FACTORS INFLUENCING THE CAREER CHOICE IN SOFTWARE DEVELOPMENT AMONG FEMALE UNDERGRADUATE STUDENTS AT JOMO KENYATTA UNIVERSITY OF AGRICULTURE AND TECHNOLOGY, KENYA

BY

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DECLARATION

This research project report is my original and has not been submitted for a degree in any other University.

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This research project report has been submitted for examination with my approval as University supervisor;

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DEDICATION

I dedicate this work to my husband Mr. Benjamin Leonard Muraguri, my son Ethan Mwangi Muraguri and my unborn child for their constant encouragement and support. I also dedicate this work to all women in computing and information technology, in Kenya who work round the clock everyday to have an impact on society.

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ACRONYMS AND ABBREVIATIONS

U.S. BLS	United States Bureau of Labor Statistics
AAUW	Association of American University Women
KTCIP	Kenya Transparency and Communications Infrastructure Project
CRA	Computing Research Association
FAWE	Forum for African Women Educationalists
CACM	Communications of Association of Computing Machinery
ABI	Anita Borg Institute
SWIFT	Supporting Women in Information Technology

ABSTRACT

The retention of women in software development is a global problem. This report reflects on the results of a comprehensive study of female undergraduate students that was carried out at Jomo Kenyatta University of Agriculture and Technology. The Government policy on Gender (Sessional Paper No. 5 of 2005 on Gender Equality and Development) requires 30% of all jobs to be held by women across all careers. This study aimed at investigating the factors influencing the career choice in software development among female undergraduate students at Jomo Kenyatta University of Agriculture and Technology. A knowledge gap exists on the reasons for female undergraduate students' career choices in software development at university level. The independent variables of the study were gender perceptions, female role models in the software development industry, cultural norms and career guidance. The moderating and intervening variables were government and education policies and environmental and technological factors respectively while the dependent variable was the career choice of software development among female undergraduate students at Jomo Kenyatta University of Agriculture and Technology. Data was collected using questionnaires and secondary data. The sample composed of 100 students selected randomly from five departments; Computing, Information Technology, Electrical and Electronics Engineering, Human Resource and Development and Telecommunication and Information Engineering. The data collected was then coded and checked for coding errors and omissions. The coded data was processed in the Statistical Package for Social Sciences (SPSS) and analysed using percentages and mean scores to come up with data models to help in meeting the study objectives. The study was then be used to draw conclusions based on the data collected. Results from the data collected indicated that the career choice in software development among female undergraduate students at Jomo Kenyatta University of Agriculture and Technology is indeed influenced by career guidance, female role models, gender perceptions and cultural norms, in that order. This research therefore recommends that the stakeholders in the ICT sector map out strategies aimed at equipping women with more skills and training in software development from university level to the job market, in order to achieve growth potential in this dynamic industry hence making a significant contribution to the economy at large.

CHAPTER ONE
INTRODUCTION

1.1 Background to the study

From its beginnings in the 1940s, writing software has evolved into a profession concerned with how best to maximize the quality of software and of how to create it. Quality can refer to how maintainable software is, to its stability, speed, usability, testability, readability, size, cost, security, and number of flaws or "bugs", as well as to less measurable qualities like elegance, conciseness, and customer satisfaction, among many other attributes. How best to create high quality software is a separate and controversial problem covering software design principles, so-called "best practices" for writing code, as well as broader management issues such as optimal team size, process, how best to deliver software on time and as quickly as possible, work-place "culture," hiring practices, and so forth. All this falls under the broad rubric of software development (Simcard, 2007).

There are a number of areas where the evolution of software development is notable:

Emergence as a profession: By the early 1980s, software development had already emerged as a bona fide profession, to stand beside computer science and traditional engineering.

Role of women: In the 1940s, 1950s, and 1960s, men often filled the more prestigious and better paying hardware engineering roles, but often delegated the writing of software to women. Grace Hopper, Jamie Fenton and many other unsung women filled many computer programming jobs during the first several decades of software development. Today, fewer women work in software development than in other professions, a situation whose cause is not clearly identified. It is often attributed to sexual discrimination, cyber culture or bias in education. Many academic and professional organizations consider this situation unbalanced and are trying hard to solve it.

Processes: Processes have become a big part of software development and are hailed for their potential to improve software and sharply criticized for their potential to constrict software developers.

Cost of hardware: The relative cost of software versus hardware has changed substantially over the last 50 years. When mainframes were expensive and required large support staffs, the few organizations buying them also had the resources to fund large, expensive custom software engineering projects. Computers are now much more numerous and much more powerful, which

has several effects on software. The larger market can support large projects to create commercial off the shelf software, as done by companies such as Microsoft. The cheap machines allow each software developer to have a terminal capable of fairly rapid compilation. On the other hand, fewer organizations are interested in employing software developers for large custom software projects, instead using commercial off the shelf software as much as possible (Schinzel, 2002).

The term software development first appeared in the late 1950s and early 1960s. Programmers have always known about civil, electrical, and computer engineering and debated what engineering might mean for software. The NATO Science Committee sponsored two conferences on software engineering in 1968 (Garmisch, Germany) and 1969, which gave the field its initial boost. Many believe these conferences marked the official start of the profession of software engineering.

The gender breakdown for software development through LinkedIn lists 416,030 people as working in Northern Europe. The National Skills Bulletin (2010) states that there were 1.88 million people working in full or part time employment in 2009. Of those listed on LinkedIn, 37,322 describe themselves as working in "Engineering" or "Information Technology" – two quite broad descriptions, both of which will include a portion of people who have absolutely nothing to do with software development. At this level, the breakdown is 28,387 male, 6,722 female. About 2,213 have not listed their gender. To try and extract the main corpus of "software developers" from the Industry section, a quick poll of LinkedIn connections shows: Computer Hardware, Computer Software, Computer Networking, Internet, Information Technology and Services, Computer & Network Security, Wireless, Online Media, Publishing and Information Services giving 13,080 people in total. The gender breakdown for this is 10,141 male, 2,148 female (791 unknown). So, do 13,000 sound like a good ballpark figure for the number of software developers in Northern Europe? 84% male vs. 16% female? Careers Portal has some information compiled from the National Skills Bulletin 2010. They conclude that there are 9,000 people employed in software development in Northern Europe, and that the gender breakdown is 89% male, 11% female. (National Skills Bulletin 2010)

The percentage of women software developers in the U.S. has declined from 42% in 1987 to less than 25% today. This is in a software/internet marketplace where women are online in equal numbers to men, directly or indirectly influence 61% of consumer electronics purchases, generate 58% of online dollars, and represent 42% of active gamers. Women avoid careers in software due to hostile environments, unsustainable pace, diminished sense of purpose, disadvantages in pay, and lack of advancement, peers or mentors. (Judy2007)

U.S. Bureau of Labor Statistics (2010) shows that not only are women underrepresented in IT, but their percentage as software developers is even lower than the general percentage in IT jobs. (BLS) Looking at the BLS numbers, it is interesting that these professions attract more women (as a percentage) than software engineers (20.2%): Bailiffs, correctional officers, jailers (26.9%), Chief executives (25.0%), Database administrators (35.3%), Biological scientists (45.1%), Chemists and materials scientists (30.0%) and Technical writers (50.4%).

