zia, p. 36)

The importation of these technologies and their applications for the purpose of education not only makes the two educational systems even more diverse, it also increases tension due to the acceptance of the influences of those technologies on the society. Those that embrace the technology are branching further from those who see its adoption as westernization, and therefore negative. This branching leads to further economic separation of the graduates strictly on the grounds of their participation within

an individual education system. That economic division - because those who are educated based on Western rather than religious standards are the ones that advance - can lead to further hostilities between different factions of society.

2.1.3 Women's Education in Islamic Countries

The kuttabs provide elementary education in basic and religious subjects for both boys and girls. In some countries it is coeducational and equal (Sonbol, 2006), although in others it is segregated by gender and often unequal (Wardak, Zaman, & Nawabi, 2007). Separation based on gender is consistently practiced at the level of the madrasa (or, in other words, when the children reach maturity, education is segregated). This separation and, often, unequal treatment of the education of the students contributes to the larger issues of gender segregation in society. Griffin makes it clear that many of these decisions are not because of the teaching of Islam in stating: "apart from having few role models, and except for certain negative aspects of Sharia Law, religion as such, and Islam in particular, is not intrinsically anti-female or anti-development" (Griffin, 2006, p. 17). Since the Qua'ran emphasizes the importance of education for all Muslims and gave rights to women that were not common in other societies of that time, the gender differences found in the educational systems are not intrinsic in the religious system.

Many of the countries of the OIC do have are significant differences in education and rights based on gender as explained by Sonbol (2006):

> "Inequities exist in personal status laws, in honor crimes supported by state-laws that 'understand' such crimes as 'hard-to-combat' tribal traditions, in the gap of power and wealth dividing the poor from the rich and in the educational chasm perpetuating differences between rich and poor, and village and town, that checks progress and opportunities for women much more than it does for men" (p. 49).

The level of attention and funds governments put toward the education of women in underdeveloped countries is often lower because they believe that the education of women is less important and, economically, there would most likely be less return on their investment when educating a woman (Kirdar, 2006).

In countries where poverty is pervasive, women are more affected than men because of their status and lack of education. Some researchers believe that "poverty is the greatest barrier for access to education by women" (Brock, Dada, & Jatta, 2006, p. 215). Women in underdeveloped countries, because they are less likely to be able to receive sufficient education and therefore lack knowledge about the workings of the rest of the world, are less likely to be able to benefit from any positive aspects of the Western definition of progress (Sonbol, 2006). This lack of advancement for women cannot be repaired through government programs that simply make the education available; the educational availability must be combined with programs that give incentives for women to remain in school and programs that attempt to change the perceptions about the station of women in the society as a whole (Kirdar, 2006).

If only the availability of education is changed, benefits will not result if the content of that education is not also improved. Belhachmi (2008) belives that "the educational system at the secondary level relies on an organized structure of knowledge which not only institutionalizes a systemic discrimination against women, but it also reproduces neo-patriarchal dominance in the access to, and benefits from educational and professional opportunities" (p. 89).

One of the largest limitations, due to both societal forces and educational structure, is the employment opportunities available to women. In countries "where

education is provided for women and girls, they are directed towards 'traditional' areas such as the arts, education and the humanities" (Griffin, 2006, p. 16) and "hesitate to enter fields other than the arts, social sciences and teaching" (Kirdar, 2006, p. 201). This problem is intensified in less developed countries as explained by Kirdar (2006) when explaining work by Kelly (1987):

> Girls rarely receive the same education as their male counterparts and most often enter fields of study that are predominantly female, which serves to further reinforce the prescribed gender roles. (Kirdar, 2006, p. 191).

Even where the standard of living is quite high in the Muslim countries, women tend toward careers that are deemed "acceptable" for women as discussed by Kirdar (2006) when discussing the result of research done in Kuwait by Davis and Gaveilides (1991). Almost all women graduates of Kuwaiti institutions of higher education chose to work for the Kuwaiti government mainly for the Ministry of Education working in girls' schools - "occupations that were acceptable to the male members of their families because of segregated sex" (p. 201). They are less likely to enter any type of technical field or start their own business.

According to Kirdar (2006), change in the status of women and their employment opportunities is not possible until change takes place in many aspects of the society. Kirdar believes that education needs to be provided and encouraged for all students who are women: "The curriculum in secondary schools and universities [needs to be] modified to encourage women into technical courses and vocational training"(p. 201). Society's rationale that "promotes the reproductive role of women rather than the productive role" (Kirdar, 2006, p. 205) needs to be changed. And lastly, the salary structures

improvements and incentives to work outside of the government need to be implemented (Kirdar, 2006, p. 201).

2.1.4 Afghanistan's Education Systems

Like many of the predominantly Islamic countries, Afghanistan had the traditional religious educational system that was well established long before the Soviet invasion (Boyle, 2007). The traditional training was provided through the mosques and their kuttabs and Qur'anic Schools and in the madrasas. These were schools funded by wealthy members of the community and existed for centuries. In the 1930s and 1940s, the first government funded madrasas were established in Afghanistan (Wardak, Zaman, & Nawabi, 2007). In the 1930s, the government also established and funded Western style institutions of higher education.

Currently little information is available about the status of enrollment for either the religious or the secular schools. Perraton (2004) states that "basic data are scarce; there are, for example, no recent figures for primary and secondary enrollment ratios, but 10 years ago Afghanistan's figures were among the lowest in the world" (p. 43). In 2002, an organization was formed which made estimates that "primary gross enrollment ratios of 38 percent for boys and three percent for girls, and secondary enrollment between five percent and 11 percent" (Perraton, 2004, p. 44). The lack of enrollment can partially be explained by the fact that many of the schools were destroyed through the decades of war and the fact that there has been a severe shortage of qualified teachers for many years; according to Perraton (2004) "some 80 percent of school buildings had been destroyed in the war, and Afghanistan needed an extra 43,500 teachers and 13,851 schools" (p. 44). In 2007, the organization named Cooperation for Peace and Unity estimated that 5 million

children were in school with approximately one third of them female (Wardak, Zaman, & Nawabi, 2007).

The Ministry of Education gave similar statistics (Ministry of Education: Islamic Republic of Afghanistan, 2008). For the 2008 school year, they reported that about half of the school age children are enrolled except with significant variation by gender and province. According to their estimates, more than 5.4 million children are in schools with almost 35% of them girls. This is significantly higher than the 2002 estimate when approximately one million that were enrolled consisting of almost no girls.

Better records exist about the history of the higher education system. In the early 1930s the Faculty of Medicine was established followed soon after by the Faculty of Science. In the 1960s and 1970s, programs were created to allow European and American institutions to work with their corresponding departments at Kabul University and the other newly formed universities in Afghanistan. During the 1980s, institutions continued to develop and women were well represented in Western portions of higher education.

During the period of the Soviet occupation, the religious schools in Afghanistan were heavily funded by the governments of the United States, Europe and the Gulf States. The madrasas were used to recruit "anti-Soviet mujahedin fighters" (Wardak, Zaman, & Nawabi, 2007).

By the end of the 1980s, the strength of the Western universities took a negative turn as explained by Bahai: "the quality of education began to decline sharply because of the political turmoil, the deterioration of security, and the 'brain drain' from higher

education" (Bahai, 2006). Because of the severity of the fighting after the Soviet withdrawal, the major institutions were nearly destroyed between 1992-1996.

In the years of Taliban control (1996-2001), the university structure could not recover. The political instability and the laws put in place both contributed to the further destruction of the universities. While women had been a significant portion of the employees at the universities, they were now banned from working and from attending as students. This caused each of the universities to either completely quit functioning (Bahai, 2006) or to operate by moving classes to buildings as needed (Meeran & Adelyar, 2006).

The growth in the number of students in the Western style universities since 2001 has been extraordinary; in many cases the pace of this growth was more than the faculty members and the infrastructure of the university can manage. According to Bahai (2006) citing statistics from Keiko Miwa's work for the World Bank in 2005, the growth in the first two years was colossal. Bahai describes that "while the education system lacked every basic facility, the number of students jumped from 4000 in six institutions of higher education in 2001, to 31,000 students in 17 institutions of higher education in the autumn of 2003" (Bahai, 2006, p. 311).

According to Miwa's statistics reported in 2005 as reported by Bahai (2006, p. 312), the class year distribution of the students as well as the education level of the faculty shows the difficulty of this recovery period. Notice in Table 2-1, over 66% of the students in 2005 were in the first two years (of the six years offered) and that women make up approximately 19% of the student population. In Table 2-2, only 7% of the faculty members held PhD's and only 12% of the faculty were women.

Number and Percentage of students in Afghan Higher Education (Miwa, 2005)			
Class	Male	Female	Total
1	10,711	2,295	13,006
2	6,174	1,983	8,157
3	3.187	668	3,855
4	2,631	642	3,273
5	2,011	171	2,182
6	183	41	224
Total	24,287	5,800	30,697

Table 2-1 Afghan Higher Education Student Distribution before 2005

Lecturers by gender and degree in Afghan Higher Education (Miwa, 2005)			
Degree	Male	Female	Total
Bachelor	840	158	998
Master	650	61	711
PhD	130	2	132
Total	1,620	221	1,841

Table 2-2 Afghan Higher Education Faculty Distribution before 2005

The religious system of education grew during the years of the Taliban control however has not fared as well and has had less government support since the fall of the Taliban. Still many madrasas supported by local individuals and communities exist, although madrasas in general and specifically those associated with the Deobandi system are viewed with suspicion.

According to Wardak, Zaman and Nawbi (2007), there is little official bookkeeping about the stats of the madrasas in most of the provinces of Afghanistan: “the size of the madrasas and their curricula varies from place to place. No official figures

exist for the numbers of madrasa students currently in Afghanistan" (p. 28). According to the Afghan Development Strategy DRAFT presented in 2007, the Ministry of Education plans to give more support to the religious system of education, except the current funds and government structure make that task impossible at the current time (p. 28). Meanwhile, most cities are experiencing drops in enrollment in the madrasas despite the increasing number of people returning to the region. The loss of enrollment in the religious educational system is being experienced to different degrees in different cities; the lack of government support of the religious educational system, at the same time as the people see support from outside the country for the secular schools and their significant increases in enrollment, causes additional tension.

> Tension between the two dominant education systems, religious and secular, has played a significant role in the way the country has developed. On the one side is the Islamic (madrasa) education system with Quran schools. Madrasas and the Faculty of Sharia at the University of Kabul, generally perceived to encourage its graduates to resist Western style development, and particularly Western style education. On the other hand is the secular education system with primary and secondary schools, colleges and universities, which graduate students who are inclined to support Western inspired development. (Wardak, Zaman, & Nawabi, 2007, p. 28)

These two segments of society each want what is best for the country, however have different ideas about how to achieve it. Afghanistan has had these two opposing forces in its society for a good portion of its history, nevertheless the rise in globalization has brought different ideas that are incompatible with each other - each of these is held strongly by some people in Afghanistan.

2.1.5 Education for the Girls of Afghanistan

Currently in Afghanistan, the status and opinion toward the education of girls is also mixed. According to Wardak, Zaman and Nawabi (2007), the Afghan people are caught between the message about universal education from one side countered by the realities of society's current restrictions on the other when they stated "girls are legally allowed to attend school until the age of 18, but in some areas only 5% of girls attend school" (p. 31). The Afghans who want progress based on the Western definition, believe that there should be more education available to girls and the government should ensure access and safety, however some religious leaders believe girls should attend only until they reach maturity. Female maturity is often defined as around 9 years of age (Wardak, Zaman, & Nawabi, 2007).

The current situation in Afghanistan makes it unsafe for many girls to attend school. Even the parents who want to see their daughters educated have real concerns about the safety of attending school. Families are worried about attacks on schools for girls and kidnapping of girls on their way to or from school and about ruined reputations if a young woman is seen talking to a young man who is not a relative. These fears have been smallest in the city of Kabul, which has always had more Western influence; nevertheless, in the provinces, these fears are extremely real and higher rates of enrollment of girls will not be achieved until the threats are removed.

The younger girls are often able to attend the mosque schools however, as the girls mature and go beyond that basic training, education becomes more difficult to obtain. There are fewer schools at the higher levels and restrictions on their travel further limit attendance. To overcome this difficulty, some girls are provided with religious education in their homes. These home schools are taught by a woman who is a relative

of a Mullah and who has gained a level of religious training herself. There are a few cases where women are taught in a separate area of a madrasa (Wardak, Zaman, & Nawabi, 2007). Since only in a few cases either of these options exists, even for those who have the luxury of attending beyond the Qur'anic school, the quality of the education received is often not at an advanced level.

2.2 Postulated Reasons for Representation of Women in Computer Science

A considerable amount of research has been focused on trying to explain the low numbers of women pursuing education at the tertiary level in computer science. The research has identified many variables corresponding to characteristics each of which could at least partially explain the low population of women in computing. Several of the characteristics explored in the research will be presented here. This chapter breaks these characteristics into categories of societal/disciplinary, departmental and personal/individual to make them more easily classified. Each category has many factors that are somewhat related to each other. When individual items spanned categories they were organized based on how they fit best with the others in that category. This chapter summarizes literature done in several developed countries that are experiencing a depressed rate of women in computer science. Much of the research in this chapter was conducted in the United States, but others in countries with a similar level of participation of women in computer science such as countries in Europe, Canada and Australia.

2.2.1 Societal/Disciplinary Characteristics

This first category deals with the issues that are present in society at large or specific to the discipline of computer science. This category is the broadest and contains some of the variables that previous research has shown to influence participation;

however, these may be the hardest to reverse or correct because of their widespread existence. These variables deal with issues that are not the characteristics of the individual students or the departments in which they study though in many cases there is significant interaction with these other categories. The topic of societal factors was mentioned by West and Ross (2002) as a topic explored in the 1990's research. The category titled "discipline factors" was mentioned by Gurer, et al, (2002) in their review of a similar period of literature. These topics were combined because many of the subtopics overlapped and it would have been repetitive to keep them separated.

Probably the most referenced issue suggests that computing is simply viewed as a 'male' activity in many societies (Margolis & Fisher, 2002; Binkerd & Moore, 2002; Beyer, et al, 2003, Adams, et al, 2005). The "computer geek," defined as a person who is interested in and does nothing except computing, is traditionally a male stereotype. It is more negative for a girl to have this label (Leever, et al, 2002), however studies indicate that men often do not accept the stereotype when describing themselves either (Margolis & Fisher, 2002). The geek is also seen as someone that, though intelligent, lacks social and interpersonal skills. Women are often expected to develop certain 'social graces' in ways that are not expected of men. Women are often repelled by this 'geek' culture – especially at the adolescent age when these issues are more important than they are later in life. Adolescence represents a time when young adults are usually making decisions about college and career.

Women often have, and are encouraged to have, multiple interests, except these multiple interests lead them to doubt if they can compete with the male 'computer geeks' of the class since the geeks have centered on this one interest over a long period of time.

Even when a woman succeeds in computer science, it is seen as an exception to the rule; therefore the stereotype is reinforced (Beyer, Rynes, Perrault, Hay, & Haller, 2003). The negative stereotype that an individual must live and breathe the computer in order to succeed, as well as the reality that the field is highly dominated by men, are both detrimental to reducing the gender digital divide.

The first influence that affects the students in the chronology of their lives is the views of family and the practices of early socialization that takes place in the home (Margolis & Fisher, 2002). The family support and decisions made early in life are mentioned as the greatest impacts on their interest in computing according to Fisher, Margolis and Miller (1997). This is primarily due to the comfort level that can develop when students are introduced to and observe parents on computers at an early age. The example set by the mother is especially important to girls; this can either be positive if the mother is comfortable with the computer or negative if the mother exhibits either fear or disinterest in the computer (Gurer & Camp, 2002).

A related problem is that there is often an unequal treatment of children based on their gender. For example the family computer is more often placed in the son's room than in the daughter's room (Gurer & Camp, 2002; Margolis & Fisher, 2002) or, more generally, parents tend to more often purchase a computer for their son rather than for their daughter (Margolis & Fisher, 2002). Even when the computer is in a neutral place, the boys tend to dominate the computer time. The girls are more likely to watch or to assume that the computer is for the boys to play with (Margolis & Fisher, 2002).

Another example of gender biased treatment in early social development is that the early toys given to boys often encourage mechanical reasoning and problem solving

skills while the toys given to girls are often more based on character development and role playing (Binkerd & Moore, 2002; Cohoon, 2002; Margolis & Fisher, 2002). The problem solving skills developed by playing with building sets develops the same type of reasoning skills they will need later in life for both computer science and engineering. This early intervention steers boys toward the computer and girls away from the computer even at the kindergarten level (Margolis & Fisher, 2002).

Many of the computer games developed and computing magazines published are also more geared toward the interest of boys or toward developing problem solving skills in boys (Binkerd & Moore, 2002). The games are often based on violence and are loud to keep the interest of the young boys for longer periods of time. In many video games, the female characters are portrayed in a negative way: either as the damsel needing to be saved or physically constructed in such a way as to be of more interest to the boys. Recently there have been more computer games geared toward the interests of girls (Leeve, Dunigan, & Turner, 2002), although those often encourage character or storyline construction in a cooperative environment rather than in a competitive environment or an environment that develops problem solving skills. Boys therefore spend more time with the computer increasing these characteristics and skills that are more aligned with the design and demands of most computer science programs. The more time they spend, the more comfortable they feel and the more they consider their own computing abilities to be above average (Gurer & Camp, 2002).

As women get older and decide to study in computer science, they are more likely to lack the support system that would be essential to their success in that field (Adams, Jensen, Lester, Olson, & Tennant, 2005). Women who are studying in computer science

and have a strong supportive family are more likely to succeed (Beyer, Rynes, Chevez, Hay, & Perrault, 2003).

Another issue affecting computer participation is the views of many of the teachers the students have through their developmental years. Teachers tend to treat boys differently even at an early age. Girls are interrupted more often and are asked fewer questions in class (Binkerd & Moore, 2002). When they are asked questions, the question is often easier or with a lower level of problem-solving skills required. Boys interrupt more, answering questions not intended for them, and then are praised for giving the correct or a thoughtful answer. These behaviors can lead to the lack of self-confidence in girls that will be discussed further later. Male students are more likely to be encouraged to explore and test on their own while girls develop a process of watching or waiting to be shown.

The lack of support from a variety of audiences is another major problem in this discipline. It sounds circular; the lack of women in the field is seen as a serious contributing factor to the continued lack of women in the field. The lack of both women as peers and women as role models cause the female students to feel isolated (Leeve, Dunigan, & Turner, 2002). There is lack of role models in general (Gurer & Camp, 2002; Leeve, Dunigan, & Turner, 2002) and a serious lack of faculty members in the universities (Binkerd & Moore, 2002; Cohoon, 2001; Gurer & Camp, 2002). Women who are studying in computer science often feel isolated – different from both their peers and their teachers (Adams, Jensen, Lester, Olson, & Tennant, 2005). Mentoring from adults who have already completed the education process and the support from their peers are both necessary (Binkerd & Moore, 2002, p. 169). These mentors and role

models are needed at the pre-college level as well as in college, and it is extremely important to provide women as teachers in these fields that are dominated by men (Leeve, Dunigan, & Turner, 2002). Mentors and role models can be provided through a direct presence or a system of tele-mentoring to allow female students to see women who have succeeded thereby helping them see their goal as more real and attainable. It is even helpful to provide female students with men as mentors assuming they understand the gender bias concerns and are supportive (Leeve, Dunigan, & Turner, 2002).

With the low percentage of women in these fields, they do not have the same peer support as the men in the same fields. According to Cohoon (2003), "this kind of peer support was important to both male and female students, but women don't have the level of access to same-sex classmates that men have" (p. 671). Women often find it easier to approach another woman because they do not want the approach to make them appear imperfect or inferior to the man. Moreover, they do not want the approach misinterpreted as something more than searching for academic support (Cohoon, 2003).

Too often, the support system put in place in biased in itself. Middle and High School teachers and guidance counselors are often women who did not pursue computer science or any related field of study. Their advice to young women often discourages them from entering the fields that are dominated by men (Leeve, Dunigan, & Turner, 2002).

The workload and job expectations, as perceived either by the student or by her family, are also a detrimental factor to a woman's choice to study computer science. The perception that computer science in school is only for the really smart students who are willing to carry a heavy workload is commonly held, however that may not completely

match reality (Fisher, Margolis, & Miller, 1997). Women also more commonly have the perception that the employment opportunities of computer scientists will require long hours, which will conflict with the demands of a possible family; this perception prevents women from entering the field despite the similar requirements for doctors and lawyers, fields that have almost reached gender parity (Gurer, et al, 2002). Another misconception of the job market that does not match reality and negatively affects a woman's decision to enter computer science is the environment she could be working in. Women are deterred by the idea that a professional computer scientist usually works in a solitary environment where they are not encouraged to have outside interests (Margolis & Fisher, 2002). Knowledge of the job market can partially counteract this effect. When the job market is strong enough that women feel they will have choices in employment, they are more likely to pursue an education in computer science (Cohoon, 2001).

2.2.2 Departmental Characteristics

The second category contains those characteristics of individual academic departments that appear to influence the recruitment and/or retention of women. These characteristics are not present in every department, nevertheless it has been observed that when certain characteristics are favorable, more women seem to be recruited and retained in those departments.

Departments that offer bachelor's degrees in computer science vary on many different spectrums. One variation is the level of selectivity of either the institution or of the department itself. Another is that computer science is sometimes taught in the school of engineering and sometimes in a school with mathematics or the other sciences. A third variation that has been studied is the level of the "hard versus soft" view of the science

that is predominant in that department. The last is the pedagogical styles of the faculty members.

When the selectivity of the institution was used as the basis of comparison, researchers found no significant difference either in the recruitment or retention of women when compared to men (Cohoon, 2001). This fact dispels the myth that women cannot compete at the same level as men. Approximately the same percentage of women was recruited overall to institutions at all levels; similarly, a proportional number of women were retained until graduation in institutions at all levels of selectivity.

When computer science is part of the school of engineering rather than with the sciences, it may have different academic requirements (even in cases where it is referred to as computer science rather than computer engineering). The level of recruitment and retention at engineering schools was not shown to be lower than the recruitment and retention of schools that were not engineering despite the trend of engineering disciplines to traditionally have lower percentages of women than the applied sciences as a whole. The grouping of computer science with engineering, mathematics or the other sciences may send the message to many that it is a field appropriate only to men. Since computers are applied to many different areas of study, having a separate department of technology may change attitudes about the gender of computer studies (Margolis & Fisher, 2002).

Another characteristic that has been shown to make a difference is the gender composition of the department. All-girls schools have been shown to graduate women at a higher rate in the mathematics and science areas when it is compared to other areas of study concentration at those schools (Lever, et al, 2002). This result is questioned by some because it is difficult to determine causality. Do more women who want to major

in mathematics and the science attend these schools because of that desire or does the desire develop because they are at the single gender school? Lack of sufficient research exists to answer this question.

"Soft" computer science is the portion of the field that is more concerned with the people involved and how the computer will be applied in society. These softer fields often emphasize the comfort of the user as applied in areas such as human computer interaction and disabled user concerns. These areas also emphasize how the computer is being applied to solve real-world problems rather than the creation of new computing fields for their own sake. Women have traditionally been more interested in this portion of the science (Borg, 2002; Gurer, et al, 2002; West & Ross, 2002; Wilson, 2003). Men often see the computer as something to learn and explore for its own sake (the "hard" part of computer science). Men appear to be more comfortable (recruited and retained at a higher rate) in departments that do not emphasize the "soft" science. Most departments have a curriculum that emphasizes the "hard" science – programming and the analysis of those programs – at the beginning of the sequence. This order in the sequence of study is detrimental to the retention of many students especially women because they often make the decision to leave before they get a chance to see the application that might spark their interest. This sequence weeds out women at the early stages of their academic careers in computer science.

The single most important characteristic of the department that appears to influence the recruitment and retention of women is the composition and actions of the teaching faculty in that department. The composition and actions of the faculty members

influence the recruitment and retention of women in many different ways including pedagogy, communication and availability.