Even the professions that are said to have a glass ceiling (such as CEO) have more women in them than software development. Based on the number of science positions listed in the BLS data with substantial numbers of women in them, it is clear that the myth that women are afraid of math or science is just plain wrong (even if less than 1% of mathematicians are women). And given the bizarre outlier of Database Administrators at 35.3%, and technical writers at 50.4%, we can see that women certainly do not dislike computing fields in general (NSF, 2003).

Women are opting out of software jobs despite high demand for skilled developers. Women are also leaving mid-career in disproportionate numbers. This is a lost opportunity. Research conducted over twenty years on serially innovative companies shows that product teams representing the diversity of their customers have an advantage in developing products that appeal to those customers (Simcard, 2007).

In this report, it was demonstrated that gender disparity exists and that it is an impediment to product success. Factors in universities that encourage gender disparity were identified. Finally, values of collaboration, craft, quality and delivery as a framework for addressing these factors are explained.

1.2 Statement of the problem

This study addressed the various factors that influence the career choice in software development among female undergraduate students at Jomo Kenyatta University of Agriculture and Technology and how this affects the information technology field. At the moment the number of undergraduate female students pursuing computing and information technology courses account for 18% of the total number of students at Jomo Kenyatta University of Agriculture and Technology (Vashti, 2002).

The software development industry faces quite a number of challenges, especially under representation from both males and females. The percentage of software developers in the U.S has been on the decline over the past five years, most especially among the females. This is disturbing as software development contributes to product development and innovations that have changed the world and the way of thinking. Many avoid careers in software development due to disadvantages in pay, hostile environments, unsustainable pace, diminished sense of purpose, and lack of advancement, peers or mentors. (Judy, 2007)

Gender disparities in software development in higher institutions of learning are apparent. For example, Jomo Kenyatta University of Agriculture and Technology, a university that offers only Science and Engineering courses, has the lowest enrollment of female students at 20% whereas Kenyatta University has 25% female enrollment (Agesa and Agesa, 2002). The number of women decreases further at the graduate level. In 1989/90 of the 227 students enrolled in graduate programs in Jomo Kenyatta University of Agriculture and Technology, one of the large public universities, only 4.2% were women. One of the explanations is the underrepresentation of women among the top 15 students (first class and upper second class honors) (Hughes and Mwiria, 1989). Academic performance is a top criterion in admission to graduate programs. In order to create effective career guidance programs for female students, it is important to understand why these women are able to make the choices they did and how they have achieved success.

1.3 Purpose of the study

The purpose of the study was to determine the factors that influence career choices in software development by female undergraduate students pursing computing and information technology related degrees at Jomo Kenyatta University of Agriculture and Technology.

1.4 Objectives of the study

i. To establish the extent to which gender perceptions influence the career choice in software development among female undergraduate students at Jomo Kenyatta University of Agriculture and Technology.

ii. To assess how existing female role models influence the career choice in software development among female undergraduate students at Jomo Kenyatta University of Agriculture and Technology.

iii. To examine the influence of cultural norms on the career choice in software development among female undergraduate students at Jomo Kenyatta University of Agriculture and Technology.

iv. To examine the influence of career guidance on the career choice in software development among female undergraduate students at Jomo Kenyatta University of Agriculture and Technology.

1.5 Research Questions

1. How do gender perceptions influence the career choice in software development among female undergraduate students at Jomo Kenyatta University of Agriculture and Technology?

2. How does the existence of female role models influence the career choice in software development among female undergraduate students at Jomo Kenyatta University of Agriculture and Technology?

3. How do cultural norms influence the career choice in software development among female undergraduate students at Jomo Kenyatta University of Agriculture and Technology?

4. How does career guidance influence the career choice in software development among female undergraduate students at Jomo Kenyatta University of Agriculture and Technology?

1.6 Justification of the study

This study established the factors influencing the career choice in software development among female undergraduate students at Jomo Kenyatta University of Agriculture and Technology. It is noted that women account for the lowest percentage in software development in Kenya despite the fact that it is a fast growing sector with vast opportunities. This study shows that unlike the women, men access software development services and make use of them, as they tend to operate businesses in computing and information technology. There have been several researches done on women engaging in computing however very few have put their attention on software development. This study shows facts and figures that will enable policy makers appreciate the need of having women in software development hence a greater contribution to development especially in the IT sector.

1.7 Scope of the study

This study focused on female undergraduate students pursuing courses in Computing and Information Technology at Jomo Kenyatta University of Agriculture and Technology. This study covered five departments at Jomo Kenyatta University of Agriculture and Technology; Computing, Information Technology, Electrical and Electronics Engineering, Human Resource and Development and Telecommunication and Information Engineering.

The scope of this study was also limited to specific variables of the study that influence career choice in software development among female undergraduate students at Jomo Kenyatta University of Agriculture and Technology. These variables are: Gender perceptions, Female role models, Cultural norms and Career guidance.

1.8 Limitations

According to Mugenda and Mugenda (2003), a limitation is some aspect of the study that the researcher knows may negatively affect the results of generalizability of the results, but over which he/she has no control. Some of the limitations of this study included the influence of socialization process and stereotyping by the respondents. This was overcome by reassuring the respondents of confidentiality of information.

1.9 Basic Assumptions of the study

This study assumed that the respondents would have good understanding of the factors that influence their career choice in software development.

1.10 Definitions of significant terms

Career	This is a profession that involves special training or formal education. It is an individuals' journey through learning and working.
Career choice	Selection of a course of study which leads to a specific profession according to one's interest, passion and ability as influenced by factors such as gender perceptions, female role models, cultural norms and career guidance**.**
Career Guidance	The provision of specific activities targeted to the particular needs and concerns of an individual whose career expectations are significantly altered.
Cultural norms	Informal understandings that govern society's behaviors, while psychologists have adopted a more general definition, recognizing smaller group units, may also endorse norms separate or in addition to cultural or societal expectations
Factors influencing career	These are aspects that control the decision on a student's career
Gender perceptions	Ideas and views that arise from socially constructed and culturally variable roles that men and women play in their daily lives that distinguish between male and female.

Female Role models	People who have had great influence in the lives of the female students such as mentors and female lecturers.
Stereotype	Belief that students hold about careers perceived to be masculine or feminine.

1.11 Organization of the study

The study is organized into five chapters. Chapter one consists of the background of the study, statement of the problem, purpose of the study, objectives of the study, research questions, significance of the study, scope of the study, limitation of the study and definition of significant terms. The second chapter reviews related literature on factors that influence career choice in software development among female students at Jomo Kenyatta University of Agriculture and Technology which include gender perceptions, female role models, cultural norms and career guidance. A conceptual framework is also presented. Chapter three details research methodology that was adopted for the study. It outlines research design, target population, sample size and sampling procedures, research instruments, validity and reliability of instruments, data collection procedures and data analysis techniques. The fourth chapter presents detailed analysis of the research, data presentation, interpretation and discussion of collected data. The fifth chapter gives a summary of findings, conclusion, recommendations and suggested areas for further research.