The teaching style chosen by the professor seems to affect the women of the class in a much more significant way than it does the men (Cohoon, 2001; Margolis & Fisher, 2002), and the teaching methods are more often geared toward the learning styles often associated with the men in the class (Adams, Jensen, Lester, Olson, & Tennant, 2005). Awareness of teaching style issues is especially important at the introductory levels. A positive experience a woman has with her computer science instructors initially is more influential on her retention than later experiences (Bernstein, 1991). Class examples created and the textbooks selected are often geared toward topics and styles that would be better understood by the men in the class (Binkerd &Moore, 2002). Textbooks are often written by men who use examples and styles similar to how they preferred to learn when they were students. Since most of the teachers are men who assume students learn best the same way they did, anyone, particularly women, who may learn in a different method are at a disadvantage.

The communication styles tend to be also different between men and women especially when they are students. These differences appear both inside and outside of the classroom. Men tend to interrupt, to give answers or opinions, more often while women will wait for an opportunity to speak (Gurer, et al, 2002, Binkerd,& Moore, 2003). These tendencies may be taught during the early socialization discussed earlier, however there is not sufficient evidence to know for sure when or if the tendencies are learned. This difference in communication style can lead to a lack of confidence on the part of the women because their ideas are not being heard and they are not getting

supportive responses. Therefore, they believe their ideas are incorrect while the ideas of their male classmates are correct.

The availability of the faculty members is another well cited characteristic (Binkerd & Moore, 2002; Cohoon, 2003; Hathaway, Sharp, & Davis, 2001; Margolis & Fisher, 2002). The availability of and comfort a woman feels in approaching the professor can greatly influence her decision to remain. A professor being unavailable for help and conversation leads to a lack of a feeling of personalization, which tends to be more sought by women. A high level of depersonalization negatively affects women. The size of the class and a large range of levels of expertise both affect a woman more negatively than it does men (Margolis & Fisher, 2002). As another example, computerized grading practice can increase the woman's feeling of isolation unless it is accompanied by benefits and supplemented with personal feedback (Barker, Garvin-Doxas, & Jackson, 2002).

In general, many of the subconscious actions of the professors can be changed if they are made aware of them. Professors need to be aware of the different communications and learning styles between the genders. They also need to make sure to watch for sexist attitudes (Gurer, et al., 2002) and demeaning or patronizing acts (Binkerd & Moore, 2002) taking place in their classroom or even in communications outside the classroom. Once departments have a higher percentage of women, they may become more likely to be able to maintain it without special programs and extra concerted effort (Cohoon, 2001).

2.2.3 Personal Characteristics

This category deals with those characteristics that are thought to be of the students themselves. Specifically it concentrates on characteristics that are often different between men and women when they are students. These characteristics, again, are not necessarily present in every student. They are generalizations made by averaging over many students and noticing that there is often a difference in the average when comparing the characteristics of the men and the women. This individual difference would not necessarily be a problem except that almost every characteristic evaluated puts the women at a disadvantage in the study of computer science when compared to the men in the same field.

The first and most often evaluated characteristic is the confidence the students have either in their ability to learn computer science or in themselves (Adams, et al, 2005; Bernstein, 1991; Beyer, et al, 2003; Gurer, et al, 2002). It has been well documented that women entering a Computer Science program often consider themselves to be less prepared than their male counterparts (Fisher, et al, 1997; Leever, et al, 2002; Margolis & Fisher, 2002). A survey conducted at MIT found that 35% of male undergraduates agreed with this statement while 65% of females agreed with it" (Adams, Jensen, Lester, Olson, & Tennant, 2005, p. 78). This lack of self-confidence is not unique to undergraduate students. Girls seem to lack self-confidence (as self reported) through all of the stages of the pipeline (Gurer, et al., 2002), they seem to lose confidence as they proceed through the pipeline (Hathaway, Sharp, & Davis, 2001), although they possibly recover self-confidence by the end of their bachelors degree program (Fisher, Margolis, & Miller, 1997).

> Female first year students [at CMU] report themselves as being significantly lower in computer experience, preparedness for their computer science courses, and ability to master the course material than males. In contrast, in response to a first semester survey, the male' stated confidence is quite high. For example, 53% of the men rated themselves as highly prepared. 50% of the men reported themselves as having an expert level of at least one programming languages prior to CMU, whereas none of the women reported themselves as having expert level of knowledge of a language. … In our first-year interviews, female students commonly refer to how much more other students (males) know, and question whether they belong. (Fisher, Margolis, & Miller, 1997, p. 107)

These studies usually find that when comparing confidence level, even when using other factors to control for the actual ability, the girls tend to more harshly rate their own abilities. In the study by Beyer, Rynes, Chevez, Hay and Perault (2003) the findings were extreme. "Men had more confidence in using computers than did women even when statistically controlling quantitative ability. In fact, female CS students had less confidence than did male non-majors" (Beyer, Rynes, Chevez, Hay, & Perrault, 2003, p. 49). Several studies did find that there does appear to be a background difference upon entering an undergraduate program between men and women when comparing the level of preparedness when it is defined as previous programming experience (Fisher, Margolis, & Miller, 1997; Gurer, et al., 2002; Leeve, Dunigan, & Turner, 2002), however this background difference does not necessarily lead to better outcomes in college (Margolis & Fisher, 2002). Girls tend to lose confidence soon after starting a computer science program because they feel that the others (usually referring to the men in the class) all know more (Leeve, Dunigan, & Turner, 2002; Margolis & Fisher, 2002). The actual background difference also does not account for the extreme difference in

computer self-efficacy which is defined as "the feeling that one is in control and can make a difference in the operation of the machine" (Bernstein, 1991, p. 57).

> There is a gap between women's perceived ability and their actual performance. Despite their modest estimates of their own standing in the class, three out of the seven first year students made the Dean's List (which turned out to be the top third of the class) in the first semester, and six of the seven women made B or A average for their first year [at CMU]. (Fisher, Margolis, & Miller, 1997, p. 107)

One thing that may cause the lower levels of self-confidence is the related issue that women seem to judge their accomplishments harsher than men do (Adams, Jensen, Lester, Olson, & Tennant, 2005) and men seem to be better at 'posturing'[7] (Margolis & Fisher, 2002). Men tend to give themselves more credit for their own accomplishments and to view those accomplishments as larger than they really are (Gurer & Camp, 2002). When the others believe the inflated posture of the one and have a lack of self-confidence in their own abilities, that one person is allowed to make decisions and control things in such a way that the "expert" perception is maintained. This is especially harmful to the people who could have been considered the expert if different choices had been made. With those other choices the design and implementation processes could have highlighted their abilities instead and therefore built-up their self-confidence instead of further diminishing it.

This increased level of preparedness can be somewhat explained by how and with what purpose young people often are attracted to computers. Men tend to like computers immediately while women tend to have an attraction that grows over time (Fisher, Margolis, & Miller, 1997; Margolis & Fisher, 2002). This difference means that women,

[7] Posturing is the action of pretending to know more than is actual in order to be seen as the expert or to be accepted as better than the others.

even after they are introduced to computers, and have it available, do not tend to start significantly using it immediately. Boys seem to jump into a new situation and explore while girls more often wait for direction and/or permission (Fisher, Margolis, & Miller, 1997; Gurer & Camp, 2002; Leeve, Dunigan, & Turner, 2002; Margolis & Fisher, 2002). This could be a result of early socialization because girls at a early age are "constantly hearing words of caution from their fathers and other adults" (Leeve, Dunigan, & Turner, 2002). Even when both girls and boys are interested in the computer, they tend to be interested in different things about it. Women emphasize applying the computer to some task while men want to develop a mastery over the machine (Margolis & Fisher, 2002). "The fun for the male students is not only in using the computer but in knowing it and having it do what you want" (Margolis & Fisher, 2002, p. 17). The combination of these characteristics allows the boys to monopolize the computer time and gain experience and therefore gain confidence in their ability to use the machine. This confidence is further enhanced by an acceptance of the "geek" mentality which allows them to concentrate on the computer ignoring other things and gaining even more experience.

The fact that women are much more likely to have multiple interests and reject the geek mentality (Adams, Jensen, Lester, Olson, & Tennant, 2005), allows them fewer opportunities to gain experience and therefore they are less likely to develop the same high level of confidence as the men in their classes. As students gain more confidence, their attitudes toward computing also improve. "Boys tend to have a more positive attitude toward computers" (Gurer & Camp, 2002).

This positive attitude towards computers in addition to their positive attitude of their own ability to control it leads to a serious difference between the genders (Beyer,

Rynes, Perrault, Hay, & Haller, 2003; Binkerd & Moore, 2002; Adams, Jensen, Lester, Olson, & Tennant, 2005). Here the positive attitude is defined as toward the computer itself rather than to the societal improvements it could be used to make. Women tend to have a more positive attitude toward the computer when they are discussing it in terms of society and the personal applications rather than for the sake of the computer itself. Women do not tend to get as excited about the new technology that was just released, however they do get excited about different ways to apply the computer in real life situations. When discussing motivation for studying computer science, men are quite likely to indicate their "love of the machine" while women more often have a societal or financial motivation (Margolis & Fisher, 2002).

The culture often present among the personalities of many peers in computer science is another reason men are often more comfortable in the environment than women are. Several aspects typically present in computer science classes, not as prevalent in other disciplines, do not match with the traditionally feminine ways of learning.

One aspect is competition. Computer science programs are often fairly competitive. Being able to show that you know more than another student gives you an advantage. The departments tend to build an informal hierarchy – ways of ranking and comparing students – that encourages competition (Barker, Garvin-Doxas, & Jackson, 2002). Many of the students who are attracted to computer science desire this competitive environment, however it is not typically a feminine characteristic. Women tend to feel more comfortable in a more cooperative environment (Binkerd & Moore, 2002). This cooperative environment would allow collaboration and team building

activities where all members of the team benefit from the effort (Gurer & Camp, 2002). The competition aspect also makes the environment more impersonal. It is more difficult for the women to build a support network where they can be comfortable if the emphasis is on competition rather than cooperation and support because other member of the class are guarded and concentrating on "jockeying for superior status" (Barker, Garvin-Doxas, & Jackson, 2002). This works against attracting and retaining any of the underrepresented populations.

Another characteristic of many men who are computer science majors which causes the environment to be a mismatch for women is what DePalma (2001) calls the "indeterminate feel." A lot of the software that has been designed is so large that we use "10% of the features 90% of the time" (DePalma, 2001, p. 28). Men in general prefer the new, bigger, more exciting features even if they do not need them. Since the manuals are not a primary focus for most computer scientists, they are often insufficient or nonexistent. This choice leads to the outcome that those who are to be really successful – to be experts – must spend a significant amount of time figuring it out. Less emphasis on the gadgetry and more on the pure logic and application may lead to a more comfortable environment for women.

> There is a mismatch between women's ways of knowing and learning and the academic environments of science and engineering. An environment that rewards competition, weeding out, individual achievement, and autonomous work within academic settings may not be the best environment for women to excel. (Hathaway, Sharp, & Davis, 2001, p. 107)

2.2.4 Summary of Characteristics

All of these levels of characteristics contain elements that hinder the improvement of the gender parity in computer science education. They cause some women to lose

interest early in computer science and others to be lost along the pipeline (Gurer & Camp, 2002). The negative trend continues through all stages of the education process because "middle and high schools do a bad job of interesting girls in computing" (Borg, 2002, p. 13). The situation is not improved after that because colleges also do a bad job of showing them that computer science is more than programming – and women non-CS majors "describe their fear, dislike, intense anxiety, disinterest in programming" (Fisher, Margolis, & Miller, 1997, p. 109) as reasons to avoid the computer science major.

2.3 Models of Retention

People have developed many different models and theories in the literature that attempt to explain retention of students in the education process. Many of these models can help explain the lack of persistence of women in the computer science education pipeline. Most of these models of retention were designed to explain retention to either the university or the educational system as a whole. For this study, these models will be applied more narrowly to explain the retention of a select population in a specific area of study. Many women who leave computer science often continue in the university by transferring to another field; this means that they are retained in the university system, however, that process fails to retain them to the field of computer science. Although the Computer Science Department has a difficult time retaining majors, women in general are more likely to be retained in the university system until graduation (Binkerd & Moore, 2002).

2.3.1 Tinto

The oldest of the retention theories is Tinto's Theory of Student Departure. The first version of this theory was developed in 1973; however, it was revised to answer

some of the critiques in 1987. The original version was based partially on Durkheim's theory of suicide with the idea that the student who departs from the educational process is making a decision of non-participation in education similar to the person who makes the decision to commit suicide decides to no longer participate in life. There are actually 13 attributes Tinto cited as predictive of student departure; the main characteristics that prevent a student's departure from the educational process are academic and social integration into their educational environment. The students depart (or fail to be retained) if they are unable to successfully integrate both academically and socially. The academic integration can be facilitated by successful faculty/student interactions or by successful student/student interactions that center around the academic growth of the student. The social integration is fostered by the less formal interactions – the social aspects of college – which increases their institutional commitment. Tinto studied dropout behaviors and therefore concluded that the inability to integrate properly into the college environment would prevent the student from being able to accept the adjustments required to accept and feel comfortable in the new environment. Failing to adjust causes the student to feel isolated and uncomfortable in their college setting (Tinto, 1998; Braxton, 2002).

With this theory it is easy to see why the women in a college computer science program may be more difficult to retain; it is more difficult because certain environmental factors prevent them from easily in integrating both academically and socially. Since the existence of both of these integrations make it easier to retain and both are more difficult for women, it would follow that it is more difficult to retain women in general.

The academic integration is more difficult because several of the societal and personal characteristics mentioned in the previous section are often associated with women in computer science education. It was mentioned that women often enter college with less experience than the men in the same class. This lack of experience would make it difficult to feel comfortable in class or in discussing the academic questions with the professor. Even when the level of preparation is equivalent, the lack of self-confidence about what they know can also hinder their academic integration. As also noted in the previous section, there seems to be a difference between how professors, both male and female, treat women compared to how they treat the men. Any patronizing actions in class or even showing a lack of respect by asking the women easier questions than they ask the men would lead to a difficult academic relationship.

The social integration would also be more difficult due to a different set of characteristics already mentioned. A primary reason would be the lack of women to identify with. Since there is a lack of women in the faculty and in the student body, the women would have a more difficult time having a social relationship within their colleagues in the major. In engineering and the lab sciences there is a higher level of friendships formed within the major – rather than forming friendships outside of the major (Margolis & Fisher, 2002). This is because of the level of working together and the number of hours spent in the labs. The women would be less likely to form these within-major friendships because, as stated above, women more often have a wider variety of outside interests. They would see the men around them forming these close friendships, and it would make them feel even more isolated. This would prevent them from ever feeling socially integrated into that department.

2.3.2 Astin

Astin developed the I-E-O model, stands for Input – Environment – Output, which was then used to test his theory of involvement. The I-E-O model is based on how variables of the input and the variables of the environment interact to determine the output. The question is how well the input characteristics of the student align with the characteristics of the environment to produce the desired output. The students must select a university where they can become involved, one that has the proper environment for their input characteristics. The involvement must take into account all aspects of the student's university life: academics, faculty and peers.

Applying the I-E-O model and the theory of involvement to women entering computer science programs on our university campuses is relatively straightforward. Since women do not always have the same background and since the computer science environment is mostly fashioned by male faculty members to match the male learning models, it is more difficult for a woman to have a successful outcome and graduate from the university by remaining a computer science major.

2.3.3 Rendon

Rendon created an alternative as a reaction to specific contested points with from Tinto's theory. Specifically Rendon questioned the application to other populations of students. Tinto's model was not created using minority populations or comparing how their transition to college experience could be different. Rendon believed the term *membership* in the college environment was more descriptive than the term *integration* used by Tinto. The major distinction is that *membership* does not require a severing of

past connections while *integration* does have that implication. The first year was found to be the most critical in assuring the successful completion of the college degree. The minority students were found to need sufficient orientation and validation both in and outside of class (Braxton, 2002).

The research with women in college computer science programs has also shown that the first year is the most important. The confidence that can be gained that first academic year and the relationships that are built during that time will make significant contributions to her completing the degree in computer science.

2.3.4 Bean

Bean's Student Departure Model is based on the concept that student departure from college can be compared to employee turnover in a business. Students weigh the pros and cons – the amount of reward they are getting to the amount of work they are putting in to determine if continuing on that path is worthwhile. This theory is more based on organizational processes than on the personal characteristics and environment. This model also included external factors that affect student attrition. These factors can shape a student's attitude toward persisting – their intention and commitment to completing the program can be influenced by many internal and external factors (Braxton, 2002).

The decision comparing the benefits to the work expected is undeniably present in the literature of women in computer science. As mentioned above, many women state the amount of time the computer science work is taking is not worth the reward of a computer science degree. Since some women are not in computer science because of the love of learning about the computer for its own sake, changing to another major can

easily be compared to changing to another job that may be more or at least as fulfilling. These options and other interests cause women to question why she should work her "butt off for 4 years – [when there are] so many people it comes naturally to" (Margolis & Fisher, 2002, p. 106).

2.3.5 Pascarella & Terenzini

Pascarella and Terenzini's theory emphasizes that the student must develop sufficient interactions and prevent isolation within the institution in order to persist. The interaction must be student-to-student and faculty-to-student, and it must be on the academic level, however it also must go beyond the formal and expected level of interaction (Pascarella & Terenzini, 2005).

This theory fits well with the departure of women from computer science. Several times in the previous section the isolation aspects of a woman's existence in the college computer science environment was emphasized. Because there is a lack of women to identify with, the women who are in computer science feel isolated and unable to fit correctly as they seem to be expected to do. This lack of relationship to the other people and to the material being taught causes feelings of isolation and ultimately departure.

2.3.6 Implications

With many different attempts to explain the lack of women in computer science, a wide variety of variables exist that have been considered as at least partially explanatory. More research needs to be done with less aggregated data. We need to determine which of the variables are significant to which women and in which environment if we hope to be able to reduce the trend.

Many of writers feel strongly about the fact that we need to understand the reasons behind the underrepresentation. The sentiments about the importance of this issue are summarized nicely in the following quote by Borg (2002): "Unless the systems that women come into have changed, the pipe will still leak. If women are not in an environment in which their own style of genius and contribution can be recognized, they will not thrive and may not stay" (p. 14).

Chapter 3. Data Collection and Review Processes

3.1 Introduction

The review of the literature indicates that the underrepresentation of women in computer science worldwide is significant and that serious cultural obstacles exist in education for women especially in underdeveloped Muslim countries. Since this study explores the interaction of these problem areas in an attempt to explain how these issues affect the computer science education for women in Afghanistan, several types of data were gathered from the students of the Computer Science Department at Kabul University in Afghanistan.

The research was conducted in three stages, as described below, with each segment clarifying the questions for the following stage. The clarification at each stage was partially necessary due to communication challenges and cultural differences between the researcher's home and the research site. The clarifications made at each stage helped to ensure that the questions were understood with the meaning intended and that they could be answered in a specific enough manner to be useful to the investigation. The multiple stages also allowed for the data analysis from each stage to support or refute the findings of the other stages – to triangulate the results. In addition to finding the numbers around gender representation of computer science in Afghanistan, my goal was to "engage in research that probes for deeper understanding rather than examining surface features" (Johnson, 1995, p. 4). To understand the factors that contribute to these

numbers is important because such a wide variety of factors exist that influence those numbers and all of these factors interact in ways that are not fully understood.

3.2 Research Site

This study took place within the Department of Computer Science at Kabul University in Afghanistan during the 2006 and 2007 academic years[8]. The Computer Science Department was at that time a department within The Kabul University Faculty of Science[9]. Since that time, the department has been upgraded to become the Faculty of Computer Science containing three separate departments. This transition was approved by the president of the university in October of 2005 and by the Ministry of Higher Education of Afghanistan in January of 2009, although the actual implementation did not take place until March of 2009, after the data for this study was collected.

3.2.1 Introduction to Kabul University

Kabul University (KU) is located in Kabul, the capital city of Afghanistan. The university was founded in the 1930s, and it has been continually operating, in some form, since that time. It was severely damaged by the three decades of political instability between 1979 and the present time. While it has been operating in this time, it has not been at full capacity or with the desired quality of education. This instability started with the Soviet invasion, followed by the Mujahideen revolution and then by the years of Taliban control. Insecurity and instability, as it affects higher education in Kabul, continues. From the period of the invasion by the Soviet Union through the Taliban regime, the university lost many of its faculty and had little contact with universities in

[8] Academic years at Kabul University run from March to December with the long break through the winter months when travel and heating the buildings are more difficult.
[9] The "Faculty of Science" corresponds to what schools in the US would refer to as the "College of Science" - one unit in a larger university headed by a dean. The faculty is then further divided up into departments of related subjects.

other countries. Currently many aid programs are in place attempting to rectify these deficiencies. Women's education at the university was especially hard hit during the Taliban regime when women were not allowed to attend school or to teach at any level.

These lost years of development were particularly difficult for the technological fields such as computer science that were evolving at an accelerated rate in other parts of the world at the end of the twentieth century. Worldwide, the various fields of computer studies as well as computer science education changed significantly during that period; however, in Afghanistan there was little opportunity for collaboration with other universities or for any technological development.

Because of these lost years, I have been working since October 2005, with the professors of computer science at Kabul University to develop curriculum and to improve their content area knowledge and formal qualifications. Within the same program, several partnerships have been created between KU and universities external to Afghanistan to help rebuild the system of higher education in Afghanistan. This series of alliances is supported by a grant from the United States Agency for International Development (USAID) and is managed through The Center to Bridge the Digital Divide located at Washington State University.

With the help of this outside support, the university is rebuilding its faculty member qualifications and the student registration levels are steadily rising. The number of students able to attend the university has been increasing each year and has recently surpassed its pre-war levels. Due to the inequity in the quality of elementary and secondary education throughout Afghanistan, most students attending Kabul University come from Kabul or from the larger cities of Afghanistan and many of the students are

expatriates who have recently returned to Afghanistan after schooling in another country (usually either Iran or Pakistan).

3.2.2 Student Admission Process

Students are selected to attend the university based on the score from one exam taken as they finish secondary school[10]. This exam is called the Kankoor. If they are selected for attendance at the university, their study is completely financed by the state while they finish their bachelor's degree. Based on this score, it is also decided at which university they will be enrolled and in which faculty (college) within the university they are to study. Students with the highest score on the placement exam receive their first choice of university and faculty. For those with lower scores, if their first choice is filled, they will receive their next available choice.

All of the students assigned to a given university and assigned in a specific faculty have exactly the same courses during that first year of study. Their scores on exams from the first year courses determine which department, within that faculty, will be their major for the remaining three years of bachelor's degree studies. Students with the highest score receive their first choice of department. Students progress through the four years of study as a cohort with all of the students taking exactly the same classes in exactly the same order. Some possibility of changing to a different faculty or department exists after these assignments are made; however, changing is extremely rare.

In the 2007 school year, there were approximately 7,000 students attending Kabul University with 21% of them female (Saay, 2006). At that time, the Computer Science Department had approximately 240 students in years 2, 3 and 4 where just over one third

[10] Secondary schools correspond to "high schools" in the US. Students usually start in the secondary schools around age 13 or 14, attend 3 or 4 years, and finish around age 17 or 18.

of them were women. The year 1 students are part of the Faculty of Science except they are not yet assigned to any specific department and, therefore, cannot be counted as part of the Computer Science Department. These statistics show that the Computer Science Department actually has a higher percentage of female students than does the university population in general. From the literature review section, it is obvious that this phenomenon is rare and would not be expected in a Muslim country where the education of women was banned for several years.

3.2.3 Visiting Kabul University

When I first visited Kabul University in the fall of 2005, I immediately noticed the number of women taking classes in the Computer Science Department. When I first went into the computer laboratories, every computer was occupied and in some cases, the only students in the room were women. When I talked to the students, I found that they were all working on group projects for the same programming class. I have been teaching computer science in the US for more than 20 years, and have never seen more than a handful of women as students in any class; seeing that number of women all working on projects from the same computer science class was quite amazing.

This relative percentage of women who are students in computer science at Kabul University made it an interesting anomaly to study. I assumed there would be differences in the characteristics of the students and their perceptions of computer science if these were compared with those reported by studies from other countries. As discussed in depth in Section 2.2, many variables expressed in the theories have been developed which attempt to explain the lack of representation of women in computer science that are different in Afghanistan when compared to the countries where those theories were

developed. My goal was to collect data to determine the students' perception of computer science, analyze how these compare to the perceptions identified for other countries in the literature and ascertain what effect those perceptions have on the attraction of women to computer science in Afghanistan.

3.3 Research Design and Data Collection

3.3.1 Overview

This study utilized a combination of quantitative and qualitative methodologies in an attempt to answer the questions stated above. Because of the use of multiple methods, the research was conducted in three stages with each step providing clarification and refinement for the stages that followed. Multiple methods of inquiry were used to achieve a deeper understanding as well as to allow the findings of each stage to support or contradict the findings of the others. The three stages included data collected by large informal focus groups, written questionnaire style surveys and individual interviews. The focus groups were used in order to get a general understanding of the issues in question. The written survey consisted of 32 questions emphasizing the issues illuminated by the focus groups and was used in order to get a collection of data from a much larger population. The individual interviews were conducted with a selection of Kabul University's fourth year computer science students to achieve a deeper understanding about some of the topics that arose from the focus group and survey answers.

3.3.2 Focus Groups

A focus group data collection method was chosen as the first level because it was important to make sure the questions on the survey covered all of the material that would be relevant and that the questions could be asked in such a way that they could be

understood. This is the purpose of a focus group when used in the design of a survey as stated by Morgan(1997):

> There are three basic ways that focus groups can contribute to the creation of survey items: (a) by capturing all the domains that need to be measured in the survey, (b) by determining the dimensions that make up each of these domains, and (c) by providing item wordings that effectively convey the researcher's intent to the survey respondent. (p. 25)

The focus groups were conducted in an informal setting and included an open discussion allowing the female computer science students to express their thoughts about studying at the university and about computer science as a field. An invitation was spread around the campus by word of mouth to let the female computer science majors of Kabul University know they were invited to meet with the researcher for discussion, tea and cookies. The meetings were held in the library conference room of the Faculty of Science building at Kabul University while the researcher was in residence working with their professors on a separate curriculum design project. The invitation was made before the start of classes in the spring of 2006, and the invitation was extended to all women who would be majoring in computer science in the upcoming year. (The academic year at Kabul University begins in the middle of March and goes until December.) The groups were self-selected from the population of all women in the Computer Science Department, and there was no necessary connection between participation in this informal gathering and the participation in the other portions of the study.

Two focus groups were formed; one met on each of two consecutive days. The first day was primarily made of women from the third and fourth year classes while the second day primarily consisted of those from the second year class (those who would be starting as computer science majors the following week). Because some of the students

are not as comfortable expressing themselves verbally in English, one former student who was proficient in English acted as a translator from Dari to English. No English to Dari translation was needed because all of the students understood the researcher's English speech quite well.

The women were introduced to the researcher and the topic of research in such a way as to make them comfortable having an open, unstructured conversation. The students talked about general demographic issues such as the history of their education, the structure of their families, and their current educational status. They also discussed their goals in computer science and their perceptions of computer science as a field of study and as an area of employment in Afghanistan. The discussion was open to anyone interested in telling the researcher and the others present about their own situation or their own opinions. A prepared list of questions was followed, although the topics drifted based on interest of those present and due to the casual conversation structure – the researcher referred to the list of questions only a couple of times when it was necessary in order to continue the conversation and to guide it toward different topics when conversation lagged.

Many of the women who attended knew one another; however, most had not previously met the researcher. They knew of the researcher as a computer science faculty member from a university in the US who had been working with and teaching their professors for the previous six months through several visits to Kabul University. Some of them mentioned their interest in attending in order to meet the first computer science teacher who is a woman they had ever seen. None of the professors (who were all men) and none of the male students or staff were in the room at the time of the focus groups

because their presence may have influenced what the participants were comfortable discussing.

The data collected from this stage cannot be identified with any individual students. Notes were taken at the meetings in order to identify generalizations of student perceptions as well as terminology/cultural differences that would need to be taken into account during the later stages. The primary purpose of the focus groups was to guide the content and the wording of the questions for the survey and interview stages.

3.3.3 Surveys of all Computer Science Majors

Using questionnaires (also referred to as printed surveys) for data collection is a accepted method to get input from many people in the same time frame. As long as the questions are understood in their written form and there is response from a good cross-section of the population, the survey data can express the views of the population in a reliable way. The questions on the survey were created based on the terminology and list of concerns understood from the focus groups.

The survey (included as Appendix A) asked computer science students, both men and women, a series of 32 questions. The answers on the survey expanded and clarified information gathered from the focus groups and guided the questions for the interviews. The survey took the students approximately 45 minutes to complete, and was administered near the end of their class periods on November 23, 2006. This date was close to the end of the fall semester of the 2006 school year (the end of their school year). The professors at Kabul University agreed to give class time for the survey; therefore the students would have the opportunity to complete it and submit it during the same class period.

A total of 225 surveys were copied and most of those copied were distributed (only a few remained undistributed). In total, 191 surveys were collected from the students at the end of the class periods. Since the students take classes as a cohort, all students of the same class year are in the room at the same time. This ensured that there was no possibility of students receiving the survey in more than one class and that all students who attended class that day did receive a survey. One class for 4th year, one class for 3rd year and one class for 2nd year were chosen in order to give all students the opportunity to complete a survey. The students of the 1st year class were not surveyed because students do not select to become computer science majors until they begin their 2nd year – in the first year they were students in the Faculty of Science though not members of any specific department.

The survey was created with several different kinds of questions. Some were demographic in nature such as the gender of the respondent and the current class level while others more opinion based such as what they believe the current ratio of gender is in the workforce and what their views are concerning gender roles are in their society. Some of the questions were closed or multiple choice in nature such as the number of siblings while others are more open ended such as what they believe to be the obstacles to gender parity in computer science.

The survey questions were selected based on the literature of gender representation in computer science education worldwide, on the literature about women's education in Muslim countries, and on the information gathered at the focus groups. Since no standard survey existed which could be applied to data collection on this issue and since no previous research was available on computer science education in

Afghanistan, these other sources were necessary to guide the questions and the wording of the survey questions. In addition to the examples given above for the effect of the focus groups on the survey, questions were added to the survey to determine if issues that relate to specific theories about the underrepresentation of women in computer science worldwide might also apply to the representation of women in computer science at Kabul University.

The questions on the survey as well as the options for any multiple choice type questions were presented in both English and Dari. The survey was originally written in English; it was translated in order that it could be presented to the students in both English and Dari (the language of instruction at Kabul University). Both the questions on the survey and the directions were translated to Dari by two independent people both of whom speak both English and Dari fluently. Two translators were chosen because the researcher does not read Dari and therefore an outside verification of the accuracy of translation was needed. Students are accustomed to reading textbooks and doing some written work in English except the topics of the survey would include terms and information less familiar in English for many of them, therefore it was translated to minimize misunderstandings and misinterpretation of the questions.

The students were informed as to the purpose of the study and given directions immediately before the survey was administered. They were also informed that their answers on the survey would only be reviewed by the researcher. The survey answers remained completely anonymous including that no one in the room could know which students chose to answer questions and which decided to put the survey form into the box without writing anything on it. The directions were given in both English and Dari to

facilitate further understanding of the purpose of this study and their option of not answering any or all of the questions.

These surveys were administered by a research assistant after the professor of the course left the room. The professor left the room to indicate to the students that he would not know anything about their choice to take the survey or any questions they might ask when taking the survey. Their participation would have no influence on their computer science courses. The students slipped the completed surveys into a slot at the top of a sealed box as they finished and then left the room. After all surveys were completed, the box was delivered to the researcher. This seal was necessary to assure the students that their answers would not be reviewed by anyone at Kabul University. The answers were read and analyzed by the researcher after the completed surveys reached the US.

The survey was distributed to everyone in attendance at those classes on that day, however if a student selected not to participate, their survey would either not be turned in or be turned in empty into the box. None of the submitted surveys was completely blank. Several had a selection of questions that were not answered, nevertheless all submitted surveys had at least some of the questions answered. Some of the open-ended questions were answered in English and others in Dari. The Dari answers were translated to English by two bilingual Dari/English speakers in the U.S. before the analysis of those began.

3.3.4 Interviews with computer science students

The limitation with the survey questionnaire format for data collection is the restriction on that it is impossible to ask a follow up question on the answers given. In order to fully understand some of the information of the survey, the interviews were

conducted. The benefit of a semi-structured interview is that the list of questions is there to guide the discussion preventing the collection of data that cannot be compared, but because the interviewer does not need only to follow that list of questions, the interview structure allows for follow-up on questions. These additional questions were are used to fully understand and answer given and to tie it to other answers already given in this interview.

The third stage of data collection was semi-structured individual interviews with a set of 4th year students who were majoring in computer science at Kabul University. These interviews were conducted in English, however a Kabul University staff member who is fluent in both English and Dari was available if translation would be needed. These interviews provided information that led to a deeper understanding about the perceptions these students have regarding the benefits and obstacles to studying computer science in Afghanistan.

The survey had been given to students in all three classes, and the original idea for the interviews was to interview students from all three classes. This plan changed due to the answers received on the surveys. Some of the answers in the survey showed that questions such as plans for their future entrance into the workforce could best be answered by students who were further along in their computer science studies. The survey showed that students who were not yet in their last year had an incredibly different understanding of computer science as a field than those who were in their last year. The choice to do this purposeful sampling was based on the facts that in qualitative research "data gathering and sampling are guided by the goal of maximizing

opportunities to uncover data relevant to the purpose of the study and that the sampling process interacts with data analysis" (Jones, Torres, & Arminio, 2006).

To find students for the interview stage, the researcher advertised around the Computer Science Department building with an open call. Approximately three weeks prior to the interviews, flyers were posted at Kabul University's faculty of science classroom building asking 4th year computer science students to become interview volunteers. Those interested contacted the researcher through an email address; they were then contacted electronically to set up an appointment time. At that time, they were given further details about the purpose of the interviews and some representative questions to help them be more comfortable with the process. The specific opinion type questions were not included in the email to prevent the students from discussing answers with each other before the time of the interview. All students who volunteered were interviewed; no second call or additional interview times were required.

Consent forms were collected at the time of the interview with consent for video/audio recording included on that same form. Only one student specified an unwillingness to be recorded therefore handwritten notes were taken during that one interview. The other interviews were recorded; audio and video of both parties were saved electronically for later review and transcription.

The researcher made the necessary arrangements for the interview stage of data collection while in Afghanistan in March of 2007, however because of difficult travel to Afghanistan in the summer of 2007, the interviews were conducted using video conferencing technology rather than face-to-face. The researcher chose to use SightSpeed as the video conferencing software because it often facilitates clear two-way

video connections between the U.S. and Afghanistan and it has an integrated recording mechanism that could be setup without any modifications needed by the person being interviewed. SightSpeed is a point-to-point video conferencing software installed on microcomputers at each site and does not go through a central server during the conversation. The hardware needed for the video conferencing was left in Kabul during the March 2007 visit to be used for the project with the Kabul University professors.

The questions for the interview phase are included in Appendix C. The general topics were strongly influenced by the results of the focus groups, the results of the survey results and the literature on related topics. There were 22 interviews conducted over a one-week period of time that included 10 men and 12 women as participants.

Because the students and the room with the best internet connection were both not available at other times, the interviews were conducted in the early afternoon hours in Afghanistan. The time difference to Maryland meant that the interviews were conducted between 3:30am and 6:30am EDT time. Several interviews were conducted on several successive days in June of 2007 with the length of time and the number of interviews each day was based on the availability of the researcher and the students.

3.4 Data Analysis Process

3.4.1 Overview

The data analysis was done after each stage of the data collection as well as continually within the process. This constant interaction with the data allowed the stages to influence the questions and sub-questions for the stages that followed, and it allowed new themes and issues to explore further to become apparent based on the data that had been collected at that time. The process of data analysis was taken from the structure

imposed in a grounded theory study and the multiple stags of data collection allowed triangulation of the findings.

As a general description of the process, the data analysis was done by taking notes (memos) during the stage, reading over the data to get general ideas, breaking down the data into portions to find commonalities from different students, and then by putting those common features into larger common themes to find the relationships between them. This process of allowing the commonalities in statements by different students to determine the overall themes was done independently for each of the stages.

There is no theory to explain why a country with so many factors against gender parity in computer science would have a higher percentage of women in computer science than it has in the university as a whole. As expounded in 2.2, several theories have been created that attempt to explain why other countries, such as the US, have women going into computer science at a much lower rate than they are going into the university. To allow the themes to emerge from the data, the data was processed according to the method of coding associated with grounded theory. Since there are no theories to explain the unexpectedly higher than normal representation of women in computer science, the basic issues that emerge in the literature of underrepresentation was used as a loose guide of where to begin investigation in looking for explanation of the representation in Afghanistan.

The coding process described in the data analysis phase of grounded theory is quite specific and fit well with the data collected and the goals of the study. In the discussion of grounded theory, Creswell (1998) says, “despite the evolving, inductive nature of this form of inquiry, the researcher must recognize that this is a systemic

approach to research with specific steps in data analysis" (p. 58). This data analysis process begins with *open coding* which involves reading over the data several times determining categories and saturating them with memos and quotes from the data, these categories are then rearranged to find connections and relationships around a central category in *axial coding*, and the categories are sequenced in order to form the narrative in *selective coding*. The emphasis is that the categories being organized should be grounded in the data collected and not in the preexisting theories and literature around the phenomenon.

In the process of open coding, the data is read repeatedly with the purpose of allowing the categories (or codes) to emerge. These categories often contain sub-categorical properties that emerge as more data is added to the category. While the interviews were guided by a list of questions, the interview data collected was not a sequential list of questions and their corresponding answers as the survey data had been. Several times the data was enriched by the student either expanding on an answer beyond what was expected or answering a completely different question. Because of the unpredictability of the responses during the interviews, many of the statements made by students were inserted into several categories because they gave insight into more than one label. Because new codes were being created, a list was maintained containing descriptions of what was intended by each code name. Without this mapping, a label might have changed meaning during the open coding process.

The process of axial coding, as defined for grounded theory data analysis, involves going through the categories and finding relationships between them. Borgatti gives a suggested "basic frame of generic relationships" (2006, p. 3). Almost all of the

categories developed fit into just a few elements of the frame. As the categories were rearranged into these sets of interrelated items, some categories were combined and others separated to allow all categories to fit together in one logical and comprehensive structure.

Selective coding is defined as going through the categories to find one central category and arranging the other categories around that theme based on their causal or contextual relationships. With the data collected for this study, no single center to the categories emerged. There were several centers and the others arranged around those centers. This seemed appropriate for data consisting of many different issues and topics discussed.

3.4.2 Data Analysis of Focus Groups

Since the purpose of this stage of data collection was to determine the parameters for the following stages, the areas of exploration were more pre-defined, based more on the related literature than they were for the following stages. Before inviting students to the focus group for discussion, the goal was set to find out three different types of information from the women who chose to meet. The first was what terminology and cultural differences would necessarily influence the content and the methods for the following stages. The second was the view of the women on the general concept of gender representation. The last was any interesting topics brought up by the students that would need to be explored further in the remaining stages.

During the focus groups, notes were taken about what was said and about body language and lack of discussion on certain topics. In order to make sure the notes were complete and accurate and the discussion was kept interesting and lively, a research

assistant, who was also acting as a translator, took notes to complement my own. Immediately after each focus group session, notes were written by both note takers concerning the general impressions and highlighted topics. After the impressions were recorded individually, the two sets of notes were merged. The notes from the focus groups included no way to identify the individuals who had participated and had few statements that were recorded verbatim. The notes included what topics had been discussed and summaries of what had been said on each topic.

Through the focus groups, things were understood about the women such as what topics would be culturally acceptable to put on the survey and the wording for questions that would more naturally correspond to their way of thinking about the issues. Each of the focus groups had between 25 and 35 girls in attendance with only the student who was acting as a translator/note taker overlapping the two groups.

There were several other minor things learned from the focus groups that made the surveys and interviews match their culture. These mainly dealt with the terminology and details of conditions of studying computer science in Afghanistan.

3.4.3 Data Analysis of Surveys

The surveys arrived back in Maryland during February of 2007, and analysis of that data began shortly after their arrival. First, questions were selected that could be analyzed by a discrete numerical scale. These were entered then into a spreadsheet, and basic statistical analysis of those answers was done; this began the process of looking for patterns and themes. Each completed survey was given a number in order that there could be correspondence between the respondent number and the line of the spreadsheet (1-191).

The survey items that were entered into the spreadsheet included the following items (see Appendix A): 1, 2, 3, 4, 5, 7, 8, 9, 19, 20, 21a, 21b, 22, 23, 24, 25, 26. Some items on individual survey paper were left blank. If the item was left blank on the survey, it was put into the spreadsheet as a blank cell. Item #1 asked the gender of the respondent and was entered into the spreadsheet as 1 for male or 2 for female. Item #2 asked for the class year at the university and was entered into the spreadsheet as 2, 3 or 4. The other questions in this list were also ones that had a small set of possible answers and therefore these were processed in a similar way.

There were some decisions made along the way about how best to represent the responses in a numerical form. One of these included the question about parental employment. Question number 6 on the survey asked about the father's employment, and question number 7 asked about the mother's employment. In Afghanistan a low percentage of the mothers of college age students are employed, nonetheless in the focus groups, it was made clear that many of their mothers do work outside the home. The question of father's employment had many answers and could not easily be recorded numerically; conversely, for mother's employment, there were three common answers and only a few that were outside of that set. Therefore for mother's employment, a 1 was entered into the spreadsheet if the student indicated that the mother did not work outside the home; a 2 was entered if the mother worked in education (usually a teacher though the specifics of the employment were not always stated); and a 3 was entered if the student indicated that the mother worked outside the home in some other field besides education.

Some answers required normalizing before they could be entered into the spreadsheet for comparison. One example of this was the number 21, which asks what year the family first acquired a computer in their home. Some students answered using the Gregorian calendar year, other students used the Solar Hejri (or Persian Calendar year). The Solar Hejri year number is 621 or 622 less than the corresponding Gregorian year number (622 is the difference from January 1 to March 20, and 621 is the difference March 21 to December 31). The Persian Calendar is distinct from the Muslim Calendar, which in 2008 was 279 years less than the Gregorian. In the year the data was collected, 2007 [Gregorian], the Persian Calendar began its year 1386 and the Muslim Calendar began its year 1428. Because of the large difference in the numbers, the calendar used could be determined easily because the possible range of the numbers was different for each calendar. In order to normalize to the Gregorian Calendar, the correct amount was added when a different calendar date was used. Because the Persian Calendar begins its year in March of the Gregorian Calendar year, 622 was used for conversion from Persian to Gregorian to obtain an estimate of when that family first owned a computer.

For the questions that required a more open-ended answer, a list of all answers was constructed for each question. As the list was constructed, the answers were typed in such a way as to order them and to put answers that were similar together.

For example when processing the question about computer skills obtained before attending the university, answers included things like none, operating systems, office applications, and programming. These were expressed in many different ways - for example those with office applications some said MS-Office, others listed the specific applications within the office suite, and others described projects they had done with

those applications. I typed all similar answers into the same area of the list marking them with the survey number for later reference back to the papers.

These categorizations of answers were then reviewed both for quantity of a given type of answer and for interesting details expressed by any individual student. The open-ended questions were left blank more often than the multiple choice type questions. If they were blank or unreadable, they were omitted from the analysis.

3.4.4 Data Analysis of Interviews

After the interviews were completed, the analysis was done in several phases. They were first transcribed giving each an anonymous identification number. Then the answers were coded into categories by several different passes over the data.

In order to transcribe the recordings of the interviews, each interview was reviewed several times. The multiple passes were done for several reasons. The main reason was to make sure the transcription matched exactly what was said. This was difficult at times both because the recording quality of some interviews was not as clear as the original electronic connection had sounded and because the structure of the sentences was not what would normally be expected. In many cases, the answer to a question was restated by the student either because the researcher asked for clarification during the interview or because the interviewee realized that the first answer was not saying exactly what they wanted to say usually because of their translating to English from Dari. Occasionally the researcher reworded the question during the interview because the question was misunderstood by the interviewee. The transcriptions were completed by January 2008.

During January and February of 2008, the transcripts were color coded in such a way as to find what topics seemed most important to the students. As a starting point, these colors were based on the different categories of questions asked during the interview, soon became apparent that the talk often cycled back to questions that had been asked earlier or to questions that had not been asked. The colors were then organized into more general topic areas. These general topic areas gave a clearer understanding of the important issues and the views of different students on these issues. Because of work and travel commitments over the Spring 2008 semester, these categories were set aside.

During the summer of 2008, the original non-color coded interviews were reviewed again. This time instead of categorizing them within the documents themselves, copy and paste were used to put categories into separate documents. Before doing this, interviewee's code number was appended at the beginning of each line in order to track both which student had given that answer and if that student was male or female. Each interview transcript was reviewed copying lines into separate files based on the specific content. Sometimes the question was copied with the answer in order to keep the answer in the proper context. In addition, lines were occasionally copied into more than one file when they spanned more than one of the content areas. When lines were found that did not match any of the content documents, a new document was made with that new content title to see if any other students made comments related to that content area. Each of the interviews was reviewed multiple times in order to be sure that interviews processed first were not limited into which content areas they would contribute.

This classification of the data into general categories fulfills the open coding of grounded theory data analysis. As the transcripts were reviewed multiple times, the categories were allowed to emerge directly from the data. There were many categories and several data items were put into multiple categories.

Once the review of the interview transcripts was completed, each of the content files was reviewed for patterns and rearranged to reflect that pattern. This process is the axial coding of grounded theory data analysis. When copying originally from the interviews into the content files, the new comments were always pasted at the end of the file where the content matched. Therefore, this second step of coding was to order the comments within each file and combine different content areas. Some content areas that first appeared separate changed; with the comments added to each file, the connections between those previously separated content areas became apparent. This reordering of the content areas and the comments within the content areas allowed the more general themes and relationships between themes to emerge. These content areas are listed in the appendix and the comments contained in each are expanded upon in the results section.

Chapter 4. Results

4.1 Overview

As stated earlier, this research at Kabul University was conducted in three stages: focus groups with the women of Computer Science Department in March of 2006, written surveys given to all computer science students attending class on November 21, 2006, and interviews conducted with volunteer 4th year computer science students in June of 2007. Each stage had results that were by themselves interesting, but these results were also used to influence the next stage of the research in order to gain a deeper understanding of the new questions that became apparent. In this chapter, the findings of each of the three stages are presented. Since the focus groups were informal discussions, the lessons learned there primarily informed what topics were important to this population of students and how questions on the survey would need to be worded to be understood by the students of Kabul University. The 191 surveys collected gave a wide overview of the population. The answers to the short answer questions gave good demographic information about the students and their experiences. The more open-ended questions gave insight but also brought up more questions for the interview stage. The 22 interviews allowed insight into the views of a smaller sample of students, but the interactive nature allowed the researcher to go into more detail on individual responses.

4.2 Focus Group Results

Since the focus groups consisted of informal discussions, some of the topics that arose were planned because they were selected based on the information from the

literature review. However, other topics discussed were ones that, before the discussion started, were not expected to matter to the students or to the investigation. Topics that were planned and expected to be important included pre-college computing experiences, typical daily university schedules and the understanding of computer science as an area of study. Topics that were not expected were family structure and the variety in types of high schools the students had attended. The discussion style of the focus groups allowed for these additional interesting topics to emerge and their influence on the student's choice to study computer science became more obvious as the investigation progressed.