CHAPTER TWO
LITERATURE REVIEW

2.1 Introduction

This section contains literature that has been written on Computer Science and Software Development, specifically pertaining women. Literature on Software Development and its influence on women has also been extensively covered here.

2.2 Gender perceptions influence

Gender usually refers to a set of characteristics that are considered to distinguish between male and female, reflect one's biological sex, or reflect one's gender identity. Gender identity is the gender(s), or lack thereof, a person self-identifies as; it is not necessarily based on biological sex, either real or perceived, and it is distinct from sexual orientation. It is one's internal, personal sense of being a man or a woman (or a boy or girl) (Collis and Williams, 1987). There are two main genders: masculine (male) and feminine (female), although some cultures acknowledge more genders. Gender expression refers to the external manifestation of one's gender identity, through "masculine," "feminine or gender-variant or gender neutral behaviour, clothing, hairstyles, or body characteristics (Lent et al., 1994). Despite more than four decades of legislation designed to break down career gender stereotypes and open up a wider range of career opportunities for women, a wealth of evidence suggests that gender remains a strong influence in career choice for both men and women. Multiple studies of so-called non-traditional careers suggest that most women choose jobs that are mostly filled by women, while men continue to choose occupations that are dominated by men. Historically, women's career choices were limited by their gender because many professions were not open to them. Affirmative action policies, intended to remove barriers to women's career choices and break down career stereotypes, originated in the early 1960s. According to data from the U.S. Bureau of Labor Statistics (BLS), the top career choices among women included elementary and secondary school teachers, nurses and secretaries or administrative assistants. Women make up more than 90 percent of the workers in these three occupations (Mattis, 2002).

Despite the high employment opportunities in the IT sector in Africa, women cannot completely avoid the gender stereotype. There is still a perception that software development jobs are more

suitable for male employees and women are more suitable for customer and technical support jobs. Gender employment patterns vary significantly among foreign and domestic companies. The male to female employment ratio is close to 1:1 in some foreign companies, whilst 4:1 in domestic companies (Liu, 2004). In spite of this gender stereotype by employers, the African IT women hold a pragmatic view themselves. According to the 'Investigation Report on the Living Conditions and Competitiveness of Women in IT', 80% of the IT women believe the female gender is no longer the biggest factor that limits their career development; instead, their biggest hurdle is the 'weakness' inherent in the female gender. This can range from mood swings, emotions, dependence on other people's help when the 'going gets tough', tendency to 'give up' when under pressure, to the lack of self confidence (Durndell et al., 2000).

The Ministry of Education has also recognized that gender is a key determinant of educational attainment, hence the need to articulate a gender policy in education. In 2007 the government made provisions in its Gender in Education Policy to ensure women participate equally in education (Republic of Kenya, 2007). The overarching goal of the policy is "to promote gender equity and equality in education, training and research, to contribute to the economic growth and sustainable development of Kenya." (p. 16). Some of its provisions include; a) enhancing educational outcomes for girls and boys, women and men; b) providing mechanisms to enhance participation of females in Science, Math and Technology (SMT) based courses; d) providing policy guidelines and a legal framework to ensure gender-responsive management and administration of universities and equity in university education. In a limited effort to implement the gender policy in education, the Ministry of Education has started collaborating with the Forum for African Women Educationalists (FAWE) to create replicable programs in schools that encourage women to get into SMT careers (FAWE, 2007). These have included training of teachers to be competent in gender responsive teaching methods and using gender-sensitive teaching and learning materials.

According to a 1998–2000 ethnographic study by Jane Margolis and Allan Fisher at Carnegie Mellon University, men and women viewed computers very differently. Women interviewees were more likely to state that they saw the computer as a tool for use within a larger societal and/or interdisciplinary context than did the men interviewed. On the other hand, men were more

likely to express an interest in the computer as a machine. Moreover, women interviewed in this study perceived that many of their male peers in areas like software development were "geeks", with limited social skills. Females often disliked the idea that software development "becomes their life." (Handcock, 2004). The students observed and interviewed in that study were probably not representative of students in general, since at that time, in order to be admitted to Carnegie Mellon University Computer Science a student needed to have some programming experience.

A study of over 7000 high school students in Vancouver, Canada showed that the degree of interest in the field of computer science for teenage girls is comparably lower than that of teenage boys (Handcock, 2004). The same effect is seen in higher education; for instance, only 4% of female college freshmen expressed intention to major in software development in the US (Cooper and Weaver, 2003). Research has shown that some aspects about computing may discourage women. One of the biggest turn-offs is the "geek factor". High school girls often envisage a career in software development as a lifetime in an isolated cubicle writing code. The "geek factor" affects both male and female high school students, but it seems to have more of a negative effect on the female students. Nearly 1000 students in University of Akron were surveyed, and it was discovered that females hold a more negative attitude towards computers than males**.** Another study assessed the computer-related attitude of over 300 students in University of Winnipeg and obtained similar results**.** This is thought to contribute to the gender disparity phenomenon in computing, in particular the females' early lack of interest in the software development (Dean, 2007).

2.3 Female role models influence

According to a survey conducted by Elance, 45% of the women interviewed said the greatest deterrent to getting more women in technology fields is a lack of female role models (www.elance.com). In a recent research by CIO Magazine, seventy-three percent of young girls said there's a big difference between using technology in their personal lives and wanting to pursue careers in technology because of the relative few "smart female role models," the survey says. More than half the girls also think there should be fewer celebrity role models like Britney Spears and Lindsay Lohan, and more inspirational business role models. Notable technology

executives who could fit the bill include CIO magazine Hall of Fame inductees Barbara Cooper and Dawn Lepore. RIM itself also has a female CIO, Robin Bienfait."Never underestimate the power of role models. If young women can see a career path which has been enjoyable and rewarding for another, they are more likely to follow it themselves," said Maggie Philbin, former host of popular British science and technology TV show, Tomorrow's World, in a press release. "It's so frustrating to see teenagers using technology naturally and creatively, seemingly unaware that they could play a key role in shaping the way we use technology in the future. And it's equally important, once they make the decision to work in this area, that they are encouraged and inspired to rise to the highest level."(CIO, 2012)

Women also lack the support and advocacy needed to promote these skills**.** Women feel alone and at a loss because they lack role models, networks, and mentors. These support systems not only help women develop talent and opportunities for career advancement, but they are also needed to promote women to more senior roles (Catalyst, 2003). Mentoring and modeling are strong influences on women who are seeking a career field (Catalyst, 2001). McQuillan and Bradley (1999) studied university women and technology in Ireland and found that role models provide powerful lessons and learning opportunities for female students. Unfortunately, though, there are limited numbers of women role models in the ranks of science and IT professors on university campuses. In the report on the status of women in computing science by a committee of the Association of Computing Machinery, one of the four primary challenges found for women who attempt to become software developers is the lack of mentoring and role models. As the report attests, “Mentors play a crucial, though usually informal, role in the training of young software developers” (Pearl, Pollack, Riskin, Thomas, Wolf, & Wu, 1990). It is desirable for women to have female role models and mentors, the report continues, and any institution truly interested in encouraging women in technology must consider the provision of mentors and knowledgeable advisors in technology education and career counseling.