One issue discussed in the focus groups that directly influenced the questions on the survey dealt with the division between the areas of computer science. Based on the current level of technological development in Afghanistan, their definition of the areas of computer science differs greatly from divisions seen at universities in the U.S. Specifically, their definition of computer science is more directly correlated to the jobs available in the workforce. Their division of topics would correspond more closely with the U.S. distinctions between information technology and software engineering[11]. Awareness of the fact that the same term is used in the two countries to mean two different things made it clear that the survey questions would need to be written and the answers understood according to their context. At that time, there were plans to divide the Kabul University Department of Computer Science into a department of networking and a department of programming, so the students understood this division of topics within computer science. This division of computer science into these two major areas of emphasis corresponded to the needs of Afghanistan and was natural in their discussion.

[11] At many US universities, these fields are offered in separate departments, but computer science itself is divided into subfield areas such as computer security, artificial intelligence, and numerical analysis. These distinctions do not relate to the Kabul University student's understanding of computer science.

The students talked about their favorite topics of study and what projects they had enjoyed the most. In answering these questions, the students displayed many of the same biases as found in the literature about women in computer science in other countries. In general, they preferred the artistic and applied areas of computer, they preferred group based projects and they hoped to go into fields of computer that include a higher degree of human interaction such as teaching computing skills or office support for computers.

Something else learned in the focus groups that influenced the questions on the survey dealt with the family background topics. The planned questions for the focus groups did not contain questions about family structure or culture since its planned purpose was to collect information about their computer science education. The conversation during the focus groups flowed naturally to the topic of family, revealing many issues that would likely have influenced their choice of computer science and their future in the workforce. The answers given during the focus groups showed that these students were not a representative cross-section of Afghan society and that the questions about their families needed to be included on the survey to see if the focus group was representative of the students in the department for these characteristics. Through the focus groups, it became clear that the women of Kabul University's Computer Science Department were predominantly from relatively wealthy families that live in the city of Kabul and most had recently returned to Afghanistan from either Iran or Pakistan. The survey was modified to include more demographic information about their families in order to clarify their family background; this allowed a deeper understanding of how it differs from the general information known about Afghan population.

Another major issue understood through the focus groups was the variation of types of schools attended for high school. Most of the participants at the focus groups attended secondary school outside of Afghanistan because of the Taliban's control in Afghanistan at that time. The variety of schools attended and the variety of places they attended schools inclined me to expand those questions on the survey and expand them even further in the interviews. For example, while in Pakistan, some of the participants had attended regular Pakistani state-run schools while others attended Afghan schools constructed in Pakistan. Some of these schools were gender segregated while others were not. The literature review and previous conversations had implied that all secondary schools in Afghanistan (and Pakistan) were gender segregated. It appears that the segregation by gender was somewhat reduced for schools at the secondary level while these students were exiled.

During the focus groups, students discussed the structure of their typical day at the university. Despite the fact that the women's dormitory was recently constructed, most of the women commute to their parents' home rather than living on campus. The classes are mainly held early in the day (completed before 1:30 or 2:00pm), and most of these women are expected to return home early in the afternoon. The expectation is that they are to be home well before the evening meal and definitely before sunset. Since many homes do not have reliable electricity, these restrictions make completing computer assignments more difficult. The professors are aware of these restrictions on travel and consider it when assigning projects.

During the focus groups, the women who attended showed that in some ways, their preferences are consistent with women in computer science in other countries, but

they also showed many significant differences. They are similar in that they tend toward the softer areas of computer science and prefer to work in groups rather than individually or competitively. The family structure with its expectations, previous computing and high school experiences, and their interpretation of the sub-fields of computer science differ significantly from the women summarized in the literature about women in computer science. Understanding these differences before the survey was written allowed the questions of the survey to be worded and the answers to be interpreted correctly for their context.

4.3 Survey Results

The survey as shown in Appendix A was distributed to just under 225 students in November 2006 soon before they completed their school year.[12] There were 225 copies of the survey made, and they were distributed in their classrooms to students as the neared the end of classes for that day. There were 191 surveys returned and analyzed. It is not known exactly how many students attended class that day. The survey was distributed to all 2nd , 3rd and 4th year computer science majors at Kabul University in Afghanistan. Since the students attend classes as a cohort, all students of a given class (corresponding to the year at the university) were scheduled to attend one and only one of the classes chosen for the survey. The incoming students are accepted into the Faculty of Science though not yet members of the Computer Science Department, therefore the 1st year cohort of students were not surveyed.

[12] The school year at Kabul University runs from March at the beginning of their calendar year and runs through December. They have their long break in the winter rather than the summer.

4.3.1 Demographic Information

The first questions on the survey were ways to gather information about the demographics of the students in the group. As for gender on the 191 surveys returned, 111 were men, 75 were women and 6 did not respond to that question. This indicates that around 40 percent of the students in the computer science major courses that day were women.

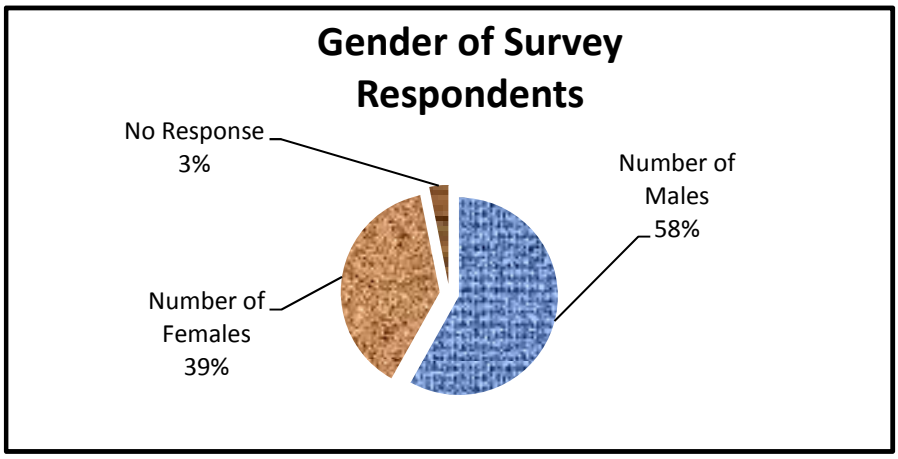


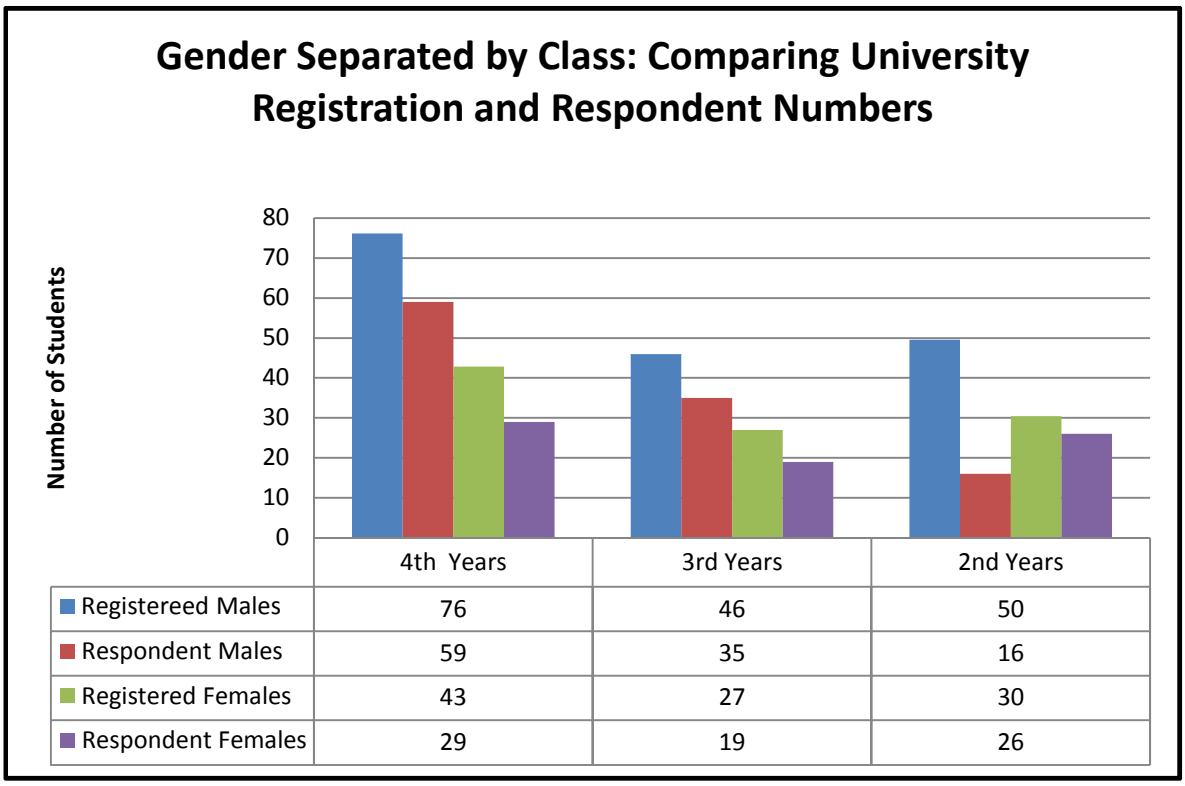
Figure 4-1: Gender of Survey Respondents

The second question asked for their year at the university. According to the responses 90 students were 4th year, 58 students were 3rd year, and 42 students were 2nd year, and one student did not answer that question. Based on the number of people enrolled in each of the cohorts of students, the 4th year class had a return rate on the surveys of over 90%. The other two cohorts were slightly smaller and the return rates were both significantly lower.[13] The disaggregated counts are shown in Figure 4-2.

The men of the 2nd year class had an extremely low return rate with only 16 of the 50 registered returning surveys (32%). The women of the same class year had an

[13] Note: since some students failed to indicate class and others failed to indicate gender on their survey. Seven returned surveys are not reflected in this table.

exceptionally high rate of return with 26 of the 30 registered returning surveys (86%). The other class and gender groups were each near a 70% return rate.



	4th Years	3rd Years	2nd Years
Registereed Males	76	46	50
Respondent Males	59	35	16
Registered Females	43	27	30
Respondent Females	29	19	26

Figure 4-2: Gender Separated by Class

4.3.2 Information about Parents and Community

The next question found that almost 90% of the students had lived with both of their parents during their secondary school years. A small number lived only with their mother and a small number with neither parent. This question was necessary in order to gage the relevance of the next two questions asking for descriptive information about the parents.

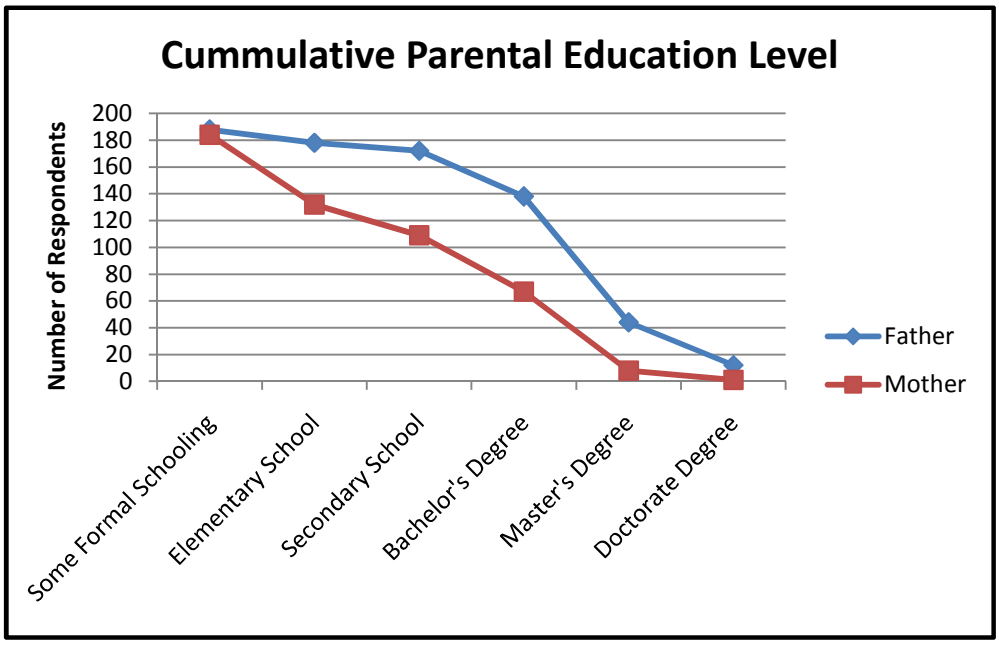


Figure 4-3: Parental Education

As for education level achieved by the parents, the numbers returned in these surveys shows an unusually well educated set of parents. The average education for the fathers was nearly at the master's level, and the average education for the mothers was just over half way between the completion of secondary school and the completion of a bachelor's degree. The father's employment covered a wide range of answers. The mothers were usually reported as being teachers or homemakers with only 11% of the respondents not indicating one of these answers.

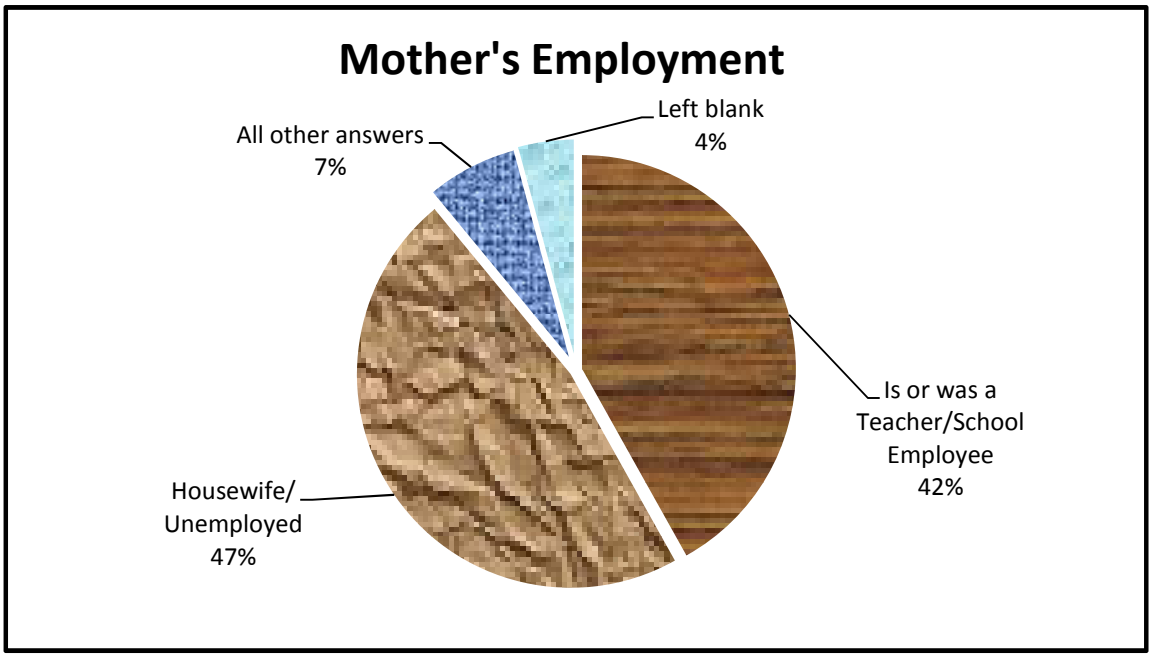


Figure 4-4: Distribution of Maternal Employment

Since the attitudes of the community and the perception of the students regarding their encouragement toward the study of computer science has been shown to be a significant factor in their selecting that major, the next set of questions asked the students to report of the level of encouragement they felt from these sources. There was no significant difference in the reporting through all of the different subgroups. The level of encouragement students received from parents was similar both when comparing by gender and when comparing by graduation cohorts. One consistent pattern is that the students who responded in each class ranked the encouragement from their parents noticeably higher than the encouragement they received from those outside of their families. The numbers are similar through all groups because almost all students reported either middle or high amount of encouragement from all sectors.

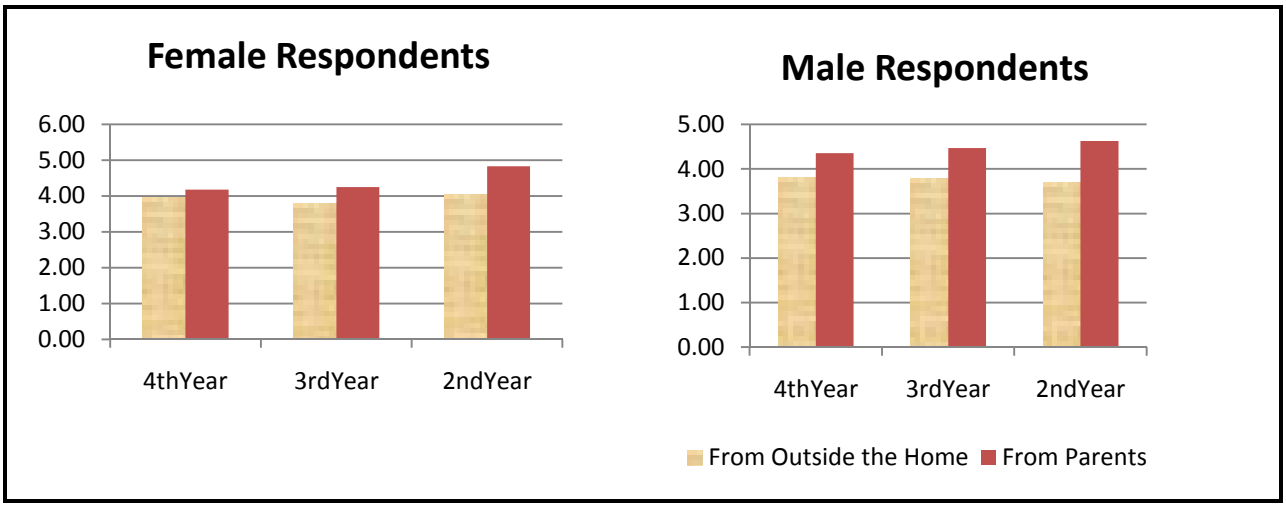


Figure 4-5: Respondent Evaluation of Encouragement to Study Computer Science

4.3.3 Selecting the Faculty and the Department

In Afghanistan, when students graduate from their secondary schools, they take the college entrance exam. At the time they take the exam, they indicate their preference for the university and for the faculty that they would like to join in their first year at the university. All students in a faculty take the same courses in their first year. Toward the end of their first year, students must select which department within that faculty they would like to join for their remaining three years at the university. They are selected for the department of their choice (within their faculty) based on their stated preference and their exam scores from the first year of courses. On the survey, the next question was to determine if people were studying computer science as their choice or because it was the field they were assigned to study based on their test results. The percent of students who selected computer science as their first choice after having one year in the faculty of science was nearly 100 percent for every one of the subgroups (male/female and cohort year) with only 2 students indicating that it was not their first choice. In the choice of the faculty of science at entrance to the university, 50% of the men who completed surveys

indicated that science had been their first choice, conversely only 34% of the women who completed surveys indicated that science had been their first choice.

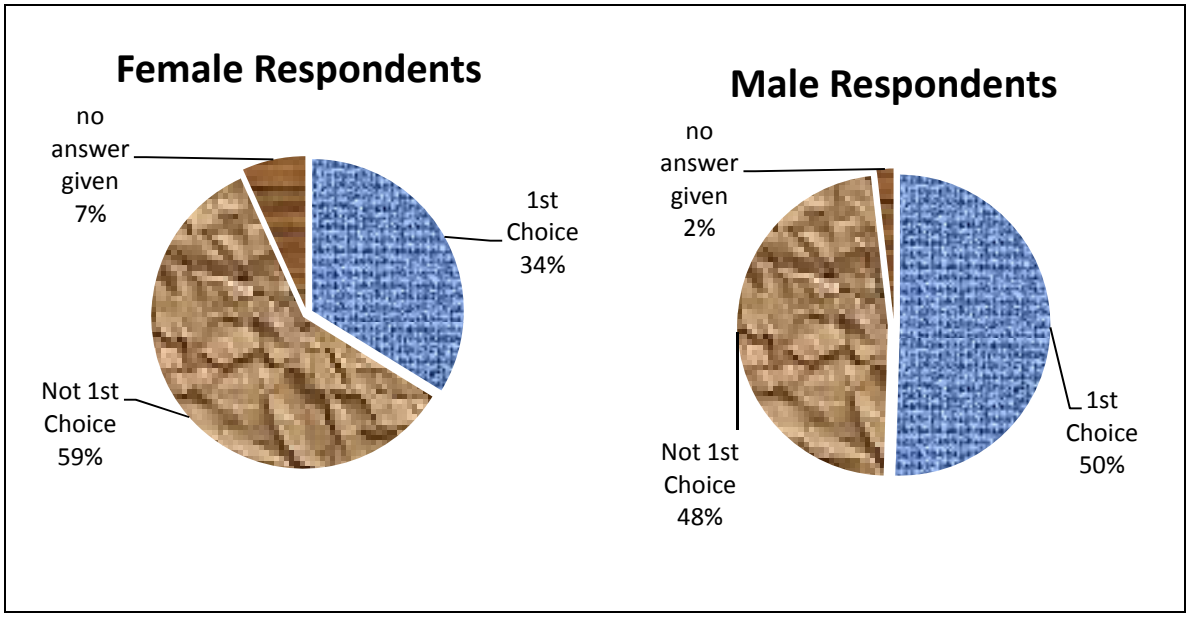


Figure 4-6: Choice of Science on University Placement Exam

Many respondents did not answer the question of what their first choice had been (if it was not the science faculty), however for those who did the most common first choices were engineering, medicine and law. The most common answer for the men by far was the faculty of engineering with approximately 50% of the male respondents giving that answer. Engineering as a choice was much less common for the women at only 18%. The men also specified political science, journalism, economics, law, medicine and specific languages as their first choice. The women who responded to this question only indicated law, medicine and specific languages in addition to engineering as their first choice. They indicated law, medicine and languages at a higher rate than the men who responded to this question. The specific percentages are shown in Figure 4-7.

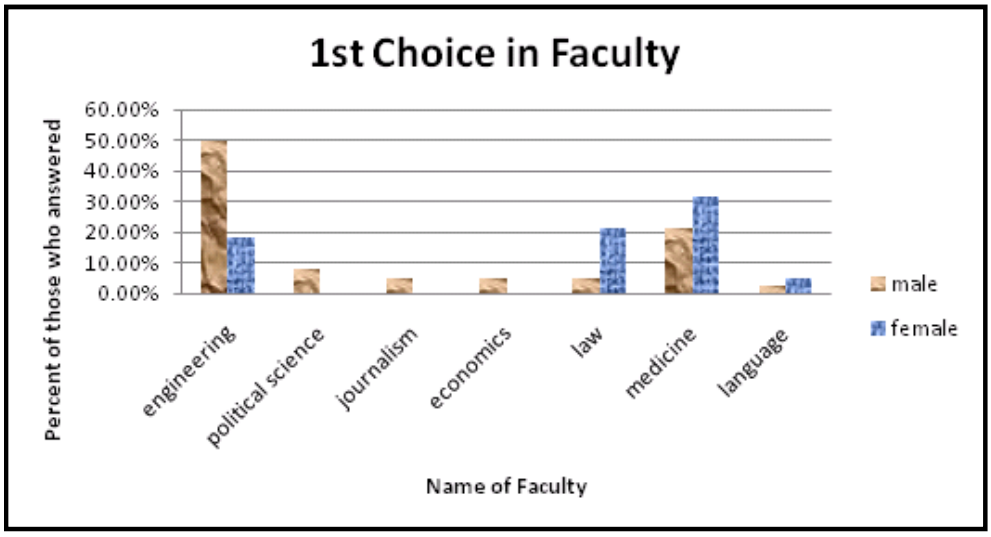


Figure 4-7: Choice of Faculty

The choice of science as their field of study in a higher percentage of men than women correlates to the next questions about comfort in selecting and continuing in the major. When asked to self-report how prepared they felt to study computer science before starting at the university level, men rated their level of preparation higher than the women rated their own. When asked how easy they find the study of computer science, men again responded that they find study in computer science to be much easier than the women ranked their own ease of studying the content of this field. These numbers are shown in Figure 4-8.

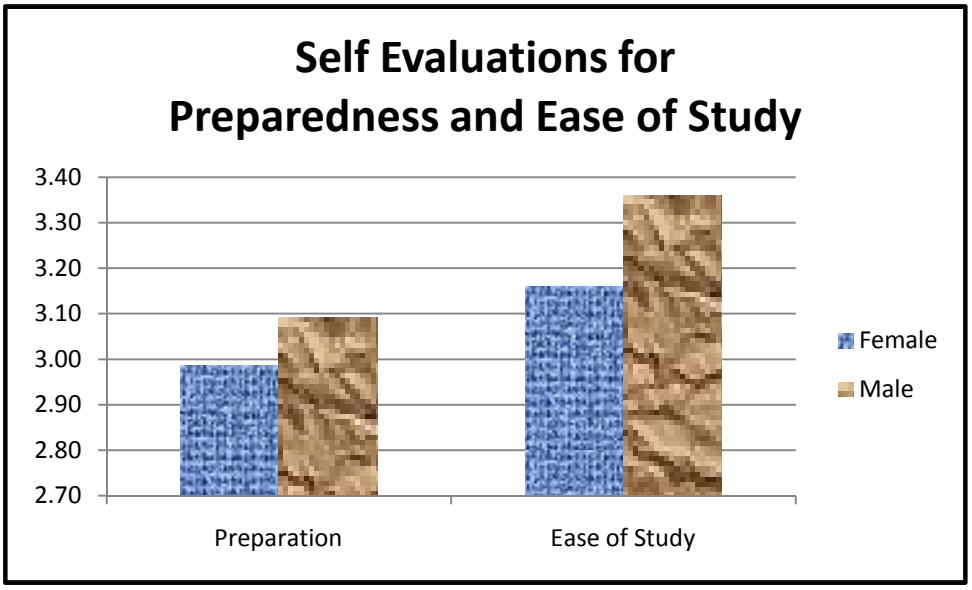


Figure 4-8: Level of Preparedness and Ease of Study

4.3.4 Computer Access and Training before the University

Access to a computer in the home prior to starting at the university was reported with similar numbers between male and female students. Therefore, this does not help to explain the difference in the self-reported feeling of being prepared before starting. Of the 179 students who answered this question, 24.4% indicated that they had no access to a computer in their home before starting at the university. This number is significantly higher for the 75 current 4th year students (32%) and significantly lower for the 37 current 2nd year students (16%) primarily because there was less infrastructure and there fewer computers in the country in 2004 than there were by 2006.

From this data and based on the fact that the students proceed through the program as a cohort, it was also possible to calculate the average number of years a student had a computer in the home before they started in the university. The average year a computer was attained is similar for all three years of students in the survey.

Therefore, the average number of years before those students started at the university increases by about 1 year between the 4th year students and the 3rd year students by about 1 year between the 3rd year students and the 2nd year students.

The students who were in their 4th year of study at the university at the time of the survey reported feeling less prepared to start their study in computer science, fewer had computers in the home before they started their studies and, out of those who did have a computer in the home, they had more recently acquired the technology.

In addition to the question about having access to a computer in the home before starting at the university, the researcher also asked what computer skills the student believed they had acquired prior to starting at the university. Many (81% of the 179 who answered this question) indicated that they had some experience through either practice at home or courses outside of the home. Most schools in Afghanistan do not provide any computer training in the standard school day, though some did have that option in school either in Afghanistan or in another country. To supplement education, many private companies in Afghanistan provide computer training, as well as in the English language, after the school day. Only five of the 179 students who answered this question on the survey mentioned that they had received computer training in their school curriculum, and only 38 indicated that they had no course training on anything computer related before they started at the university. Eight mentioned that they learned these packages in their own home on their own at home or from a parent.

The answers for these questions about where computing skills were learned differed significantly by gender. Of the five students who indicated they had learned computing skills in their secondary school, only one was a woman; conversely, of the

eight who indicated they had learned these skills at home, six were women. These results may not completely reflect the computer classes available in secondary schools because many students only answered they had taken a class while others specified if that course had been part of their secondary school curriculum or if the course had been taken at one of the training centers.

The depth of the skills learned at these training centers also showed a difference by gender. Several of the training programs offer a series of courses and exams that lead to certification in one specific applied area of computing or another. Some of these programs provide certification through a specific corporation such as the MCSE (Microsoft) and the CCNA (Cisco). Others indicate more general knowledge of information technology such as the A+ certificate offered by the Computing Technology Industry Association (CompTIA) and the ITG certificate offered by the Information Technology Society. A total of 22 students indicated that they had earned one or more of these certificates prior to starting their education at Kabul University. Of these 22 students, only one woman indicated that she had earned a certificate. The certificate she earned was one of the MCTS certificates from Microsoft that indicates a significant mastery of the Microsoft Office products. Several of the men who had earned certificates did not indicate specifics, but those who did named a wide range from hardware and routers in the CISCO certificate to software engineering in Microsoft's MCSE certificate to information technology from CompTIA.

The follow-up question to the one about training asked the students to list the set of skills they believe they had at the time they started at Kabul University. Of the total 179 who answered this question, 20% indicated that they had no skills before entering the

university. This was slightly higher for the women (22.4%) and slightly lower for the men (17.9%). Some specific skills were relatively even between the genders - for example programming was right above 5% for both genders. However, other specific skills varied significantly between the genders. Students that indicated that they had previous experience in networking were 37.5% for the men and 5% for the women and in hardware was 39.6% for the men and 6% for the women. Even in the programs that would likely be used in an office setting, the men indicated that they had higher levels of experience. In counting the students who indicated that they knew the Microsoft Office Suite or indicated that they had skill in at least two applications that are included in that suite, the survey question showed that 73.3% of the men and only 56.7% of the women fell into this category. For those who indicated they knew only Microsoft Word or only Windows, the women showed a higher percentage. From the women, 14.9% indicated that they had Microsoft Word as their highest level of skill while only 3.8% of the men indicated they only knew Word but nothing else from the suite. There were 6.0% of the women who indicated that they knew Windows but not the other applications that run in that platform, but only 0.9% of the men indicated that Windows was the highest level of skill they had in that environment.

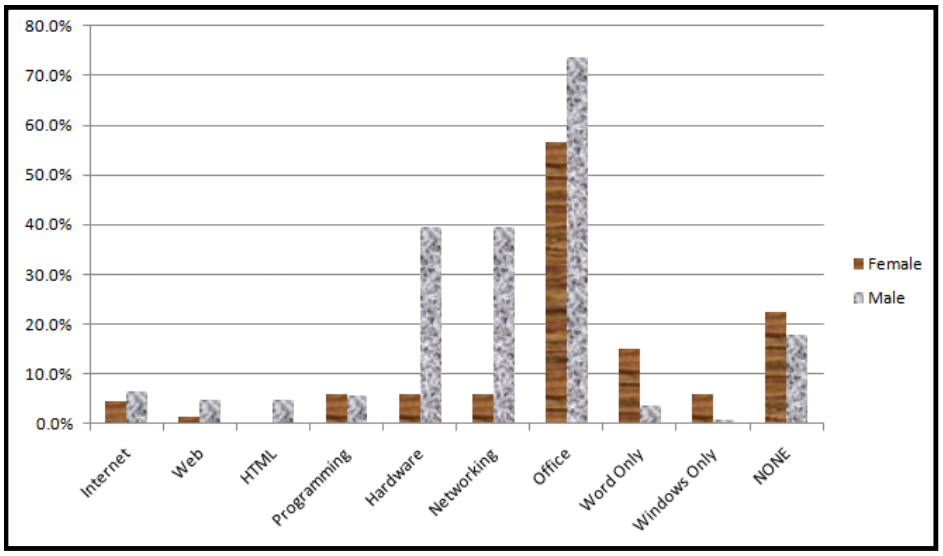


Figure 4-9: Skills Possessed before starting at the university

As depicted on Figure 4-9, there is a significant difference in type of experience gained from the courses taken before entering the university. Programming is the one area that was reported at a very similar rate. The only columns that the women reported significantly more often than the men are the three on the far right. The column titled "Office" was recorded if the students wrote that they had "Microsoft Office" product training in general or if they reported having experience with more than one of the products within the Microsoft Office Suite. The "Word Only" column reports those students who indicated that they had experience with Microsoft Word but they didn't report knowing any other of the programs in the Suite. The column titled "Windows" also refers to those students who reported knowing Windows but did not report knowing other products that would run on that platform. This means that the women either reported having no computing skills prior to admission or reported knowing a nominal portion of the software taught.

4.3.5 Perceptions of Gender in Computing

The open-ended questions of the survey were more often skipped than the shorter answer questions on the survey. Although, when they were answered, they gave significant insight into how these computer science majors view the issues around gender parity. These questions left a short blank space for them to write in their own opinions about factors they see in society that are encouraging and discouraging to women's participation in computer science as a field of study. The respondents interpreted this in several different ways, though these differences do reflect their personal emphases.

When asked what society does to encourage/discourage women in computer studies, some interpreted society in a worldwide sense. These people responded that they saw the projections on media – specifically television and radio were mentioned – as places they see women working with computers and the wide variety of types of work that can be done with computers. One woman specifically mentioned the influence of people from other cultures. "We get encouraged when we see people from other places of different genders working in the Computer Science Department at Kabul University."

Some interpreted society as the government or the university. The Kabul University and the government of Afghanistan each have programs in place to improve the education of women – attempts to repair the lack of participation caused by the years of Taliban rule. These answers showed some difference between men and women. Three men reported that the government encourages women to study, although made no comment about if that encouragement was successful or if it was irrelevant to the progress made. Two women wrote that these programs do not do enough and that "women are very illiterate" and that the programs "don't encourage us, it was all our own potential that we studied computer science".

Some students also went on to make suggestions of what more the government and the university could do to encourage more women to study. The programs that were suggested by these respondents all included providing additional learning opportunities for women. Several students suggested making classes available in computer topics outside of the secondary school that would be accessible to more women[14]. They suggested that these classes should be free or at little cost, they should be designed to have only women as students, and that the teachers should be women. The number of women available to teach these computer literacy classes held by private companies is small and yet the cultural standard is to have female students taught only by female teachers. The belief that it is inappropriate to have a man as a teacher before entering the university is strongly supported even in the city of Kabul which is often more lax on these restrictions than the other provinces. One student suggested that the government should be "making computer department in girl's [secondary] schools" rather than only having classes available outside of school since these are more difficult for women to attend than for men.

Men and women responded differently when they interpreted the question of why people would select computer science as a field of study. More of the men who answered this question indicated that it is a good way to earn a living while more of the women indicated improvement of the Afghan society. A total of 30 students answered in some way that could be interpreted as either for bettering society or for the ability to get a good job and earn money. Of these 30 students, 20 men and 10 women answered this question interpreting it in this way. Of those, all 20 men indicated the employment opportunities

[14] Often the classes offered outside of school are not segregated by gender and/or taught by a male teacher. Both of these factors limit the number of female students whose families will allow them to participate.

and/or the money were the main motivation. On the other hand, only three of the ten women answered this way while the other seven indicated the improvement to the society was the primary motivator.

Comments of these type included statements that indicated that computer science provides "a good salary and a good, secured environment" or that "learn computer science because they are poor and need money" that this would allow them a "to find money and technological knowledge." Some women who mentioned the benefit to society said how they thought people would study computer science "for the improvement of Afghanistan" and "espanding[sic] learning opportunities to women outside of Kabul."

Several of the respondents emphasize society's influence on studying either in general at the university or in this field specifically. Two women said quite plainly that "in my mind they don't encourage them so much, just they say that computer science is best for boys" or that "society thinks that girls should not study such faculties." When referring to studying in general, one man wrote in such a way that it was compared to the encouragement of men in their studies saying "the society give[s] more priority for men to study and the women are more in the house." One woman had similar sentiments, however reported that without the assistance of friends and family, it would be impossible. She stated that "actually our society is MEN dominated so most of women cannot study computer science as they are not supported by their family and friends." Another woman connected it to the rights of women in general saying "because women's right is not good in Afghanistan, most people don't let their women study [especially] to study in colleges."

The largest percentage of answers interpreted society's encouragement or discouragement in terms of the employment that would be available by completing this area of education. Some of these responses talked about women's employment in general, others about the environment they would need to work in, others about the employment options that would be available to women and others about the areas of employment that would be particularly difficult for women.

In the area of employment in general, there were answers both encouraging because of the availability of computer science jobs and also discouraging because of where they see women in that employment. Several stated that there were many jobs available in computer science because it is an extremely fast growing field within Afghanistan. Others stated quite succinctly that this will not encourage women "because of no jobs for women" and by society "saying 'it is not the job for girls'." One man said quite bluntly that society discourages women from studying computer science because "there are many reasons for ex: women can't work". Another man said that a women studying in computer science is not time well spent: "they shouldn't learn this because after marriage, all computer science knowledge will be for naught." For some of these more extreme answers from male students, it is difficult to tell (because of the wording and the poor grammar) if the student was actually saying this because he believes it to be the case or because he believes that it is a stance among some members of society though not necessarily his own view. In many ways, though, the distinction does not matter, because the perception of what others believe, especially for adolescent age women, will greatly influence decisions of the correct course of action.

Some of the women see their role of studying computer science just as a slight modification of the standard gender roles encouraged by society. Several indicate their intention to teach after they graduate. One woman states that she sees her purpose of these studies as changing the education available to girls in the future when she said, "I [want] to make a better society with professional teachers in computers for women." One man reflects the same idea by saying that the reason women should study computer science is "for teaching computer subjects to girls in schools." Another woman makes it clear that teaching is the expectation of the society in general when she says, "As always we hear that a woman can't do anything else without teaching - just otherwise marriage and doing house work."

Some are less strict in what they see concerning the expectations of society and only limit certain parts of computer science employment. Two women see general information technology and system administration as inappropriate according to society. They stay that "people question when a woman is trying to work as an IT officer" and that "they say you can't work as an administrator." Most of the students who answered by referring to specific areas of computer science only rule out the more physical labor that may be required with network installation or maintenance. Several mention the fact that a woman is not capable of "working hard" which in context indicates physical labor. Specifically saying things like "they can't do networking – women can't work hard" and "especially in networking field their going to the site of work and working there is a problem for them."

The largest collection of answers, though, refers to the fact that the work environment would not be appropriate for women. In general, both men and women are

concerned with a woman's ability to find employment in a safe environment that the family will accept as appropriate for her without a male family member present. Very succinctly one woman says that female students "after graduation, they can't find [a] job in a safe environment." Another female student says how this knowledge can cause a woman not to select this area of study "when a girl thinks she will only be able to work in an environment that her family won't allow, she'll be discouraged." One man more directly addresses the issue of what would make an environment unsafe. He says that the environment "discourages for women that in lots of offices there is abusing manner with females so they don't want to work there."

Several students indicated that there were specific types of offices and expectations that would make many jobs in this field inappropriate for women. Some specify that working in any type of mixed gender environment may not be acceptable by saying "especially in Afghanistan, women are not allowed to work with men in the same office and workplace." Others only limit the work environment making some mixed gender environments acceptable though not all. One man said, "When they can't find a job in government, it may not be suitable for them in [a] private company or [an] NGO." Two other students said that there is "a lot of discouragement that they do for example that women can't work in the business offices or in foreign organizations" and that they would not be allowed to "work with men or foreigners, not up late and not work hard."

These perceptions of society's view of their role after graduation would discourage many women, however some women put it into perspective saying that they believe that there will be jobs that are available to them and deemed appropriate. They believe that computer science is a "thing that is new and growing in Afghanistan" and

because of that they cannot predict what will be available to them once they have completed their education.

4.3.6 Summary of Survey Results

The surveys allowed the researcher to discover many characteristics of the computer science students of Kabul University from demographic information, to background and experiences to views of women in computing. There were a total of 191 survey respondents from the 272 students registered (70% return rate). In the sample 39% reported being female and 58% reported being male. In demographic information, the researcher found that the computer science students at Kabul University were from well educated parents where the mothers were mostly either not employed outside the home or were employed in the education system. In terms of selecting to study computer science, almost all selected computer science after one year in the faculty of science, but only 50% of the men and 34% of the women indicated the faculty of science as their first choice on the Kankoor exam. Similar to trends reported in other countries, the women reported that they felt less prepared and had fewer computing experiences before entering the university. However, views about the state of computer science in Afghanistan and their views about the participation of women in the field showed a high variation.

4.4 Results of Interviews

The interviews were conducted over a period of one week by using video conferencing facilities setup at Kabul University and in Maryland. There were 22 interviews conducted with 22 different students. All of the interviewed students were approximately half way through their fourth year of study and currently students in the Computer Science Department. The students were reached by a sign posted outside the

departmental offices in the building where they have their computer science classes. The sign asked them to send email or to phone to setup an appointment (all students requested appointments through email). All interviews were conducted with the student in a small office that is upstairs in the library at Kabul University. This area is known as part of the ANGeL (Afghan Next Generation e-Learning) center at that time. The facilitators arranged the interview schedule, assembled the video conferencing equipment, and collected the consent forms. This location was selected because it is used for distance learning projects, and therefore it is one of the best locations for internet connectivity on the campus. It was also secluded in such a way that students could answer questions without being overheard by other students. The interviews were recorded by the video conferencing software for later transcription.

During the interview, a list of questions, included as Appendix B, was the basis for the conversation, though often students added ideas and content outside of the list of questions or answered a specific question before it was asked; adjustments were made as each conversation progressed. In general, the students had exceptionally good English skills, except, because English is not the primary language for the students being interviewed, there were times questions needed to be repeated and their answers were repeated for clarification. When a student had to repeat a word or modify the word slightly to get the correct meaning, those quick corrections are omitted from the quotes below for ease in reading. When whole sentences or ideas were rephrased to clarify the intent, both versions were put into the transcript and only the second was used in the quotes below. When a change in grammar was necessary to maintain readability, the words are added in square brackets when quoted below.

The rest of this section reports on topics that emerged during those interviews. Often the topics were arrived at through different prompts in the interview process, but when the interviews were transcribed and coded the parallel and related topics became evident. These topics included issues of previous computer experience including access and training and how this related to their understanding of computer science as an area of study and their choice to study it at the university. It also included issues of group work, future plans for employment and their views on the participation of women.

4.4.1 Computer Access

A major theme in the literature that tries to explain why more women do not select computer science as a field of study is the experience (or lack of experience) they have with computers at a younger age. In Afghanistan, fewer children have a computer in their home than in the US and fewer have training in how to use the computer prior to or during secondary school. Even with these smaller numbers, there seemed to be evidence that the availability and determination to get access to a computer were more prevalent in the male students. The numbers from the survey showed no significant difference when comparing the percentage of men versus women who had access to computers prior to or in secondary school, yet their attitudes, as reflected in the interviews, seemed quite different.

Many women, when asked about their access to a computer before starting at the university were quite factual in their reporting that they did not have a computer in their homes and did not have access to a computer before starting at the university. They stated the lack of access as if it were a fact that did not relate to their selection of computer science as a major. Statements similar to “I didn’t. It’s not available”(F-

060530) and "No, I didn't have any access to computer or I didn't know about it"(F-020600) were common from the women interviewed. Even when talking about computing experience in general, one woman factually replied "No. No. I don't have any kind of experience of computer before coming to university" (F-060530).

Men, on the other hand, when asked about access were more likely to respond with more information about how or when they did have access. They would volunteer information about when they did get a computer "I got [a computer] when I was in class 12 – that school year"(M-020500). They were also eager to state what type of computer - "I got a 486…nothing special"(M-040500). Other man explained that they had options in order to gain access to computers even while in secondary school because they would "go to the internet clubs and use the internet sometimes"(M-020430).

Both men and women made it clear that it would be difficult to do their lessons for the Computer Science Department without having access to a computer outside of the university, and most now have a computer at home for their use. "I work with them at the home because our lesson is all of them only in computers. We cannot do all of them at the university. You have to work at home also" (F-030500). Students confirmed the information from the survey that indicated most computers were recent acquisitions with statements like "I entered in the faculty, science and computer science, and I continued my faculty lessons. Then I need a computer so I got a computer – now and to last year I have my own computer" (F-020530).

4.4.2 Computer Training

On the survey, several, both men and women, mentioned having some computer training before starting at the university. In the interview, I asked more questions about

that training in order to ascertain the content of the training, the source through which it had been provided, and the age they were when beginning that training. Several of the students who were in Pakistan for secondary school refer to classes done in the schools however most refer to the classes taught in the evenings outside of the school curriculum. Most talk about learning basic office applications, although a few had content that was more advanced.

The content of the courses seemed to center on the Microsoft products. The classes taught computer productivity and, for most students, included Windows, Word and some sort of typing/keyboarding. Only a few men mentioned content beyond secretarial productivity – no women students mentioned anything beyond computer usage. One male student said he learned "DOS, Windows and GW BASIC – that's it – programming" (M-040530). Another man mentioned that he learned "web pages … HTML" (M-060700) at his school. The women only mentioned the Microsoft Office applications and typing. They made statements about the content such as "yeah, just I have to enter an individual course - I learned some special programs like windows and other Office"(F-020530) and "we were taught to work with computer, with office programs, that's it" (F-030430).

Many students did not have access to computers in their schools; instead, they received training in the evening from the companies that run training centers. In Kabul the researcher saw many small storefronts with "tech training center" or some similar name above the door. A training center visited during the time of the research was near Kabul University. It had about a half dozen computers in a small room with no internet or board for the teacher to use. The teacher was able to move around behind the students

telling them what tasks to perform. One woman made the distinction between the training center and the school incredibly clear when she said "when I was in tech training school, I mean three years ago [in 12th grade], I have assigned to learn office program in [my province], but at school nothing; just in province [training] center I have studied Office programs" (F-030500). Another indicated that when she returned to Afghanistan to finish her schooling, she did training "outside the secondary school because we have learned, we have graduated from [another province in Afghanistan outside of Kabul] so there were no computers in our school, at which time we have graduated" (F-020530).

One woman explained that she had received training in her regular school curriculum. "In my secondary schooling, I was in Pakistan. … We were taught to work with computer, with Office programs" (F-030430). Several of the men also talked about it being part of the curriculum in their secondary school in Pakistan as a choice for which type of science they wanted to study. There were three students interviewed who had a description of their secondary school curriculum similar to the following "we have a choice. There were two sessions – one biological science and one computer. So I chose computer at that time"(M-040530). Another man had the same choice between biology and computers and chose to do biology in school except he chose to learn about computers outside of the school curriculum. "During secondary school we were in Pakistan and there we had a subject with the name of 'computer' in our school. But we had a choice of whether we study computer or biology. I mean we had a choice between biology and computer and, at the time, I chose biology due to some reason. But besides, I had a tutor outside [of school] where I was studying computer"(M-020430).

Most students who gave information about what year they started studying computers indicated 12th grade (or age 17-18). There were two men who indicated they started learning about computers at an earlier age, and, in both cases, it was because they had a computer at home on which to learn by themselves at their own pace. Three men said they started when they were approximately 15, and another said it was "in 1991 and 1992 I have a computer … I like working with that computer … from that years I got interest in computer science, just this" (M-040530).

4.4.3 Understanding of Computer Science as a Field of Study

Since there seemed to be extremely little experience in or exposure to actual computer science topics, some of the interview questions were asked in order to determine what the students understood computer science to be before they began studying at the university. Responses from the men indicated that their understanding of computer science content had not significantly changed in the three and a half years they have been at the university. "I'm not changed how I see information about computer science – I always wanted to do computer science. The computer size and speed – interested in computer for [many] things"(M-050611).

Several women, though, indicated that this was not the case. They were studying something different than what they "expected to be studying – good but different"(F-060530). Another explained how her expectations were different from what she found computer science at the university to be. "First I thought that we will study about the Office programs or something like using computers in offices like this, but when I started, I found that we can program computer and we can have software like that" (F-020600).