It has often been said that, if there were more female teachers and lecturers who could act as a role model to girls, there would possibly be an increase in the number of girls attending such establishments. However, there are very few female staff in many of the African polytechnics. The number of women teaching technical programmes varies from country to country. In Nigeria

and Tanzania, a large proportion of the female lecturers are teaching technical programmes whilst in Malawi the figure is much lower (Leigh-Doyle,1991)

2.4 Cultural norms influence

This report presents a cultural perspective towards thinking about, and acting on, issues concerning women and software development. We posit and demonstrate that the notion of a gender divide in how men and women relate to computing, traditionally attributed to gender differences, is largely a result of cultural and environmental conditions. We illustrate that under specific cultural and environmental situations, women fit very well into software development. Indeed, where cultural conditions *allow for* diversity, and where women are perceived as capable of doing computer science (or any science), the "Women-Computer Science fit" is visible and active (Adams et. al., 2003). The implications are that women do not need handholding or a "female friendly" curriculum in order for them to enter and be successful in Computer Science or related fields, nor is there need to change the fields to suit women (Vashti, 2002). To the contrary, curricular changes, for example, based on presumed gender differences can be misguided, particularly if they do not provide the skills and depth needed to succeed and lead in the field. Such changes will only serve to reinforce, even perpetuate, stereotypes and promote further marginalization (Schinzel, 2002).

We argue that our understanding and experience with successful interventions that promote micro-cultural change have broad implications for increasing participation in software development and for creating environments where both men and women can flourish. At the same time, it is also important to recognize the crucial role played by the public's perception and misconception of software development in attracting (or not) students to the field (Frieze and Treat, 2005). For the most part, Computer Science has been equated with programming, particularly in the US. This is largely due to the dearth of pre or entry level college/university curricula that present the depth and breadth of computer science and computational thinking. While curricula and perception are not the focus of this paper, we have also been working to develop curricular materials, teacher training programs and outreach efforts to broaden and correct the image of what computer science is and who computer scientists are (Blum and Frieze, 2005).

With respect to all our case studies, we explore *cultural factors*, acknowledging that *culture* is a very complex concept and the term is open to various interpretations. Here we are using the term *culture* to refer to the complex and broad set of relationships, values, attitudes and behaviors (along with the micro-cultures and counter-cultures that also may exist) that bind a specific community consciously and unconsciously (Schinzel, 2002). Our definition posits that culture is bound by context and history and that we are born into specific cultures with prevailing values and structures of opportunity. But culture, like history, *allows for change.* Culture is dynamic, *shaping and being shaped by those who occupy it*, in a synergistic diffusive process. Indeed, while a dominant culture may embrace and influence a community, counter or micro-cultures may exhibit unexpected features. As individuals, and/or as groups, we contribute to culture(s) in different ways to different degrees, and are impacted by culture(s) in different ways to different degrees. In this sense we view culture, and cultural occupants, as agents of change, and environments as appropriate sites for interventions and opportunities (Frieze and Treat, 2005). In this paper, therefore, we propose moving away from discussing gender issues towards talking about *cultural issues*. This raises an obvious but interesting point: *Isn't gender a cultural issue?* Here we try to explain the distinction and why our suggestion to focus on culture is a more pragmatic and positive move.

With regards to the larger cultural picture illustrated in our section on Eastern cultures, there is ample evidence to show that "gender distribution (in software development) is culturally diversified" (Schinzel, 2002). The work of Adams, *et al*., showed that on the tiny island of Mauritius, women were entering and graduating in computing related fields at rates comparable to their proportion in the general population (Adams *et al*., 2003). The same appears to be the case in Malaysia (Othman and Latih, 2006). Britta Schinzel has looked at female enrollment in Computer Science around the world and notes a multiplicity of reasons that account for higher and lower rates of female participation. She describes how in countries with good gender distribution in computing like India, Brazil, and Argentina, "there seems to be no conviction like in the Northwest stereotyping women as less capable of pursuing education in science and technology." In the North African and Arabic countries where there is an "extremely high

participation of women in Computer Science," she highlights the fact that there is "no coeducation at any level of education in these countries" (Schinzel, 2002, p. 10).

In the US, a study by Antonio Lopez and Lisa Schultz looked at African American students of Computer Science in Historically Black Colleges and Universities (HBCUs) and in non-HCBUs during the period 1989-97. They found that at HBCUs, consistently more African American females were awarded bachelor's degrees in Computer Science than their male counterparts, while the opposite was true for African Americans (as well as for non African Americans) at non-HBCUs. They concluded: "For African American females, this might suggest that being awarded a bachelor's degree in computer science has less to do with gender differences and more to do with cultural factors" (Lopez and Schultze, 2002). There seems to be no single theory that covers all cases, nor should we expect to find one when the variables are so numerous, but what these studies reveal is a multitude of complex cultural factors—some specific and some more general—playing a significant role. "While the problem is wide-spread, the under-representation of women in computer science is not a universal problem. It is a problem confined to specific countries and cultures" (Adams *et al*., 2003, p. 59).

2.4.1 Western Cultures

This section is based on the work of Blum and Frieze (2005) at Carnegie Mellon University in Pittsburgh and illustrates how women's (and men's) relationship to computing is shaped by the ambient micro-culture. Specifically, this case study illustrates the evolvement of a computing culture—and its synergistic impact—as the environment shifted from an *unbalanced* to a more *balanced environment* in three critical domains: gender, the range of student personalities and interests, and professional support afforded to all students. Prior to 1999, the undergraduate Computer Science environment at Carnegie Mellon was *unbalanced* in these domains. Indeed, in the mid-1990's less than 10% of the undergraduate Computer Science students were women. The admissions policies, as well as the culture of computing at that time, supported a specific type of (male) student, in particular those who had exhibited great programming proclivity. And women students, being in the minority, did not have access to the various informal professional support systems available to the majority male students. Early research, conducted by Margolis and Fisher during 1995-1999, which examined the perspectives of this specific student body, found a gender divide in the way men and women related to computer science (Margolis and Fisher,

2002). The core of the divide, in particular their findings that women wanted to do useful things with computing while men liked to focus on programming and the machine itself, was summarized by Margolis and Fisher as "computing with a purpose" and "dreaming in code," respectively. They also found that women's confidence was extremely low (even "extinguished"). Not surprisingly, women *in their cohort* felt they did not fit into the computing culture. Not surprisingly, given that most undergraduate computing environments were similar to that of Carnegie Mellon's in the 1990's, these findings rang true with many in the Computer Science community.