4.4.4 Selecting Science/Computer Science as a Field of Study

Another natural question is why these students would select computer science (even as a second or third choice) when they did not really know what it was. Several (especially women) indicated that their mothers had urged them to go into computer science. Statements like "my mother was wanting me to go to the university for IT" (F-060503) or "my mother say that I study science – and then I decided to study computer's field" (F-030500) were common even if the mother had never worked on a computer and had no further knowledge of computer beyond things like "she is heard good field but she is very interested"(F-050300).

4.4.5 Computer Use Outside of Schoolwork

The use of the computer for things outside of class work can show a deeper interest in the subject and it often causes people to become more interested in their studies. The difference reported in the literature relative to the interests of representatives of each gender is paralleled in the reporting of those interviewed in Afghanistan.

The men report that when they are not doing homework they are still exploring about the computer itself or writing code. One man said "favorite thing to do in computer – I want to be a good programmer because I, I love programming … [in] Java. I want to program software like Word but I don't know that. I'm working on that and I want to work on my last project"(M-040600). Another man said "I like doing things like coding. I like Java, I like HTML"(M-040500). The women, on the other hand, more commonly reported much more interest in the artistic applications or just using the computer to complete their homework. "Although I don't have time, but I usually use the graphics things – like Photoshop and Movie Maker, like this"(F-020600).

4.4.6 The Group Work Dynamic

During visits to Kabul University, the researcher noticed one process that was quite different from how computer science students do their coursework in the classes taught by the researcher in the US. That difference is the amount of work that is done as a group. In the lower-level computer science classes in Kabul, the students are always working together in small groups. Even when they see the professor for help on a project, the students often approach the professor together to obtain help as a group. This group method of projects and homework could lead to more interest on the part of female students, because of the social nature of the process.

There was a wide variety of answers to the questions of what makes up the groups and how they are formed. The groups are sometimes single gender and sometimes mixed gender.[15] The groups are sometimes a unit that has remained only changed only in minor ways during the three and a half years they have studied and other times they are new groups formed just for the specific project. Some say that they prefer to work individually, rather than in a group. In the computer science classes at the University of Maryland, some projects are denoted as individual and some as group projects and all students are required to work in the manner specified – they do not get to choose when to work with others and when not to because different skills are to be learned in each methodology.

Students seem to understand the benefits of working in a group. They state the ability to learn from each other as the primary motivation to wanting to work with a group on homework or a project. One woman stated this exceptionally nicely. She said

[15] I have visited Kabul University several times while classes were in session. I witnessed these groups working together in the computer labs or studying together on the lawn. Personally, I observed that most of the groups were single gender, but the students reported in the interviews that groups are most often mixed gender groups.

"we work with a group and we can learn much from each other if we have some problems; the one who knows can help the others in the group"(F-030500). The students report that these groups are also open to others and adjustable. One woman reported that "anyone can participate [in their group] according to their knowledge in the group"(F-030430). They also report that it is the common practice "most of our time we done our homework and our projects together within a group" (F-020530).

One problem that often arises with groups is the unequal distribution of the workload. Members often do not work equally, and it is often difficult to determine which student contributed which parts to the final product. In a highly competitive field like computer science, this causes a problem in accuracy of grades and learning assessment. In Afghanistan, the competitiveness does not appear to be a big concern. They concentrate more on the cooperative model and helping each other learn.

Some students (all women) say that evenly sharing the workload is not a problem. They say "all of them work together"(F-030500) and "we almost always try to work equally"(F-060530). In addition, the girls were more likely to say that they work in a single gender group. One student said that "when we study in a group, usually we have only female groups, but sometimes both male and female"(F-030430). Another said they tried a mixed group which then became a single gender group "in our second year, our group there were 4 girls and 1 boy; our boy not interested like us, just the girls were interested and we done nicely on our project" (F-020530).

Several students acknowledge that some people do not participate; most just accept that as normal and to be expected. They also do not seem to have any problem with the fact that those who do not participate receive the same grade on the project. This

inequality of contribution to the finished product is accepted when as one male student says "some of them work high end, some of them low, low levels"(M-04530). One student says that in a larger group "only three or four people participated in actually doing the project"(M-020430) and when asked why he thought they did not participate he responded with "well, maybe some of them were not interested, some of them did not have enough talent to do that; I have not thought about it, I am not sure" (M-020430). One student says that he prefers "to work individually … because my students in my group will not work properly"(M-040500). Another student says that on average in a group of size six, there are "two to three persons do almost nothing"(M-040600). Two man specifically mentioned that women are less likely to be contributing than the men in the group. "I don't want to work [with] girls in the team working. They just want other to do their job. They don't think about it. … It is usual – yeah, it is OK" (M-040500). Some women also agree that students exist who do not contribute to the group. One says "when we work together some of them are not working really. It's just pass the time"(F-020600).

4.4.7 Employment Plans after Graduation

In the surveys, a set of answers that emerged centered on the issue of employment after graduation. Because the survey results did not reveal the student's motivation, the interviews included a series of questions to determine their goals after graduation. Several students had difficulty answering the questions about what they plan or hope to be doing after graduation. It was as though many had not fully considered that they had options. Since all of the students interviewed were half way through their last year at the university, this was surprising. Several students explained that planning or even hoping

for something, even short term, is difficult. One student responded to the question of what they hope to be doing in seven years by explaining that the instability has taught them not to plan or hope for the future. "Yes, this is really hard to say this. Because as far as I think, in Afghanistan, we don't predict. We don't make this much decision, or this much plan for us for so long time because here in Afghanistan, we even not predict what we are going to do, or what we are, what we are maybe doing tomorrow. That's I think difficult in this place a little to decide to what to do in 7 years…because here [Afghanistan], life is not too much stable for us. So I don't know" (F-030430).

When asked what type of employment they would like to see themselves doing in the near future, there was a wide variety of answers. Both men and women expressed interest in being an Information Technology Officer "solving problems of the office – I mean networking and computer problems – the problems of the staff in their jobs - working with computers" (M-020430). This technical staff – supporting those working in an office was the type of job that was most mentioned in the interviews. Some answers leaned more specifically to the networking side and others to a specific type of office such as accounting. In general, the students see the need for companies to expand their use of computers and therefore a good opportunity for employment by supporting those who need to change to a more technological focus in the offices and their specific job roles.

There were also both men and women who mentioned programming as a possible type of employment. One woman stated that she likes programming in any language and wants to work in "anything related to coding"(F-030430), and a man said he likes programming except that in Afghanistan he is not sure it is possible to make a good living

programming because of their lack of copyright protection laws. He said "in Afghanistan, I don't think programming is a good [career] … because there is no computerize [protection] law. We can copy and make our own. All the Microsoft software sites that are very, very expensive in America and other countries in the world. Here in Afghanistan, you can buy them in, for $3. Or maybe $1" (M-040500). He says he will probably select web design as his area of employment in spite of the fact that he really likes programming the best because he feels it is more practical in Afghanistan.

Several other students also mentioned web design as a good career choice. It is a good way to earn money in addition it is something that will help Afghanistan to become part of the global community. "These days, when the world is turning into a global village, our country is far away from other countries. These companies need to have web pages on the internet. If I work as a web page developer, it would affect the community. And businesses who want to have web sites – if they want to have more popularity, probably my job will affect their work and through them, the society" (M-020430).

Some students, similar to the one previously mentioned, see application of computing technology as a way to help Afghanistan recover and enter the world-wide global economy. Other students were clear that their motivation is to be able to support their family and improve their own economic status. "Well, I have an opinion. In the poorer countries, like Afghanistan, people usually try to have a profession that can give them some money in the future. With the help of that, they can earn some money, and these days in Afghanistan, I think computer science is the most wanted profession. I mean that most of the people are interested in this field. About the job, I used to think

that after I graduate I will get a job in the field of IT and I would be an IT officer or something but I am not sure" (M-070530).

When questioned about what they would do right after graduation, some students realized that their first goal would need to be to gain some experience. They realize that the material they are learning in their computer science classes at Kabul University may not be directly applicable to the work world – that experience gained in the job market is essential. Kabul University's computer science curriculum does not have any applied internship requirement. They are required to do a final project in their last year. That project is often done within the university and always under the supervision of the computer science professors and seldom has any application outside or in relation to anything outside of the university. Several students stated that their first job would be to gain experience and training in one narrower, applicable area. After that "on the job training" period, students stated different things as their goals. One student said that this first job might not provide the income he would like; that would be the goal of the second job. "My primary motivation is that I want to first work to gain all experiences and more knowledge about my field and after that, I want really to gain more money -- first [comes] my knowledge and experience" (M-040530). One woman also said she wants to be able to study and learn more about the field, after that "the main goal is to help my country"(F-020600). One other man sees the first job as a way to gain the knowledge of computer science that he feels is lacking in his undergraduate education in order that he can be prepared to study computer science at the master's level outside of Afghanistan. "I want to first complete – improve – my job skills. Because, if you are aware, we have a lack of good background while here [at Kabul University], especially in this field of

study. So after one year or 6 months, I'll prepare myself for my master's degree study [in the U.S.]" (M-070530).

4.4.8 Perceptions of Limitations on Employment for Women

Several students did talk about the restrictions the society places on many of the women. However, many do not see or have the same restrictions. One student gave her estimate of how many of her classmates from secondary school have to live under the restriction of not continuing their education at the university at all. "Here, yeah, there is like [a] different culture and different ideas of our people, between our people. Therefore, some of our people think that girls shouldn't go out of their home. Just they do their duty of their home. Then they don't want to go their girls to the outside of the home. But until now, most I've met some most of the family think like this. I don't know which kind of idea that have in their mind. But every family should like the girls to enjoy the faculty and central education. But I think that most of the Afghan families don't want their girls go outside their home. Almost 70%. Yes, 70%. When I go back to my province after 3 years, I met the several [schoolmates from secondary school] but all they are married. Their family don't let them go to join the faculty" (F-020530).

Another woman says she does not see that there is any restrictions remaining in Afghanistan and she will go to the workforce after graduation because the talk about restrictions is not true. Partially, the difference of opinion comes from the geographical location of the woman's family. The families that are within the city of Kabul are often much less conservative than the families of women from the provinces. A high percentage of the students at Kabul University are from Kabul, and an even higher percentage of the women are from Kabul. This is partially because the schools in the city

often are a higher quality and that a higher percentage of the female secondary students are able to attend school in the city because there is relatively safe travel as compared to the schools in the other provinces. One woman who is from Kabul originally says "Yes, sometimes people say that it's not good, and you can't work outside when you graduate, but I see it's not like that" (F-020600).

Experiences gained from attending the university and external experiences acquired through working on campus can make a huge difference in the viewpoints of the students. The students that work for the ITCK (Information Technology Center at Kabul University) have access to a wide variety of experiences that would have been otherwise unavailable, and the ITCK has a strict hiring policy supporting gender equality. The student workers are part time support for the computer operations of the university similar to our undergraduate students employed by OIT (Office of Information Technology) at the University of Maryland. About six months before the interviews, these students were involved in setting up new satellite communications to improve the university's bandwidth, and therefore, went to abroad for two months in order to receive training on that new equipment. Not all of the women that qualified for the program were allowed to attend the training, however one student explained how it opened her mind to the possibilities of what she could do in the future. "I really saw that there was good universities. They had good technologies and techniques at their university. I think it will be good to stay and study there" (F-020600). Another woman who works in the ITCK mentioned that seeing the researcher teaching the Computer Science Department professors (in a room at the ITCK) made her aware of how much more there must be to learn in addition to the possibilities for her future. "I work in the ITCK and helped you

setup for your [class] with our professors. To see that the professors who are teaching us having more learning and that you travel away from your home to be [their teacher], makes me need to work to learn and find where I can learn more"(F-070330).

Also, the restriction placed on some women also affects the variety of places they can consider working. None of the men has this restriction and therefore have many options of organizations with which to work. One man said, "I think I am still planning on working in some NGO or government places. I cannot decide it now" (M-040600). However, women who feel the pressure of family choices do not have the same options. One woman reported, "I would prefer to work in offices … in the field of database or web designing. I cannot work at an NGO, but I would prefer to work in a ministry or university, because of my old brother. He is a little strict and he doesn't like me to work in an NGO"(F-060530). Other female students like the idea of working in an NGO after graduation and do not have family members that would prevent it. "I think I'll be doing [computer] work. I will work with NGO, maybe" (F-030430).

Others are restricted to the traditional female role of teaching (specifically teaching girls). Some accept this as an unchangeable way of life and others see it as their way of improving Afghanistan. One woman would much rather work in an office and thinks teaching is boring, however, she sees it might be the only option available to her. "Then I will decide to do teaching. I would teach computers. If I couldn't find a job at some organization, some office that is acceptable [to my family], then I have to teach. I love the idea of [office] working. I think working at office is better than teaching because teaching is a little good. When you have working at office we can work, I mean, study a little for our self and when you are just teaching … that's boring" (F-030500).

Others see teaching as a way to continue learning and using the new technologies. One mentioned the "workshop for e-learning that was held in the library [the ANGeL Center – Afghan Next Generation e-Learning system]"(F-020600) as a new way to teach. Another sees teaching in our [Kabul University's] faculty as a good goal because "if it is possible I want to continue my master's degree in programming language"(F-020530).

One woman sees teaching other women and girls to use the technology as her contribution to the improvement of Afghanistan. "I have just one suggestion because in that time Afghanistan was so decreased and low degree of education so just I want to improve the education in Afghanistan so I want to [get] every kind of technical education, to every other field of this faculty and now also, I want to improve this and teach others … I like this" (F-020530).

4.4.9 Summary of Interview Results

The interviews questions were designed based on questions that arose from the evaluation of the survey data. Some major questions that arose from the survey data involved the access to computers and computer training; since there was (and still is) far less access and training than many students have in the US, that difference could still contribute to the lack of gender parity in the field. The amount of computing and the style of that interaction and even the attitude toward the computer training seems to have significant differences between the men and the women in the study. Because of this lack of computer experience, the decision made to study computers was made on different grounds. For several of those interviewed, computer science was not what they expected it to be, but they had encouragement to study especially from their parents. The students' views on employment and the place for women in the professional computer world, the

answers were the most interesting but had a high variability. Some students saw problems with any planning or preparing for the future while others had very specific goals both short and long term. Some students saw immediate contributions they would make to their employers while others saw their first employment as another learning environment. Also, some students saw no obstacles to women while others saw most work environments as unattainable goals for the women. This wide variety and the patterns in which they appeared shows the change currently taking place in Afghanistan both technologically and societally.

Chapter 5. Discussion

5.1 Overview

This study relies on the current literature as a backdrop in understanding why Kabul University's computer science program is an anomaly in its representation of women. Since the literature gives several theories about which characteristics could be affecting women's representation in computer science in other countries, the focus groups, the surveys and the interviews each contributed to the understanding how these characteristics may or may not be influencing women in Afghanistan. As shown in the results section, some of the characteristics mentioned in the literature review are not present to the same degree in Afghanistan, others characteristics are present but do not appear to have the same impact and other characteristics exist in Afghanistan that do appear to have a big influence on women's participation.

5.2 Retention

The literature on retention is important to this investigation because one issue that contributes to the lack of women in computing subjects is the loss of women from the educational pipeline. In many countries, more women than men are lost at each stage through the educational pipeline. This research suggests that this dynamic does not apply in Afghanistan because three characteristics make it different from the societies previously studied.

The first of premise suggests that the number of computers in the home and developing a gradual comfort of using them increase the likelihood that women will

continue in computer science education. The early exposure and the existence of a computer in the home was less a factor in explaining the number of women in Kabul University's Computer Science Program because very few had either of these benefits. In Afghanistan few of these students, both men and women, had access to computers in their homes as a child. The introduction of technology in their lives was in general much later. By the end of their secondary school years, many were encouraged to study computer subjects outside of the home or school environment. Before that time, there was relatively little access to technology. Even at the time of secondary school most were only exposed to productivity applications and therefore had little knowledge of or opinion about computer studies before they started at the university. Because of the lateness of their exposure to computing, the reference to the pipeline and the loss of women from the pipeline is not relevant in Afghanistan. The integration or membership as required in the models of Tinto and Rendon respectively cannot be applied to the concept of the inclusion into the computing culture in Afghanistan as it can in the US. When the Afghan students are learning the computing material in college, it is new and exciting. They do not seem to feel that they must be completely integrated or have membership in the worldwide computing culture because they view themselves (and their country) as newcomers to the world of technology. In contrast, in countries where students often have significant exposure to computers before starting college, the students who know more "buzz words" and can impress their classmates when starting college feel more integrated into the computing culture and are more likely to be retained in computer science.

The second difference is the method used for students to select areas of study at Kabul University. Students are assigned to a faculty based on test scores and their list of preferences of fields and university as they complete secondary schools. They are assigned to a major based on other test scores and another list of preferences as they complete their first year. The decisions about choice do not have as great of an impact in Afghanistan. Therefore, choice of field of study at the stage where they enter the university does not influence the numbers in the pipeline; the administration simply assigns the number of students desired to each college in each university. This explains why many students did not select the Faculty of Science as their first choice when entering the university. When students needed to select from the departments within the Faculty of Science, they have a much better understanding of the content of computer science and almost 100% of the computer science majors selected it as their first choice at that juncture.

The third major factor differs in the financing of their study at the university and the economic system of the country. In Afghanistan, the government provides for the tertiary education of the students who are selected to study at the university. The students who are selected to attend the university know the economic impact attending the university and attaining a degree will have on their lives. This incentive makes the percentage of students who drop out of the university negligible. During their four years, they have their basic needs provided in a way unlikely by any other method. The fear of losing this benefit places a level of responsibility on them during their studies, while at the same time giving or providing them good incentive to study for the exams that take place at the end of each course. The number of students who start at the university in a

given faculty is quite similar to the number of students that graduate from that university and that faculty four years later (Saay, 2006; Meeran & Adelyar, 2006). Retention within the university and within the Computer Science Department is not the major concern as in some other countries. Bean's Student Departure Model explains these choices quite well. In Bean's theory, students weigh the pros and cons and then choose to stay in school. Because they do not have a choice to switch to a different major and because leaving the university would have very negative consequences to their financial status, students choose to stay at the university until they graduate.

5.3 Societal/Disciplinary Characteristics

Many societal characteristics of Afghanistan differ greatly from the corresponding characteristics in the countries where the underrepresentation of women in computer science has been studied the most. These characteristics include the perception of stereotypes, socialization of children, extent of support systems, and expectations in employment.

As noted earlier, in Chapter 2, one of the most cited barriers to women's participation is the "computer geek" stereotype and gender biases inherent in that title. Among the students at the university there seems to be little thought about the 'geek' culture. The students at Kabul University are selected to attend based on their college entrance exam test scores. They truly see it as a privilege and, for many, a path to a much better life. With the difference in societal norms, as far as dating and gender interaction, and the value of being educated in general, the negativity associated with being a female geek is minimized. That women more often have multiple interests and often choose to

study outside of this field is also minimized by the process of assigning people to a single college and then later a single department based on examination results.

The students do specify choices of fields of study both at the faculty and major levels, however from the survey results above it is clear that students are directed toward studying in the sciences even when that is not their first choice. On the survey only 50% of the men and only 30% of the women indicated that the Faculty of Science was their first choice. The survey also shows that once they have studied for one year in the Faculty of Science, the attraction to computer science is much higher; almost 100% of both men and women who answered that question on the survey indicated that the Department of Computer Science was their first choice when being assigned into a department.

The parental influence mentioned earlier in another well documented factor contributing to the underrepresentation of women; however this factor is also quite different in the Afghan society. Because of the general lack of technology in the family, there appeared to be little of the unequal treatment of children both by parents and by society as a whole in regards to exposure as elucidated in some of the research. The influence from the parents came more in the form of encouraging their children to study in order to improve their prospects for a better life. Gurer and Camp (2002) emphasize the importance of the mother's influence over the girl's attitude toward computing. In Afghanistan, this influence was shown through the mothers, encouraging of their daughters to study at the university in general and of the hope that their daughters would have access to more opportunities for employment than they had themselves. The female students interviewed in Afghanistan seem to have the strong support of their families

needed for success as noted in the research by Beyer et al. (2003). During the interviews, the female students mentioned encouragement from their mothers more often than the male students did.

A negative societal/disciplinary characteristic in Afghanistan is the lack of female role models in the STEM fields which is documented as a contributing factor in several studies noted earlier. There were no female professors in the Computer Science Department at Kabul University at the time of this study. In addition, none of the women at the focus group knew of any women that worked with computers except for a few that use Microsoft Office programs. Many stated how excited they were about the presence of the researcher in Afghanistan; a woman in computer science teaching classes for their professors was an interesting anomaly. They implied they feel a need for female role models though they have a much larger definition of community when they referred to women they either has heard about or that have visited Afghanistan from other countries and in other science fields.

The literature indicates that males who are active supporters of female students can act as mentors and advocates especially when there is a lack of female mentors available. In Afghanistan, the male mentors, the professors of computer science, are aware of the gender differences of their society and are supportive of the women studying in their department. Since the female students in Afghanistan have more gender based peer support, since they have the support of male mentors, and since they identify with female role models that are not local, the lack of female professors does not seem to contribute to their lack of participation in computer science.

The workload and job expectations of computer science graduates is different in Afghanistan than in many of the countries that are experiencing the underrepresentation of women. One difference is the types of jobs the students are hoping to get after graduation. Several mentioned goals of becoming IT Officers or web developers after graduation. These jobs are different from the project management/development jobs, which are the goals of most students when they graduate in Maryland. Large project development jobs are primarily stereotyped as being solitary and separated from benefitting the real world. In Afghanistan few, if any, of these jobs exist. In Afghanistan, computer science graduates are needed in companies that are modernizing in order to allow the company to advance in record keeping and media advertising. Because of the availability of these jobs, the computer science job market in Afghanistan has not developed the same stereotypes as those that exist in the U.S.

5.4 Departmental Characteristics

Some departmental characteristics have both similarities and identifiable differences between Afghanistan and the countries represented in the literature review about underrepresentation. One characteristic reviewed here is the "hard versus soft" science characteristic of the department. Another is the teaching and grading style employed by the professors.

In the literature of underrepresentation, the numbers show that women are more interested in computers when their computer skills can be applied directly to society (Borg, 2002; Gurer, et al., 2002; West & Ross, 2002; Wilson, 2003). In Afghanistan at the time of this study, Kabul University's computer science degree covered the whole spectrum of computing -- from network installation training (Cisco) to web development

to electronics to programming. The different areas on this spectrum are often handled by different universities or at least different departments within the university. Since the Computer Science Department at Kabul University provides for most of the computing needs of the country, the students receive a broad education; however, it is not as deep in any one area. When discussing the required classes with the students, there were clear preferences that some students like the "harder" sciences, while others liked the "softer" areas. The distinction of preference based on gender was not as clear anywhere else as when they were discussing what areas they would like to pursue after graduation. Several of the male students expressed an interest in network installation and maintenance. The female students were, in general, not interested in that area, and, on the survey, several male students noted that women are deterred from work in these fields. Many men interviewed were also interested in the softer areas such as graphics and web development. Most of the students were not aware of all of the areas of computer studies, though each found areas where they felt comfortable because they are required, within the four-year program, to have an introduction to many of the areas.

According to the literature, the remote teaching styles and automated grading methods are also factors that contribute to the underrepresentation of women (Cohoon, 2001; Margolis & Fisher, 2002; Binkerd & Moore, 2002). Simply put, any depersonalization of the professors and the material negatively affects the women in the class at a higher rate than the men. In Afghanistan, the teaching style is definitely based in the lecture presentation style, however the professors are approachable on an individual basis. The lecture style may actually help the female students since men are more likely to interrupt with additional questions or to answer a question prematurely. In

Afghanistan, there is little interaction from the class during the lecture. Therefore, the male students do not have the opportunity to dominate the class period. The arrangements for students seeking help outside of the lecture period is much less formal as the professors have desks in one large department office and are often available to the students. The students (both male and female) often come to the department office in small groups to ask questions rather than alone. The grading is personal with adequate feedback and personal comments to the students rather than an automated system that determines if the program the student wrote determines the correct output. These methods of personalization, even with hundreds of students, allow the students to feel that they can get help from their professor in a friendly environment when needed.

5.5 Personal Characteristics

The personal characteristics of the students who choose to study computer science also contain factors that positively or negatively affect their interest in the field. Some of these include the comfort level with the study expected, the level of preparedness and confidence in their ability to learn, and the competitiveness of the students in the program.

In the literature, the solitary nature and the large time expectations of the project work in computer science undergraduate programs is touted as another contributing factor to the underrepresentation of women. This is because women often have more interests outside of their computer science classes and, especially at college age, are interested in the social interactions available. In Afghanistan, the projects given in classes are much less time demanding and the final grade for the course is mostly based on the written final exam. The time spent on projects is also more appealing to women

because most of the projects are done in a group setting rather than as individual work. This group work activity provides much more of a collaborative working environment than a competitive environment. Several researchers suggest that this type of learning environment is more beneficial to women. The increase in the interaction and the decrease in the time commitment would both appeal to women based on results of other studies.

Concerning the level of preparedness to study and the confidence of their knowledge in the field, the students at Kabul come from a wide variety of backgrounds. Several of them have gained experience in computing in the couple of years prior to starting at the university, and some had no computing experience at all until after becoming a student in the Faculty of Science. Since many, both male and female, come into the program with little knowledge of actual computer science topics, the confidence issues women face when they assume they are less prepared are not applicable. Also, because the students go through the four years of study as a cohort (all students taking all of the same classes together), they eliminate the possibility that some students have taken more classes and are better prepared. Since the lack of confidence in their own ability more negatively effects women, the minimization of factors that can cause them to doubt their own level of preparedness to study or their ability to complete the program would improve the recruitment and retention of women in the field.

A closely related feature that also negatively affects women is the competitiveness of many computer science programs. Men, in general, thrive in a competitive environment more than women do. The Computer Science Department in Afghanistan appears to have little competitiveness between the students. The students

are selected to be there, receive the same stipend for living expenses, and, with the high demand of skilled workers, fully expect to be employed after graduation if they choose. The successful completion rate of classes is also almost 100% and a high portion of that grade is based on the written final exam. Removing the competitiveness during the semester projects encourages the students to work together and help each other rather than compete.

Chapter 6. Conclusion

6.1 Overview

Several factors, each of which may discourage women from entering the computer science field, have long since been established in the research community (Cohoon, 2001; DePalma, 2001; Margolis & Fisher, 2002; Stross, 2008). Nonetheless, Afghanistan has had a disproportionally high percentage of women studying computer science when compared to the number of women in the university as a whole (Saay, 2006). In addition, Afghanistan has had a significantly different pattern of technology development when compared to most of the countries where the underrepresentation of women in computer science has been studied. This study found that there are characteristics of the society, the department and the students in Afghanistan that have been previously identified in the underrepresentation literature as factors that discourage women from entering the field. Other characteristics, not previously identified as corresponding to representation of women in computer science, have been identified in this study because these new factors may be influencing the representation of women Afghanistan is experiencing. Through the focus groups, surveys and interviews, the researcher explored these characteristics to determine their possible impact on women's participation in computer science in Afghanistan.

Some characteristics differ between Afghanistan and the countries that are mentioned in the underrepresentation literature. Since these characteristics are theorized to discourage women's participation in other countries, it was important to explore how

these characteristics affect the women in Afghanistan. The characteristics which are different and therefore may be contributing to the gender representation in Kabul University's Computer Science Department include the entrance examination system, the lack of freedom to change majors once at the university, the lack of perception of a "geek" culture, the lack of competitiveness, and the group work emphasis.

The "closed" structure of the admissions and major selection process would lead to higher recruitment and retention of women because the students' freedom of choice is reduced in this method. Although they are able to specify a list of options, they do not have complete freedom in selecting their field of study. Once in the department, the culture and expectations in the department also have features that minimize some characteristics thought to discourage women's participation. The department's structure for assignments is much more cooperative with its lack of competition and the group work. This working environment has been previously established as a positive factor that also supports the participation of women, because women, in general, are more social and supportive rather than competitive (Gurer & Camp, 2002; Barker, Garvin-Doxas, & Jackson, 2002; Binkerd & Moore, 2002).

Other characteristics reported to support the inclusion of women in computer science also exist in Afghanistan and may be contributing to the level of participation of women. These include the encouragement of parents (Margolis & Fisher, 2002; Adams, Jensen, Lester, Olson, & Tennant, 2005; Beyer, Rynes, Perrault, Hay, & Haller, 2003), the support of the professors that understand the gender gap (Adams, Jensen, Lester, Olson, & Tennant, 2005), and the selection of individual preferences for areas within computing (Gurer & Camp, 2002). This suggests that the personal support and

encouragement students feel as well as acknowledgement of their expression of individual strengths allow the students to feel an inclusion into both the university and the computer science culture.

On the other hand, additional characteristics exist in Afghanistan that have been posited in the literature to hinder gender parity. Although these characteristics are present, possibly even at higher levels in Afghanistan, they do not seem to have the same negative effects on women's participation in computer science. In Afghanistan, women believe themselves to be less prepared and have less confidence in their study of computer science, but it does not appear to prevent them from completing the degree. In addition, the lack of female mentors and role models in Afghanistan would appear to be a factor working against the inclusion of women in the field (Leeve, Dunigan, & Turner, 2002); however, the female students have learned to rely on peer support and non-local exemplars. Having the availability of help and support even in different forms from other contexts, encourages the students to complete the degree in computer science.

Lastly, the socio-economic characteristics are different in Afghanistan from what is reported in the literature based in other countries where and it is difficult to determine if they would have a positive or a negative effect on the participation of women. First is the economic condition of Afghanistan that limits the other alternatives available to the students as an option to staying in school. Second is the lack of technology exposure and preparation the students have before entering the university. And, the third is the gender influenced employment conditions that exist after graduation.

Many characteristics have been identified in this study. Each of these could have an influence on the participation of women in computer science at Kabul University.

That several of the characteristics that were identified in the literature as negatively influencing participation exist at Kabul University, however, appears not to have detrimental effects leads to the hypothesis that the interaction and compounding effects of these characteristics are likely negatively influencing participation in universities that are experiencing lack of gender parity.

6.2 Study Limitations

Because remarkably little was known about women in computer science in Afghanistan before this study and because there is such a wide variety of characteristics that could affect participation, it was only possible to identify one set of possible contributing characteristics. To understand any additional characteristics or their interactions would require a much larger multi-country comparative study.

At the time of this research, only one university Computer Science Department was active in Afghanistan, so the population of computer science students was much more limited than it would be now that there are multiple universities offering computer science degrees. Since the women in Afghanistan are not often allowed to travel far from home and many of them were expected to go home to their parents at the end of the school day, the female students at Kabul University are more likely to be from Kabul while the male students are from a larger region. The culture of Kabul is vastly different from the culture in many of the provinces especially in terms of more rights for women; therefore, the views expressed by the female students interviewed may not reflect the views of the wider population.

Some of the differences between Kabul University's structure and the universities reported in the literature were large enough that they may hinder the determination of

what other characteristics influence the participation of women. The first of these big differences was that once a student is selected to attend the university, their expenses while they are a student are almost entirely covered by the government. Little of the cost to attend the university is paid by students and their families. The second major difference is the assignment of students to a field of study and the lack of ability to change. In many other countries, the original choice of major and the choice to remain in that major are left up to the student. The third major difference is the class structure and grading methods used at Kabul University. The students take classes as a cohort and there is little failure thus the cohort starts at the university together and graduates four years later together. The grading is almost completely based on the written exams given after the semester completes, and students are allowed to retake that exam if they do not pass it. A completion rate of near 100% is rare is computer science programs in many of the universities. These three issues and their interactions all but eliminate many of the recruitment and retention issues.

6.3 Planned Further Research

Afghanistan is an interesting location to study computer science education because it is having a phase of accelerated technological advancement at the current time. The number of computers in homes and school is increasing at this accelerated rate because the series of wars prevented development during the past few decades. In 2010, the Department of Computer Science was removed from the Faculty of Science and a new Faculty of Computing was formed. This change makes it possible to have students specializing in computer science from their first year rather than being part of the faculty of science for one year and then becoming a computer science major. It also allows

several tracks to be available so that graduates can be specialized in a specific area of computer science. In addition, in the past year, three other Afghan universities have created active faculties of computer science in addition to new foreign universities being constructed in the country. These changes all increase the number of computer science graduates, how prepared they are for the workforce and how many specializations they represent.

This switch of the departments to faculty and the proliferation of computers through the country will all influence the choices students make about what to study and the level of preparation they have when entering the university. These factors will be changing rapidly over the next few years. The background knowledge of the field and interactions with computers and those who use them have been theorized as influencing the gender computer science education balance in countries that experience underrepresentation of women.

The ten choices specified by students when they take the Kankoor about what they would prefer to study is available and can be disaggregated by gender and location. It would be interesting to track this data over several years to determine how the demographics of the students selecting to study computer change due to these societal changes. It would also be interesting to know information about gender, about province and about previous computer exposure and training of each incoming computer science cohort.

Pakistan is also undergoing a period of technological proliferation. The universities in Pakistan are improving and enlarging their computer science tracks. Discussing these imminent changes with a professor at a university in Pakistan, I have

learned that their entrance exam structure is very similar to Afghanistan's, but they currently have a representation of women similar to the US. Since that professor has access to the data about choices made on their entrance exam, a comparison of how the changes in technology use affects the choices of women in these countries over the next several years may shed light on some reasons for underrepresentation.

The other major change in Afghanistan is the quantity and types of jobs available to computer science graduates. Tracking student career trajectories, the types of jobs the students obtain immediately after graduation and the types of jobs they have after five years in the job market, would inform the Kabul University's computer science professors and allow them to keep their curriculum geared toward the future as the country goes through these rapid changes.

Appendix A: Survey

Survey for Study of Computer Science Education in Afghanistan

This survey is to assist the researcher in determining demographic data and attitudes of the students currently studying computer science in Afghanistan. If you would rather not participate in the survey, you may put your survey paper into the box leaving it blank. The answers you give on this paper will be completely confidential. Neither your name nor any other identification information will be associated with the answers you give on this paper, and the papers will not be viewed by anyone associated with your education at Kabul University.

(این سروی بمنظور کمک نمودن شخص تحقیق کننده است در مورد تعیین آمار گیری معلومات و و گرایش محصلین که فعلاً در افغانستان در رشته کمپیوتر ساینس تحصیل میکنند. اگر شما نمیخواهید که در این سروی اشتراک کنید، ورق سروی را بدون خانه پوری در قوطی بگذارید. جوابات را که شما در این ورق می نویسید کاملاً محرم خواهد بود. نام و دیگر معلومات شناخت شما با جوابات که میدهد ارتباط ندارند و این ورق توسط هر شخص که یا تعلیم و تربیه شما در پوهنتون کابل ارتباط دارند، دیده نخواهد شد.)

1. What is your gender? (جنس شما چیست؟) Male_____ Female _____

2. What year are you currently in school? (فعلاً محصل کدام سال استید؟)
   4th Year_____ 3rd Year _____ 2nd Year _____

Questions about your parents:

3. When you graduated from high school you lived with (وقتیکه از مکتب فارغ شدید با کی زندگی کردید؟):
   Both Parents (با والدین شان) _____
   Mother Only (صرف با مادر شان)_____
   Father Only (صرف با پدر شان)_____
   Neither of your parents (با هیچ کدام شان)_____

4. What is your father's highest level of educational attainment?(بلندترین دست آورد تحصیلی پدر شان چیست ؟)
   Did not complete elementary school (مکتب ابتدائیه را تکمیل ننموده) _____
   Completed Elementary School (مکتب ابتدائیه را تکمیل نموده) _____
   Completed Secondary School (مکتب متوسطه را تکمیل نموده) _____
   Completed a Bachelor's Degree (درجه لیسانس را تکمیل نموده) _____
   Completed a Master's Degree (درجه ماستری را تکمیل نموده) _____
   Completed a Doctorate Degree (درجه داکتری راتکمیل نموده) _____

5. What is your mother's highest level of educational attainment? (بلندتری دست آورد تحصیلی مادر شان چیست؟)
   Did not complete elementary school (مکتب ابتدائیه را تکمیل ننموده) _____
   Completed Elementary School (مکتب ابتدائیه را تکمیل نموده) _____
   Completed Secondary School (مکتب متوسطه را تکمیل نموده) _____
   Completed a Bachelor's Degree (درجه لیسانس را تکمیل نموده) _____
   Completed a Master's Degree (درجه ماستری را تکمیل نموده) _____
   Completed a Doctorate Degree (درجه داکتری راتکمیل نموده) _____

6. What is/was your father's employment? (وظیفه پدرشان چی است/بود؟)_____

7. What is/was your mother's employment? (وظیفه مادرشان چی است/بود؟)_____

8. How would you classify the amount of encouragement you had from your parents to study computer science at the university? (چطور میتوانید درجه بندی کنید، مقدار تشویق را که ازطرف والدین شان بخاطرتحصیل در رشته کمپیوتر ساینس صورت گرفته است ؟)
   Low (پائین)( ) Low/Middle(پائین/متوسط)( ) Middle(متوسط)( ) High/Middle(متوسط/بلند)( ) High(بلند)( )

9. How would you classify the amount of encouragement you had from people other than your parents to study computer science at the university (چطور میتوانید درجه بندی کنید، مقدار تشویق را که ازطرف اشخاص دیگریه غیر از والدین شان بخاطرتحصیل در رشته کمپیوتر ساینس صورت گرفته است ؟)?
   Low (پائین)( ) Low/Middle(پائین/متوسط)( ) Middle(متوسط)( ) High/Middle(متوسط/بلند)( ) High(بلند)( )

Family Questions(سوالات فامیلی):

10. How many siblings do you have? (چند برادر و خواهر دارید؟)

brothers(برادرها) _____ sisters(خواهرها) _____

11. How many are older than you? (چند تن شان از شما بزرگتر استند؟) _____
How many are younger than you(چند تن شان از شما کوچکتر استند؟)? _____

12. If any of your siblings are in college or have already completed college, tell me where they went to school and what major they completed(اگر خواهر ویا برادر شما درپوهنتون استند و یا تحصیل را تکمیل کرده اند، بگوید که در کجا به پوهنتون رفتند و رشته تحصیلی شان چی است؟).

_____

_____

General Background Questions(سوالات عمومی در مورد سابقه تان):

13. Where did you study for secondary school (indicate city and country, private vs. public school, etc.)? If you studied more than one place, list all of them. (مکتب متوسطه را در کجا تکمیل نمودید" شهر، مملکت، مکتب خصوصی، مکتب عامه و غیره"؟ اگر در بیشتر از یکجا درس خوانده اید، همهء شان را بنویسید)

_____

_____

14. Who or what experience was most influential in your decision to study computer science? (کی و یا کدام تجربه بیشترین موثریت رادر تصمیم گیری تحصیل شما دررشته کمپیوتر ساینس داشت؟)

_____

_____

15. On average, what time do you leave the campus each school day? (بطور متوسط، روزانه پوهنتون را چند بجه ترک میکنید؟)

_____

16. If you are working in a self-selected group on a computer science project, usually what type of a group is it? (اگر شما به یک گروپ- انتخابی خودتان در یک پروژه کمپیوتر ساینس کار کنید، معمولا چی نوع گروپ است؟)

all male(همهء شان مذکر) ( ) mixed with mostly male(مخلوط با اکثریت ذکور) ( ) mixed evenly(مخلوط مساویانه) ( )
mixed with mostly female(مخلوط با اکثریت اناث) ( ) all female(همه اناث) ( )

Computer Background Questions(سوالات در مورد سابق کمپیوتر):

17. What computer classes did you have before starting at the university? (قبل از آمدن به پوهنتون کدام صنف کمپیوتر را شما خوانده بودید؟)

_____

_____

_____

18. What other computer skills did you have before attending the university? (کدام مهارت های کمپیوتری را قبل از آمدن به پوهنتون داشتید؟)

_____

_____

_____

19. How do you self rate the amount of computer preparation you had before starting the university? (چطور میتوانید خودتان مقدار آمده گی را که قبل از شروع پوهنتون داشتید درجه بندی کنید؟)

Low (پائین) ( ) Low/Middle (پائین/متوسط) ( ) Middle (متوسط) ( ) High/Middle (بلند/متوسط) ( )
High (بلند) ( )

20. How do you self rate your level of ease in studying computer science at the university? (چطور میتوانید (خودتان درجه سهولت تحصیل در رشته کمپیوتر ساینس را درجه بندی کنید؟

Low (پائین) Low/Middle (پائین/متوسط) Middle (متوسط) High/Middle (بلند/متوسط) High(بلند)

21. Do you have a computer in your home? (آیا در خانه کمپیوتر دارید؟) If so what year did you get it(اگر دارید، درکدام سال آنرا بدست آوردید؟)

Yes ( ) No ( ) Year _____

22. If you have a computer in your home how much would you estimate that you personally use it(اگر شما در خانه کمپیوتر دارید، تخمین استفاده شخصی شما به چی حد است؟)

Less than 1 hour per week (کمتر از یک ساعت در هفته) _____
1-4 hours per week (4-1 ساعت در هفته) _____
4-8 hours per week (8-4 ساعت در هفته) _____
8-12 hours per week (12-8 ساعت در هفته) _____
12-16 hours per week (16-12 ساعت در هفته) _____
More than 16 hours per week (بیشتر از 16 ساعت در هفته) _____

23. When you started at the university, was the faculty of science your first choice of area of study (وقتیکه شما پوهنتون را آغاز کردید، آیا فاکولته ساینس اولین انتخاب رشته تحصیلی شما بود؟)? If not, what was? (اگر نی، انتخاب اول شما چی بود؟)

Yes ( ) No ( ) _____

24. When you completed your first year of study, was the department of computer science your first choice of area of study(وقتیکه شما سال اول را تکمیل کردید، آیا کمپیوتر ساینس اول انتخاب رشته تحصیلی شما بود؟)? If not, what was? (اگر نی، انتخاب شما چی بود؟)

Yes ( ) No ( ) _____

Opinion Questions (سوالات فکری):

These questions are to be answered in your opinion – if you do not know an answer, just give a guess of what you think it is(این سوالات را از نظر خود جواب دهید. اگر جواب آنرا نمیدانید، فقط حدث بزنید که چی است).

25. On the scale below indicate where you believe computer science lies on a masculine/feminine scale (در درجه بندی ذیل نشان دهید که کمپیوتر ساینس در کدام درجه مذکر/مونث قرار دارد.).

Masculine Feminine

26. In the current Afghan computer science workforce, where do you believe the gender ratio lies (فعلاً در قوه کاری کمپیوتر ساینس افغان، شما چی فکر میکنید که نسبت جنس در کدام حد است؟)?

Male Female

27. In what ways do you think society encourages women to study computer science? (شما چی فکر میکنید که به کدام شیوه ها جامعه زنها را در تحصیل در رشته کمپیوتر ساینس تشویق میکند؟

_____

_____

_____

28. In what ways do you think society discourages women from studying computer science? (شما چی فکر میکنید که به کدام شیوه ها جامعه زنها را در تحصیل در رشته کمپیوتر ساینس تشویق نمیکند؟)

_____

_____

_____

29. Personally, what factors have encouraged your desire or ability to complete your studies in computer science? (شخصاً، کدام فکتور ها آرزو و توانائی شما را تقویت میبخشد تا تحصیل تانرا در رشته کمپیوتر ساینس تکمیل کنید؟)

_____

30. Personally, what factors have hindered your desire or ability to complete your studies in computer science? (شخصاً، کدام فکتور ها آرزو و توانائی شما را مانع میشود تا تحصیل تانرا در رشته کمپیوتر ساینس تکمیل کنید؟)

_____

31. Do you think that the equal gender representation among educators of computer science is important? (آیا شما فکر میکند که نمایش توازن جنسی مساویانه در میان آموزگاران کمپیوتر ساینس مهم است؟)? Why?(چرا؟)

_____

32. Do you think that the equal gender representation among computer scientists in the workforce is important? (آیا شما فکر میکند که نمایش توازن جنسی مساویانه در میان قوه کاری کمپیوتر ساینس مهم است؟) Why? (چرا؟)

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Appendix B: Survey Directions

Survey Directions

These directions will be read to the class after the survey papers are handed out before they begin answering the questions on the survey papers. The directions will be read both in English and in Dari (one of the official languages of Afghanistan – the language of the university lectures).

==========In English==========

This survey is being conducted by Jan Plane, a member of the faculty of computer science at the University of Maryland who will be using this data to complete a dissertation toward a PhD in Education. Many of you have met Jan Plane through her work here as part of the USAID e-Quality Alliance assisting the Kabul University Computer Science Department. Your participation in this survey and your answers on the survey (if you choose to participate) will be kept completely confidential. The survey papers will be slid through the slot in the top of this sealed box; the papers will be transported back to Maryland and will only be viewed by Jan Plane there. Your participation in this survey is completely voluntary and will have no bearing on your grade in this or any other class. If you elect not to participate, simply fold the paper in half and slide the blank survey paper you were given into the box. If you would like to participate, answer the questions on the survey to the best of your ability, fold the paper in half and slide the survey paper into the box. If there are any words on the paper for which you need translation, raise your hand and ask one of us for help. Thank you for your help in gathering this data.

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========== In Dari ==========

translated by the person giving the directions - so they were hand written

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Appendix C: Interview Questions

1. Exploring your prior experience with computing
    a. During secondary school (or earlier), what formal training did you have on the computer?
        i. What was available within your school?
        ii. What did you decide to take?
        iii. What was available outside of your school?
        iv. What did you decide to take there?
    b. When you were in secondary school, did your family own a computer?
        i. If yes
            1. Approximately when did you start using the computer?
            2. What things did you do on the computer
            3. What things did you see other family members doing on the computer?
        ii. If no – was there another computer you had access to on a regular basis?
            1. Approximately when did you start using the computer?
            2. What things did you do on the computer
            3. What things did you see other people doing on the computer?
        iii. If no – was there another computer you could use occasionally?
            1. What things did you do on that computer?
    c. What are your favorite things to do with the computer?
2. Exploring your study of computer science at the university

a. What courses have you already taken while at the university?

b. What courses have you enjoyed the most / least?

c. Is the study of computer science as an academic field what you thought it would be before you started?

d. Have you been assigned any group projects – if yes, tell me about your group members and its interactions

3. Exploring the influences on your decision to study computer science

    a. Who or what most influenced you to study computer science?

    b. What were other positive and negative influences?

4. Exploring your career goals and views of the field

    a. What area of computer science do you want to concentrate in at the university?

    b. What do you see yourself doing 1-2 years after graduation?

    c. What do you see yourself doing 7-10 years after graduation?

    d. Describe the ideal job that you would like to go into after graduation.

    e. Describe, in addition to that, the social, cultural and longer term goals of that ideal job.

Appendix D: Two Sample Interview Transcripts

x

06.03.07.0500

Researcher: If there is anything you don't understand while I'm talking, just let me know. The interview is called semi-structured, meaning I have a list of questions but anything you want to add outside of those is fine. Just say whatever you are feeling.

The first set of questions has to do with your experience with computer science. In secondary school, or anytime younger, did you have any formal training in computing?

(F-030500) Student: When I was in tech training school, I mean 3 years ago, I have assigned to learn office program at [province], but in a school, nothing. Just in [province] I have studied office software??…

Researcher: So these classes were outside of the school, at a training center?

(F-030500) Student: Yeah, at [province]

Researcher: What content did you take at that time? The operating system?

(F-030500) Student: Yeah, just the operating system. Like windows, word, excel, or ?? and s??.

Researcher: Ok. While you were doing that, did you have access to a computer in your home, or just at the training center?

(F-030500) Student: No, I have access at the home. I have one laptop, and one, two desktop at home.

Researcher: What are your favorite things to do on those computers at home?

(F-030500) Student: I just work my lessons at the that.