Furthermore, in contrast to the early Carnegie Mellon studies, and others that have been conducted in situations where there have been *very few* girls and women, *our findings show a similar spectrum of attitudes and attachments amongst women and men rather than a gender divide* (http://www.cra.org/Activities/craw/creu/). We argue: the experiences and perspectives of the women in these other studies were in part shaped by their minority, and sometimes token, status rather than by gender. To borrow Kanter's analysis of men and women we might say, "It was rarity and scarcity, rather than femaleness *per se*, that shaped the environment for women in the [departments] mostly populated by men" (Kanter, 2005). Likewise, our findings serve to confirm the importance of micro-culture and environment as significant contributors to student perspectives on computing. Our conclusion here is that the observed gender differences from the 1995-1999 study tell more about the *biases in the former admissions criteria* into the Computer Science program at Carnegie Mellon and, a narrow conception of the undergraduate program, rather than significant or intrinsic gender differences in potential computer scientists. During the latter half of the 1990's, the undergraduate Computer Science program fed primarily into the booming high tech industry, thus the high school computer "geek" had a definite admissions advantage. Women and men with potential to become computer science leaders, but without long-standing programming experience or commitment, had little chance (Blum and Frieze, 2005).

2.4.2 Eastern Cultures

This section within an Eastern culture focuses on Jewish and Arab *Israeli high school Advanced Placement (AP) Computer Science classes*. Most Jewish and Arab students in Israel attend

separate educational systems with similar curricula in most subjects. Specifically, the AP Computer Science classes are all coed, the syllabus is identical in both systems and the only differences are in the teaching language and the language of the matriculation exam. Eidelman and Hazzan (2005) studied a population of 146 12th grade AP Computer Science students from 9 typical high schools from both sectors (5 schools from the Jewish sector, 4 schools from Arab sector).15 In the Jewish sector, 25 of the 90 AP CS students (i.e., 28%) were female; in the Arab sector, 34 of the 56 students (i.e., 61%) were female. That is, while female high school students in the Jewish sector are *under represented* in AP Computer Science classes, they are *highly represented* in the Arab sector.

We focus here on the cultural factor 'support and encouragement' which is one explanation for the difference in the participation of female students in the two sectors (Eidelman and Hazzan, 2005). One of the questions students were asked was: "Who encouraged you to choose computer science studies?" Arab female high school students receive much more encouragement to choose Computer Science than do their Jewish counterparts. Specifically, Arab female high school students are encouraged more by their mothers (56% vs. 40%), fathers (44% vs. 40%), siblings (44% vs. 16%), friends (44% vs. 20%), acquaintances who had studied CS (50% vs. 20%) and – with the greatest difference – by their teachers (56% vs. 8%). This broad based network of encouragement that the Arab female students receive is supported by additional data (Eidelman and Hazzan, 2005). The noticeable differences in the extent of encouragement Arab female students receive from various agents can be explained by looking at findings from other studies that have explored *cultural and familial* differences between Arab and Jewish adolescents (Peleg-Popko, Klingman; Nahhas, 2003). According to these studies, since Arab students are part of an Eastern collective culture, as well as a minority group in Israel, it is likely that they are strongly encouraged by their parents to higher scholastic achievement in order to improve their social status. In addition, Arab students perceive their family environment as more authoritarian than do their Jewish counterparts. The hierarchical structure of the Arab family is based on age and traditionally requires the young to obey the old and adhere to their expectations (Peleg-Popko *et al.,* 2003). Hence different social and cultural characteristics stimulate the extensive encouragement the Arab female students receive. This might lead us to the intermediate

conclusion that in a culture that supports positive attitudes towards Computer Science, we can probably attract more female students to study advanced levels of Computer Science.

The reasons that women choose to study computing will vary from culture to culture, and from country to country, and it is beyond the scope of this paper to consider this issue in detail. When seeking solutions for women's low participation in computing, it is important to consider all cultural and societal factors that may affect this participation. (Barinaga, 1994): This also allows for identification of solutions from one country which may or may not be suitable for use in another country. For example, Mukhopadhyay (Mukhopadhyay, 1996) argues that the 'internal' 'self-selection' model used to explain the participation of women in science in the USA, cannot be applied to India. A model with the family as decision-maker is more appropriate and explains why there is lower participation of women in software development. Researchers have investigated cross-cultural gender issues in software development and some of these studies are now briefly described. The lack of difference in the USA was attributed to high number of female teachers, parental encouragement and computer use outside school, and in Bulgaria it was attributed to high number of female teachers. In their study of university students in 23 countries, (Weil and Rosen, 1995) Weil and Rosen found that in Thailand, Italy and Kenya, males were significantly more anxious about software development, whereas in Israel and Hungary, women were significantly more anxious. There were significantly more male technophobes in Kenya, and significantly more female technophobes in the USA, Hungary and Australia. In the USA, Singapore, Kenya, Israel, Hungary, Czechoslovakia, Belgium, Australia and South Africa (Clarke, 2000) men had significantly more positive cognitions with the reverse in Northern Ireland.

2.5 Career Guidance influence

Choosing the right career can be a very daunting task especially in a world which offers an array of paths, all of which seem to be leading to a golden goal. Careers can actually make or break one's life, so it is important to make the right choice. Career guidance can help you in pursuing the right courses, in the right colleges or institutes and can guide you in choosing a suitable career (Osoro et al., 2000). Education, of course, plays an important role in getting you the right job in your chosen field. The stepping stones or pre-requisites for choosing your dream career

are, of course, the qualifications required to achieve it. With the right qualifications, the top careers are open to an individual and the power of choice would be achieved (Tumuti, 1985). Career counseling can guide an individual in selecting the careers suitable for him/her. It could be a course for example for purposes of this research paper, software development. The current education system often means that students sometimes make career choices based on inaccurate information, a fact that has been acknowledged by the Ministry of Education in its guide book on careers (Ministry of Education, 2007). This means that students may be eliminating many potential careers that they qualify for because they lack accurate information. Thus the effects of poor career guidance may have lifetime implications.

The reality in Kenyan universities is that the career departments and teachers are not equipped to offer appropriate career guidance to assist students in making these decisions (Kithyo and Petrina, 2002; Osoro et al., 2000). Career masters are usually teachers with no training and have neither the time nor the facilities to provide career counseling to students. This is because they head the so called career departments in addition to their regular teaching load and do not have career guidance resources. Limited career information is provided by churches, non-governmental organizations, individual professionals who volunteer their time and resources. (Osoro et al., 2000; Tumuti, 1985). Simply put, career departments exist in name only. This lack of guidance results in students choosing careers based on gender stereotypes, parental pressure and misinformation regarding career requirements. In fact the Ministry of Education has acknowledged that there is insufficient career guidance and students make choices "out of ignorance" (Republic of Kenya, 2007). The Ministry also acknowledges that students do not get information that helps them relate subjects chosen to specific careers. All these factors exacerbate the cultural, social and policy barriers discussed earlier especially for female students, potentially contributing to their exclusion from many rewarding careers. Kenyan students face many challenges in choosing careers, the main ones being inadequate information and lack of career guidance.

Empirical evidence available suggests that career interventions are very limited or non-existent in the Kenyan universities. In an effort to remedy the dire situation, the Ministry of Education published a career guidance book in 2007 titled "Careers Guide Book for Schools" with the aim

of providing occupational information to students as they choose college majors (Republic of Kenya, 2007). In the book the Ministry acknowledges gender disparities in career selection with women choosing more female dominated careers and men choosing more male dominated careers. The book also contains a brief summary 23 of personal and academic attributes required for different degree and technical training programs. There is no evidence regarding the extent to which this publication is being used in the universities.

2.6 Conceptual Framework

Figure 1 shows various factors that influence career choice in software development among female undergraduate students at Jomo Kenyatta University of Agriculture and Technology. The independent variables include gender perceptions, female role models, cultural norms and career guidance. The dependent variable is career choice in software development.

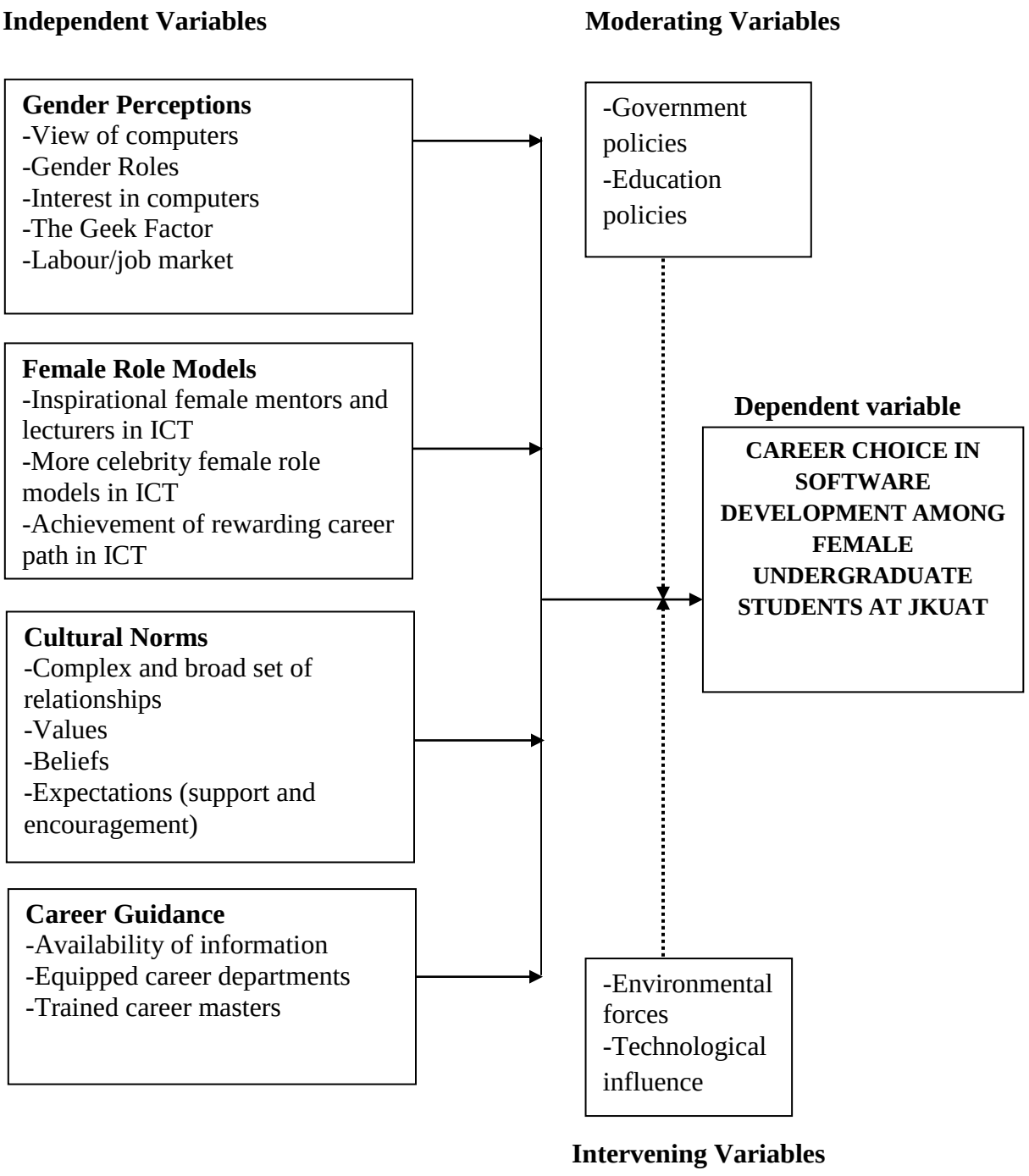

Figure 1: Conceptual Framework

2.7 Chapter Summary

The reviewed literature on the influence of gender perceptions on career choice in software development has revealed that the view of computers, interest in computers, the geek factor, gender roles in society and the labor/job market have a major influence on female students career choices. There is still a perception that software development jobs are more suitable for male employees and women are more suitable for customer and technical support jobs. Gender employment patterns vary significantly among foreign and domestic companies. The male to female employment ratio is close to 1:1 in some foreign companies, whilst 4:1 in domestic companies (Liu, 2004). The biggest hurdle is the 'weakness' inherent in the female gender. This can range from mood swings, emotions, dependence on other people's help when the 'going gets tough', tendency to 'give up' when under pressure, to the lack of self confidence (Durndell et al., 2000).

The Literature reviewed on female role models on career choice in software development among female undergraduate students has revealed that female role models and mentors have a crucial influence on the career planning of female students in the area of software development. Women also lack the support and advocacy needed to promote these skills. Women feel alone and at a loss because they lack role models, networks, and mentors. These support systems not only help women develop talent and opportunities for career advancement, but they are also needed to promote women to more senior roles (Catalyst, 2003). Mentoring and modeling are strong influences on women who are seeking a career field (Catalyst, 2001).

The literature reviewed on cultural norms influence on career choice in software development revealed that culture affects career choice directly and indirectly through its influence in values, beliefs and expectations from society. With regards to the larger cultural picture illustrated in our section on cultures, there is ample evidence to show that "gender distribution (in software development) is culturally diversified" (Schinzel, 2002). The work of Adams, et al., showed that women were entering and graduating in computing related fields at rates comparable to their proportion in the general population (Adams et al., 2003).

The reviewed literature on career guidance shows that it plays a significant role in the career choice of career of software development. Choosing the right career can be a very daunting task

especially in a world which offers an array of paths, all of which seem to be leading to a golden goal. Careers can actually make or break one's life, so it is important to make the right choice. Career guidance can help you in pursuing the right courses, in the right colleges or institutes and can guide you in choosing a suitable career (Osoro et al., 2000). The Ministry of Education has periodically produced career books to support learners in the career development process, (Ministry of Education, 2012).

CHAPTER THREE
RESEARCH METHODOLOGY

3.1 Introduction

This chapter deals with the description of the methods which were applied in carrying out the research study. This chapter is organized under the following headings: Research Design, Target Population, Sample Size and Sampling procedure, Data Collection Methods, Research instruments, Procedure Validity of the Research Instruments, Reliability of the Research Instruments, Data Analysis, Summary and Operationalization of Variables.

3.2 Research Design

The research study adopted descriptive survey design which was used to establish how the elements of the research fit together. It consisted of the elements the researcher used in collecting, analyzing and interpreting the findings from the research (Nachmias, 1996). This kind of research was based on a scientific and analytical examination of dependent and independent variables. Independent variables were studied in retrospect for seeking possible and plausible relations and the likely effects that the changes in independent variables produced on a single or a set of dependent variables (Kothari, 2004).