Researcher: Say it again.

(F-030500) Student: I work with them at the home because our lesson is all of them as o?? in computers. We can not do all of them at the university. You have to work at the home also.

Researcher: Ok, but if you're not working on the computer, as far as doing homework, what do you like to do?

(F-030500) Student: Sorry?

Researcher: Do you have any time that you're on the computer that you're not doing things you were assigned to do? That you just play and explore things on the computer?

(F-030500) Student: No, I just study.

Researcher: Just study. Ok. You said you have a laptop and two desktops at home. What did the other members of your family do with the computers? I assume everybody uses those.

(F-030500) Student: We have, one of my brothers loves to use - to a computerize and he also work at computers. And one of my sister also – in computerize.

Researcher: Ok. Is this brother and sister older or in following classes?

(F-030500) Student: My sister is one year older than me and my brother is younger.

Researcher: Ok, but you're all in computer science. That's good. What about your parents? Do they use those computers?

(F-030500) Student: My father uses office programs for work?? but my mother do not use.

Researcher: Does not. Ok. While studying computer science at the university, which classes have been your favorites?

(F-030500) Student: The second class was good because all of this was new for me.

Researcher: Which topics were your favorites?

(F-030500) Student: Oh… sorry?

Researcher: What topic? As in, do you like the programming, like Mr. Hassan?? teaches, or do you like the networking that Mr. Terrick?? teaches?

(F-030500) Student: I like all of that.

Researcher: You like both! No favorite? If you had to pick one class that you say was your favorite, can you? Or are they all equal?

(F-030500) Student: I think that program is a little good.

Researcher: Ok. Anything you didn't like, that you had to study?

(F-030500) Student: Mathematic.

Researcher: Math? Ok. That's understandable. Ok. While doing the classes at the university, sometimes you've done group projects. Have those group projects, I don't know, been helpful as far as people sharing what they know with each other?

(F-030500) Student: Yeah, we work with a group and we can learn?? each other if we have some problems. The one who knows can help the others in the group.

Researcher: In your group, is it usually all women, or a mixture of men and women?

(F-030500) Student: No, it's mixed, a mixture of women and men to be helped

Researcher: Do you see yourself in that group as one of the leaders, or do you think there's not really a leader in your group? How is the structure of your group?

(F-030500) Student: Sometimes I'm the leader, but…

Researcher: Does everyone contribute when you have a group project, or do some people not participate?

(F-030500) Student: Sorry?

Researcher: When you're doing a group project, do all the people in the group contribute to finishing the project, or do some more just ride along?

(F-030500) Student: No, all of them work together.

Researcher: Ok. Ok. When you decided to study computer science, who influenced you? Who encouraged you to do that field of study?

(F-030500) Student: When I finished my school, my mother say that I study science. And then I decided to study computer's field.

Researcher: Could you talk a little louder because I'm having a hard time catching it on the microphone. Ok?

(F-030500) Student: Ok. I said of the…

Researcher: Was there anyone who discouraged you?

(F-030500) Student: Just my family say that, said the science faculty. When I studied first class, after that I decide that, that the study computer science field.

Researcher: But why when you first left secondary school and took the test, did you choose the faculty of science?

(F-030500) Student: Just because of my family say.

Researcher: Because of what?

(F-030500) Student: My family said.

Researcher: Ok. I couldn't…. can you… hold the microphone away from your scarf. I think that might be the problem -- that it's brushing. So, what, why did you choose the faculty of science?

(F-030500) Student: Because my family says that I have to study for the faculty science.

Researcher: After you finished the first year and you decided to do computer science, rather than one of the other sciences, was there any reason you chose computer science?

(F-030500) Student: Because it was a little new. Others was, I don't like the others.

Researcher: It was more exciting because it was new? Ok. The last set of questions deal with your… career goals, and so, the first one is probably the easiest. In less than a year you're going to be graduating. What kind of job do you see yourself doing at that time? Have you thought…?

(F-030500) Student: I want to work at some offices.

Researcher: Doing what kind of work?

(F-030500) Student: I want to work at the programming field.

Researcher: What kind of an office do you think you'll be in?

(F-030500) Student: Some organization.

Researcher: Say it again.

(F-030500) Student: Some organization.

Researcher: Some organization. Would you prefer to work in a government office, or at the university, or an NGO, or any goal? Where would you like to work?

(F-030500) Student: I want to work at the government….

Researcher: At government, why? Do you know why?

(F-030500) Student: No, I don't.

Researcher: Ok. Ok, now, this one is a harder question. If you could imagine in 7-10 years… where do you think you'll be working, and what kind of a job? Those kinds of things.

(F-030500) Student: I don't know that.

Researcher: Ok. If you could dream about where you'll be in 7-10 years?

(F-030500) Student: I don't know, maybe I'll be at some other countries.

Researcher: You'll be where?

(F-030500) Student: Some other countries.

Researcher: What kind of a job will you be doing in 7-10 years? What do you think?

(F-030500) Student: I want to improve, have my knowledge at my field, study more at that field because it's not like this at the, when I graduated and didn't?? study much. I want to study more than I've studied.

Researcher: The last one is completely a dream about question. If you could ignore all the context of Afghanistan and everything, what would your ideal job be? What would you really like to do, if there was nothing else blocking you?

(F-030500) Student: Then I will decide to teaching.

Researcher: You'd like to teach. Ok. What kind of thing would you like to teach?

(F-030500) Student: Sorry.

Researcher: What would you like to teach?

(F-030500) Student: I would teach computers.

Researcher: At the university?

(F-030500) Student: Maybe at university or some schools.

Researcher: What content would you teach?

(F-030500) Student: Maybe office programs or networking or some other programming.

Researcher: Where would you like to teach this?

(F-030500) Student: School, ah?

Researcher: In Afghanistan? In Kabul or in the provinces, or where do you see yourself? Cuz this is completely a…

(F-030500) Student: In Kabul.

Researcher: In Kabul, ok.

(F-030500) Student: Yeah, just in Kabul.

Researcher: Ok. In that ideal job, how do you see that, I don't know, changing the culture and the society and everything of Afghanistan? What is your goal in doing that teaching?

(F-030500) Student: My goal is… I can't say?

Researcher: Ok. That's fine, not everybody has thought like that. This question isn't on my list, but when you first talked about what kind of job you thought you'd be doing, it was in an office, doing coding and that kind of thing. And then when I asked what your ideal job would be, it'd be teaching. Why the difference? Why do you think you…?

(F-030500) Student: If I couldn't find a job at some organization, some office, then I have to teach.

Researcher: Then you'll teach? So, which would you rather do? Working in an office or teaching?

(F-030500) Student: My brothers… my brothers all of ah… all the?? students…

Researcher: No. Which would you rather do? What would you prefer?

(F-030500) Student: Sorry?

Researcher: Between teaching and working in an office, writing code, which would you prefer to do?

(F-030500) Student: I love working.

Researcher: You'd do either… it doesn't matter? I'm sorry, I can't understand. Which would you prefer? If you had the choice, which you do, of working in an office or teaching, what is the better job for you? There isn't a right answer… it's just your opinion.

(F-030500) Student: I think working at office is better than teaching.

Researcher: Why?

(F-030500) Student: Because teaching is a little good.

Researcher: Ok. But why is working in an office better?

(F-030500) Student: Cuz when you have working at office we can work, I mean, a study a little for our self and when you are just teaching… that's boring.

Researcher: That's a good answer. Ok. That's the end of my list of questions. If you have anything to add, or if you have any questions for me, let me know what they would be. Is there anything else you would like to add?

(F-030500) Student: Why you decide to interview with us?

Researcher: Primarily because, here at the university where I teach, in Maryland, we have a very small percentage women… like 9%. Where, at Kabul, you have closer to 1/3rd of your students are women. And this varies in different countries. Like Turkey and South Korea have actually a high percentage women but the United States has a pretty low percentage. Because Afghanistan is changing so fast, I think it's an interesting place to study to see how you are going to develop. Will you continue to have more women in computer science as more women come into the university, or will you have less women in computer science? So I am trying to find the reasons each of you chose computer science. And the rest of the questions were based on the literature, that in the United States and mainly Europe and Australia, they have studied why women don't go into computer science. And some of them deal with your access to computers before going to the university, and some deal with group dynamics, and some deal with career… there's all these explanations but non of them seem to apply -- all the time. And so I'm trying to understand it. Ok. It was because when I first came to Kabul in 2005, I walked into the lab where students were working and it was all women. No men were working on the computers and I found that amazing… cuz I never see that here. So, it was good to see. And that's where I thought that most groups for study are mainly all women. And yet, that's not the answers I'm hearing.

(F-030500) Student: It's also nice to see you.

Researcher: It was good to see you.

(F-030500) Student: See you at the our country.

Researcher: I will probably be coming yet this summer. So I will meet you in person within a couple months. Ok. Thank you very much for participating. Sardar has a form that I need you to fill out. Ok. So, thank you very much.

(F-030500) Student: Thank you too. Have a nice day.

06.04.07.0530

Researcher: I'm Jan Plane and I'm doing research to try to understand different perceptions about computer science as a field of study. What we have is a semi-structured interview, which means I have a list of questions to ask you, but anytime you want to add anything else just let me know. Of if you have trouble understanding my English, let me know. Our connection today isn't as good -- in fact, a lot of noise in the background -- I'm having trouble. Could you ask Kudseaha to talk to somebody outside of the room?

(M-040530) Student: Is this ok?

Researcher: Yes, it's better. Ok. My first set of questions deal with your history in studying computing. When you were in secondary school, or earlier, before you started at the university, did you have any formal training in computing, about how to use the computer?

(M-040530) Student: During my secondary school in Pakistan, I studied computer IT and science field.

Researcher: What kind of subjects?

(M-040530) Student: At that time, we studied Dos and Windows and GW BASIC That's it. Programming.

Researcher: Ok. Any computer usage type classes, as in on the word processor or Excel or anything?

(M-040530) Student: No, not at this, that time.

Researcher: Just programming. And those were done in your school, not in an external training center?

(M-040530) Student: No. Just in our school.

Researcher: Where were you in school? Where was…

(M-040530) Student: In [Pakistan Province]

Researcher: How old were you when you took those classes?

(M-040530) Student: I was 14 or 15.

Researcher: Why did you decide to take those? Did everyone have to take them, or was it your choice?

(M-040530) Student: No. We have choice. There were two sessions -- one biological science and one computer. So I chose computer at that.

Researcher: Do you know why you chose computing?

(M-040530) Student: Because, I think computer, I thought the computer was new technology, and according to my interests at that time, I continued that, that field.

Researcher: While you were taking that class in secondary school, did you have a computer at your home to practice on?

(M-040530) Student: Yeah.

Researcher: When did you first get a computer in your home?

(M-040530) Student: And here 1937 - I think, 1999.

Researcher: What kind of things do you like to do on that computer, when you're not doing homework? What's your favorite things to do?

(M-040530) Student: Now, or at that time?

Researcher: Start then, at that time. What did you like to do?

(M-040530) Student: At that time… just practicing on GW Basic programs… and little more playing games.

Researcher: Ok. What kind of games?

(M-040530) Student: At that time, Day 3?? and Transgate??.

Researcher: Ok. What do you like to do now, on the computer?

(M-040530) Student: Now, I am working computer a lot. Now.

Researcher: When you're not working or doing school work, do you still play games and just program for fun?

(M-040530) Student: No. In my other class I learned, I do some designing, site designing for Web and things.

Researcher: So, website things? Ok. When you chose to study computer science at the university, what do you think most influenced you? As in, did somebody tell you this is what you should do, or was it your decision completely?

(M-040530) Student: No. It was my decision… because the time of secondary school, I thought the computer is the best field. So when I finished the secondary school, then high school, then I decided to continue my father's way and get a science use degree.

Researcher: What did your parents think about computer science as an area of study? Did they like that idea or think you should've studied something else?

(M-040530) Student: Yeah. They appreciate me a lot in this field.

Researcher: They what? I'm sorry. Say that again…

(M-040530) Student: Appreciate. Appreciate.

Researcher: Ok. Was there anyone that really discouraged you from studying computer science, trying to talk you into doing something else?

(M-040530) Student: No, not a special thing person here. No person

Researcher: No? Ok. In your computer science classes, sometime you have individual projects and sometime you have group projects. Which way do you prefer to work? Would you prefer to have an individual or a group project?

(M-040530) Student: I think group project is best.

Researcher: Group. Ok. In those group projects, how… describe the group. As in do they all participate equally, or somebody more leading and everyone else following… how do your groups usually work?

(M-040530) Student: In a group, we have different skills so I think all of the groups can work to their ability.

Researcher: Everyone works equally?

(M-040530) Student: I don't know, I think, they are able to work equally. Some of them work high end, some of them low, low levels.

Researcher: Is it usually a mixed group, as far as some boys and some girls, or is it usually all boys in your group?

(M-040530) Student: Sorry?

Researcher: Your groups, when you do a group project, is it usually mixed, having some boys and some girls, or is it usually all boys?

(M-040530) Student: No. It's mixed.

Researcher: Mixed. Ok. Is there any difference in the kind of work the boys do versus the girls?

(M-040530) Student: Right now my team, they all work equally.

Researcher: They all work equally?

(M-040530) Student: Yeah.

Researcher: Ok. There's no difference?

(M-040530) Student: No.

Researcher: Ok. When you… the last... oh, no... let's stay with the group thing a minute. One more question about the groups -- are your groups usually the same for each class or for every class do you choose different people to work with?

(M-040530) Student: In our group, everyone is from same class.

Researcher: No, I know everyone is from the same class, but… for example, when you did the java course and you had a group project, did you work with the same people as when you went to the data structures course, which also had a group project, I think? Right?

(M-040530) Student: No.

Researcher: It's different people.

(M-040530) Student: We actually change our class. Yeah. Sometimes we change our members.

Researcher: In computer science, what is your favorite area of study? So, out of the classes you've taken which class did you like the best?

(M-040530) Student: In computer science field, I like the best… networking.

Researcher: Networking. Ok.

(M-040530) Student: Yeah. Especially in the area of wireless. And now I am get my teaches CISCO on my next class

Researcher: Which area do you like the least? Which class?

(M-040530) Student: Wireless.

Researcher: Which one?

(M-040530) Student: Wireless classes.

Researcher: I couldn't understand.

(M-040530) Student: Wireless networking and security programming. Wireless networking.

Researcher: Ok. Which one did you not like? What do you like the least, as far as a course?

(M-040530) Student: Ok. Programming.

Researcher: Programming. Any certain language you don't like programming?

(M-040530) Student: Java.

Researcher: Java. Ok. That's consistent. Ok. The last group of questions all deal with what you see yourself doing as a career. So, in one year you will be graduated and out working. What kind of thing do you see yourself doing in 1-2 years? During that first year after graduation, what kind of job?

(M-040530) Student: So, after my graduation, I'd like to work in that filed mmm netork programming. It would depend on my field. And, first of all, I want to join company with high speed/ISP, have an idea to make it also. And, if I can't do that, just so I can have a mentor teach on private sectors in field of IT.

Researcher: Ok. Now looking at it… actually, describe that job a little bit more. What kind of job you think you'll have. Is it working in a group or as an individual, or what do you think, if you were to work in IT? So describe the job more. What kind of work and what kind of people.

(M-040530) Student: People is using it doesn't matter what. So, I want to be in IT all the same to do it. Which, and ah… Especially hire us going into companies. I want to go for it in the wireless networks. And that's why I'm doing IT on WIMAX, and I want to complement the WIMAX on??

Researcher: That sounds good. How do you see this job… or what is your motivation for what kind of job? Is it were you can earn the most money, or how you can better society, or how you can increase your own knowledge? What do you think is your primary motivation?

(M-040530) Student: Yeah, my primary motivation is that I want to first work to gain all experiences and more knowledge about my field and after that, I want good job to gain more money. First my knowledge and experience.

Researcher: That's good. Ok. Now a couple of questions that are more imagination. In 7-10 years, what kind of job do you see yourself doing?

(M-040530) Student: In the future?

Researcher: Yes… 7 or 10 years.

(M-040530) Student: Ok. Just for me?

Researcher: Yes. What best fits you?

(M-040530) Student: That's IT field. IT tasks.

Researcher: IT?

(M-040530) Student: IT. Yeah.

Researcher: Ok. Describe a little more how that job would be different than the one for 1-2 years.

(M-040530) Student: Sorry, I can't explain it quickly.

Researcher: Say it again.

(M-040530) Student: Yeah... sorry, I can't understand it? Can you explain it again?

Researcher: Ok. How would the job in 7-10 years be different from the job in 1-2 years? So how would your job grow in those 7 years?

(M-040530) Student: Yeah. According to the internet, day-to-day technology is increasing and growing faster, so in 7 years, or after that, maybe the technology is change. And the jobs also change, so I think, that's it.

Researcher: Ok. Now, a little bit more imagination. If you can ignore all the context of Afghanistan, and you could do any kind of computing job, anywhere, what would you really like to do?

(M-040530) Student: In what field? Or what?

Researcher: In computer science…yes. Or? … Yeah.

(M-040530) Student: Ok. Yeah. Anywhere in the world, I want to do job networking field. Doesn't matter if it's organization or any other country to go

Researcher: Ok. Good. So you're in the field you like. That's good. That's the end of my questions. So, I would like to ask if you have just anything you'd like to add… anything you've thought about computer science as a field of study.

(M-040530) Student: In the field of study I think the fastest field growing is the computer science. I think now it is increasing a lot… and I think for organization it is very good in truth for advancement and it's just the IT that pays and makes difference and we are trying to get our progressing in the state.

Researcher: Ok. Do you have any questions for me?

(M-040530) Student: Let me think. … Ok. What's the difference between the computer field here and over there… anything different in organization and over there?

Researcher: The difference in computer science? As in an area of study?

(M-040530) Student: Yeah.

Researcher: One major difference between our universities is the, I don't know, the variety -- that here, we have many different tracts and people can major in computer science but concentrate, for example completely in theoretical computer science, which is more mathematics or completely in network, and there is a lot more variety that's partly because of our credit system, but that variety isn't in Afghanistan yet, primarily because you don't have the teaching resources, as in, it's going to take a little while to build it up so that you can have that variety. So, the goal in your bachelor's program is to make people that graduate, that are general purpose, that you can go into many different jobs. Because that's what Afghanistan needs, there are so many jobs for IT people. So, I think that's the major difference.

(M-040530) Student: Ok. So, if a student that graduate from here, can he study further, I mean take his master's degree over there? Or he'll face problem over there?

Researcher: There would probably need to be some work done to make up the difference between them, at most universities here. Primarily because you wouldn't have specialized enough in one area. But it would be very close, that you would be able to. So…

(M-040530) Student: So, if I want to continue my final education stage in masters over there, and so is it possible to me and to continue over there, over there easily, or I'll face some problem over there?

Researcher: Yes. It would be possible. It would probably be a lot of hard work, to start, because you would be coming in not with the strongest background. So you would have to do some things to make up that difference, but it's definitely possible. Ok?

(M-040530) Student: Ok. Yeah. Ok. I'll do my best to come up with a…

Researcher: Good. Just keep studying, cuz the more you study and the more you practice, the better computer scientist you're going to be. Ok. Do you plan to go on for a masters?

(M-040530) Student: Yeah. But first, for 6 months or a year, I want to complete a station that I left in this duration. And I want to first… complete… improve my job skills now. Because if you are good at job you can make money. We have a ok background while in there, especially in the field of study. So after 1 year or 6 months, I'll prepare myself for my master's degree [in US].

Researcher: That's good. Very good.

(M-040530) Student: Thank you.

Researcher: There is also a possibility of some distance courses that the people in the Angel Center are helping to arrange, and those could give you some more background in areas that you don't have classes in. So that would be a good way to prepare also. Ok?

(M-040530) Student: Ok.

Researcher: Ok. Well, thank you for participating. Kudseaha has a form for you…

Appendix E: Themes Around the Area of Employment

Work

(F-030430) Student: Yes. This really hard to say this, because as far as I think, in Afghanistan, we don't predict. We don't make this much decision, or this much plan for us for so long time because… here in Afghanistan, we even not predict what we are going to do, or what we are, what we are maybe doing tomorrow. That's I think difficult ????? a little to decide to what to do in 7 years.
(F-030430) Student: Cuz here, life is not so much stable for us. So, I don't know.

IT

(M-020430)Student: Working maybe in a small office working as an IT supporter or an IT officer maybe – solving the problems of the office. I mean the networking and computer problems – the problems of the staff in their jobs – working with computers.
(M-040500) Student: I think I may become an IT Officer. Maybe? Cuz I like most ?? ?? yes?

PROGRAMMING

(F-030430) Student: I would like to… programming… anything related to coding.

(M-040500) Student: I like the most web designing, but, also programming. But in Afghanistan, I don't think programming is a good major.
Researcher: You don't think what?
(M-040500) Student: Because, there is no computerize [protection] law. We can copy and make our own. All the Microsoft software sites that are very, very expensive in America or other countries in the world. Here in Afghanistan, you can just buy them in, for $3. Or maybe $1.

NETWORK ADMIN

(F-020600) Student: I will be a network administrator.

WEB DEVELOPMENT

(M-020430)Student: Of course, it will affect the community and society. These days, when the world is turning into a global village. Our country is far away from other countries. These companies need to have web pages on the internet. If I work as a web page developer, it would affect the community. And businesses who want to have web sites, if they want to have more popularity, probably my job will affect their work and through them the society.

ACCOUNTING

(F-020600) Student: I think it would be accounting or management. I like accounting also.

WHERE

(F-030500) Student: I want to work at the government....

(F-030430) Student: I think I'll be doing, I will work with NGO, maybe.

(M-040600) Student: I think I'm still working in some NGO or in government places. I can not decide it now.

(F-060530) Student: She's saying at first, in offices, at offices, I would prefer to work in offices.
(F-060530) Student: She say she prefer to work at office, I mean, like working in the projects in field of database or web designing.
(F-060530) Student: She saying that I can not work in an NGO but I would prefer to work in a ministries or university.
(F-060530) Student: She says because of my old brother. He is a little bit strict and he doesn't like me to work in an NGO.

STEROTYPE

(F-020600) Student: Yes. Sometimes people say that it's not good, and you can't work outside when you graduate, but I see it's not like that.
(F-020600) Student: I just came from [Germany], from there, and I really saw that there was good universities. They had technique at their university. I think it will be good to stay/study??? there.

(F-020530) Student: Here. Yeah, here is like different culture and different ideas in our people, between our people. So some, our people think that a shouldn't girls go out from their home. Just they do their duty of their home. Then they don't want to go their girls to the outside of the home. But ah, until now, most I've met some most of the family think like this. I don't know which kind of idea that have in our mind, in their mind. But I like, every family should live the girls to enjoy the faculty and jandis???? and central education.
(F-020530) Student: But I think that most of the Afghan family don't want to let their girls go outside their home. Almost 70%. 70%.
(F-020530) Student: I, yeah, just when I go back to my province after 3 years, I met the several but all they are married. Their family don't let them to go to join the faculty.

MONEY

(M-020430)Student: Well, I have an opinion. In the poorer countries like Afghanistan, people usually try to have a profession or choose a profession that can give them some money in the future. With the help of that they can earn some money, and these days in Afghanistan I think computer science is the most wanted profession. I mean that most of the people are interested in this field. About the job, I used to think that after I graduate I will get a job in the field of IT. And I would be an IT officer or something but I am not sure. OK you can continue.

EXPERIENCE ANYWHERE – THEN…

(M-040530) Student: Yeah, my primary motivation is that I want to first work to gain all experiences and more knowledge about my field and after that, I want?? gain more money. First my knowledge and experience.

(F-020600) Student: First, my goal is to study more. And the second, the main goal is to help my people.

(M-040530) Student: Yeah. But first, for 6 months or a year, I want to complete a station that I left in this duration. And I want to first… complete… improve my job?? now. Because if you are?? We have a ?? background while in there, especially in the field of study. So after 1 year or 6 months, I'll prepare myself for my master's degree [in US].

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