3.3 Target population

The population targeted in this study consisted of approximately 1000 female undergraduate students in the Institute of Computer Science and Information Technology and the School of Electrical, Electronic and Information Engineering at Jomo Kenyatta University of Agriculture and Technology. The reason for selecting this university was because it is one of the biggest universities in Kenya, offering courses in Computer Science, Computer Engineering and Information Technology over a long period of time.

3.4 Sampling procedure

Sampling is the procedure a researcher uses to select individuals, places to things for a study. This study adopted probability sampling as this approach uses random selection (Gay, 1992). The students selected in this research were selected randomly. This ensured that every member of the population had equal chances of being included in study. This was appropriate in this

research in order to draw conclusions and make predictions on the factors influencing the career choice in software development among female undergraduate students at Jomo Kenyatta University of Agriculture and Technology.

3.4.1 Sample Size

The sample size consisted of 100 female undergraduate students. This sample size meets the minimum requirement of 10% sample, out of the accessible population (Mugenda and Mugenda 1999). Gay (1992) suggests that at least 10% of the population is a good representation for a sample. Simple stratified random sampling was used to select departments where the students sample size came from. Stratified sampling is suitable when dealing with homogenous subgroups like departments which forms several segments or stratas. Random sampling is then selected for each strata (Mugenda & Mugenda, 1999).

Table 3.4.1 Sample Frame

Table 3.4.1 consists of the sample frame of the study.

Department	Degree Program	Total	Sample size
Computing	BSc Computer Science	140	14
Electrical and Electronics Engineering	BSc Electronic and Computer Engineering	70	7
Information Technology	BSc Information Technology	380	38
Human Resource and Development	Bachelor of Business and Information Technology	230	23
Telecommunication and Information Engineering	BSc Telecommunications and Information Engineering	180	18
	Total	**1000**	**100**

3.5 Research Instruments

This study used questionnaires that were handed over to female undergraduate students at Jomo Kenyatta University of Agriculture and Technology. The questionnaire had various sections; Section A gave the general information of the respondents and the following sections addressed

specific objectives of the study which included gender perceptions, female role models, cultural norms and career guidance. Secondary data on female undergraduate students in computing and particularly on women's involvement was also collected through literature review of all relevant and existing data.

3.5.1 Validity of the Research Instruments

Validity is the extent to which an instrument measures what it is supposed to measure and performs as it is designed to perform. It is rare, if nearly impossible, that an instrument be 100% valid, so validity is generally measured in degrees. As a process, validation involves collecting and analyzing data to assess the accuracy of an instrument (Denzin & Lincoln, 2005). To ensure validity in this study, indicators used in the career choice in software development were clearly specified in the instrument ensuring the concepts were well understood. Content-related validity was adapted by ensuring the content in the questionnaires was appropriate to the purpose of the study. The questionnaires addressed the variables in the study in this case gender perceptions, female role models in software development, cultural norms and career guidance. Any aspects that affect these variables were included in the questionnaire to ensure it was comprehensive enough to achieve the purpose of the study.

To assess content validity, the instruments were given to a few experts in the software development sector from the university so as to assess the effectiveness of the questionnaires administered.

3.5.2 Reliability of the Research Instruments

A test is reliable to the extent that whatever it measures, it measures it consistently. If I were to stand on a scale and the scale read 15 pounds, I might wonder. Suppose I were to step off the scale and stand on it again, and again it read 15 pounds. The scale is producing consistent results. From a research point of view, the scale seems to be reliable because whatever it is measuring, it is measuring it consistently. Whether those consistent results are valid is another question. However, an instrument cannot be valid if it is not reliable (Gay, 1992).

There are various categories of reliability for most instruments: test-retest and scorer agreement were used in this study. Test-retest measured consistency from one week of handing out questionnaires to the next. Scorer agreement was used to measure consistency of rating the performance of the research instrument and a reliability of 0.8 (r=0.8) was reached.

3.6 Data Collection procedures

To obtain primary data, this research study used survey questionnaires. A letter of authorization was handed over to respondents prior to data collection. Three research assistants were required in data collection within Jomo Kenyatta University of Agriculture and Technology. This study collected its secondary data from Journals, the internet and academic and professional books as well as the Jomo Kenyatta University of Agriculture and Technology Student Management Information System.

3.7 Data Analysis

After data was collected, it was analyzed. This was important for ensuring that all the relevant data was available for making contemplated comparisons and analysis. Processing of data implied editing, coding, classification and tabulation of collected data so that they were amenable to analysis (Mugenda and Mugenda, 1999). In this study the outcomes of quantitative data collected were analyzed. Once the questionnaires were received from the field, they were sorted and counted and 90 out of the 100 questionnaires collected and systematically organized in a manner that facilitated analysis. The responses were placed into categories to ease the coding process. The coding data was converted to numerical codes representing the variables- gender perceptions, female role models in software development, cultural norms and career guidance. This study used technology to code the data where the values representing the subjects or variables were entered into the computer.

This study had qualitative data mainly obtained from the questionnaire and a few open ended questions in the instrument. To analyze this data, patterns, and relationships of concepts being addressed were used. The first step was to briefly describe the data using descriptive statistics. Measures of central tendency were used to measure the scores in the study.

Obtaining the mean was one of the methods used. The mean is the average of a set of scores or measurements (Mugenda & Mugenda, 1999). The following formula was used for this:-

$$\overline{X} = \Sigma x / n$$

Where: $\overline{X}$ = mean, Σ = Sum of the scores, x = each score and n = number of scores

Variability was also measured in order to see how spread out the scores for each variable was done. Measuring this helped in giving information regarding the extent to which individual differences on each variable had an influence. This study used the standard deviation to obtain the variance of variables. The formula below was used to obtain this:

$$S^2 = \frac{\sum(X_i - \overline{X})^2}{n-1}$$

Where: S^2 = sample variance, S = sample standard deviation, Xi = each value or score, $\overline{X}$ = sample mean, n= sample size and n-1= degree of freedom

Percentages were used to enable comparison of responses and groups from data collected which ranged from 0% to 100%.

3.8 Ethical Considerations

An important aspect of research is the respect and consideration shown to the people who participate in the study. Research ethics, now often called the responsible conduct of research, is a large area, and this discussion will only touch on a few of the major issues (Wulff, 1979). There are four areas of concern where the rights and dignity of the subject must be preserved. These areas are: consent, harm, privacy, and deception (Sigma Xi, 1986).

Consent is the procedure by which research subjects choose whether or not they wish to participate in a research study. The researcher ensured that the subjects choose to be in the study out of their own free will, without any element of force, duress or deceit. In addition, the researcher ensured that all subjects were told, and that they understood the purpose of the study and their roles as subjects.

Harm is the most important issue in all of research ethics, that subjects are not be harmed by the researcher's study. To avoid physical harm is obvious, but other areas need to be avoided also. These areas are: psychological stress, personal embarrassment, and humiliation. The dignity of the subject (be it human or animal) was a concern of the researcher.

Privacy, every subject has the right to keep private the fact that he/she participated in your study, and the right that information given to the researcher should not be linked to them. Research often is based on information obtained from the subjects. The information used in the study may be published, but it will be done in a way that ensures the respondents anonymity.

Deception in research involves the misrepresentation of facts related to the purpose, nature, or consequences of a research study. The omission of facts is the same as misrepresentation. Subjects were fully informed in order to give consent and facts were not misrepresented.

3.9 Operationalization of variables

These are the variables and measuring indicators used in the research report as illustrated in Table 3.9.1.

Table 3.9.1: Operational Definitions of Variables

Variables	Indicators	Measurements	Measurement Scale	Study Design	Tools of Analysis
Research Objective 1	To establish the extent to which gender perceptions influence career choice in software development among female undergraduate students at Jomo Kenyatta University of Agriculture and Technology.				
Dependent Variable Software Development	Increase in the number of females in software development	Number of females in software development	Nominal Interval	Qualitative and Quantitative	Statistical analysis by computing the means, standard deviation and percentages of responses.
Independent Variables Gender Perceptions	1. The various views of females about computers. 2. The roles of females in the computing society. 3. The Geek Factor and how it is viewed by females.	Number of females in software development from application to enrolment to qualifications.	Nominal Interval		Statistical analysis by computing the means, standard deviation and percentages of responses.

	4. The labor/job market approach to females in ICT.				
Research Objective 2	To assess how existing female role models influence career choice in software development among female undergraduate students at Jomo Kenyatta University of Agriculture and Technology.				
Independent Variables Female Role Models	1. Use of existing female role models to encourage and mentor females in ICT. 2. Use of celebrity role models in ICT to encourage females. 3. Highlighting successes and achievements of women in ICT.	1. Records showing increased number of applications and females qualifying in software development. 2. Number of females being mentored by existing female role models in ICT.	Nominal Interval	Qualitative and Quantitative	Statistical analysis by computing the means, standard deviation and percentages of responses.
Research Objective 3	To examine the influence of cultural norms on the career choice in software development among female undergraduate students at Jomo Kenyatta University of Agriculture and Technology.				
Independent Variables Cultural Norms	1. Highlighting complex and broad relationships in society. 2. Use of cultural values, beliefs and expectations	Increased number of females in software development from application to enrolment to	Nominal Interval	Qualitative and Quantitative	Statistical analysis by computing the means, standard deviation and percentages of

	from the external environment.	qualifications.			responses.
Research Objective 4	To examine the influence of career guidance on the career choice in software development among female undergraduate female students at Jomo Kenyatta University of Agriculture and Technology.				
Independent variables Career Guidance	1. Use of information on careers in software development. 2. Use of career departments and career masters/guides in software development.	Increased number of females in software development from application to enrolment to qualifications.	Nominal Interval	Qualitative and Quantitative	Statistical analysis by computing the means, standard deviation and percentages of responses.

CHAPTER FOUR

DATA ANALYSIS, PRESENTATION AND INTERPRETATION

4.1 Introduction

This chapter contains data analysis, presentation and interpretation for this study. It contains data on the factors influencing career choice in software development among female undergraduate students at Jomo Kenyatta University of Agriculture and Technology. The findings are presented in percentages; frequency distributions tables; means and standard deviations.

4.2 Questionnaire return rate

A total of 100 questionnaires were administered. The completed questionnaires were edited for completeness and consistency. Of the 100 questionnaires only 90 were returned. The remaining 10 were not returned, representing a response rate of 90%. This conformed to Mugenda and Mugenda (2003) who recommended that for simplification a response rate of 50% is sufficient for scrutiny and exposure, 60% is good and a response rate of 70% and over is excellent.

4.3 Demographic characteristics

This shows the profile and characteristics of the female students pursuing courses in computing and information technology related fields at JKUAT.

Table 4.3.1 Ages of the respondents

Based on the findings, over 80% of the respondents were aged between 19 to 23 years, the remaining 20% being over 23 years as shown in the table.

Age	Frequency	Percent (%)
19	7	8.2
20	16	18.8
21	15	17.6
22	20	23.5
23	17	20.0
24	6	7.1
25	1	1.2
26	1	1.2

27	1	1.2
38	1	1.2
Total who indicated age	85	94.4
Did not indicate age	5	5.6
Total	**90**	**100.0**

Table 4.3.2 Gender of the respondents

As was expected of the research, all 90 questionnaires returned confirmed that the respondents were female as is shown in the table.

Gender	**Frequency**	**Percent (%)**
Female	90	100

Table 4.3.3 Marital Status of the respondents

Out of the 90 questionnaires returned, only 1.1% of the respondents are married, 92.2% are single and 6.7% did not indicate their marital status.

Marital Status	**Frequency**	**Percent (%)**
Married	1	1.1
Single	83	92.2
Did not indicate Marital Status	6	6.7
Total	**90**	**100.0**

Table 4.3.4 Degree programs of the respondents

From the data collected, Bachelor of Science in Information Technology had a percentage of 42.2% followed by Bachelor of Science in Computer Science at 20%, Bachelor of Science in Telecom and Information Engineering at 17.8%, Bachelor of Business and Information Technology at 12.2%, Bachelor of Science in Electronic and Computer Engineering at 4.4% and those who did not indicate their degree program accounted for 3.3%.

Degree Program	Frequency	Percent (%)
Bachelor of Business and Information Technology	11	12.2
Bachelor of Science in Computer Science	18	20.0
Bachelor of Science in Electronic and Computer Engineering	4	4.4
Bachelor of Science in Information Technology	38	42.2
Bachelor of Science in Telecom and Information Engineering	16	17.8
Did not indicate Degree Program	3	3.3
Total	**90**	**100.0**

Table 4.3.5 Year of study of the respondents

From the findings, 31.1% of the respondents are in their 4th year, followed by 3rd years at 26.7%, 24.4% are in their 2nd year, 13.3% in their 1st year, 3.3% in their 5th year and 1.1% did not indicate their year of study.

Year of study	Frequency	Percent (%)
1	12	13.3
2	22	24.4
3	24	26.7
4	28	31.1
5	3	3.3
Total who indicated year of study	89	98.9
Did not indicate year of study	1	1.1
Total	**90**	**100.0**

4.4 Factors influencing career choice in software development among female undergraduate students at JKUAT.

The remaining part of this chapter will address variables that affect the career choice in software development among female undergraduate students at JKUAT.

4.4.1 Gender Perceptions

The respondents were asked to give their opinions on the extent to which gender perceptions affect their career choice in software development. The findings are shown in Table 4.4.1.

Table 4.4.1 Gender Perceptions influence

Table 4.4.1 shows the extent to which respondents rated the influence of gender perceptions on career choice in software development. A five point Likert scale was used to interpret the respondent's responses. According to the scale, those responses who strongly disagreed were awarded value 1, disagreed was assigned value 2, neutral was assigned value 3, agreed was assigned value 4 and strongly agreed was assigned a value 5. Mean (weighted average) and standard deviation were then used to analyze the data. The standard deviation was used to indicate the dispersion of the responses. According to the researcher those variables with a mean close to 4.0 were rated to a great extent and those which had mean values of close and below 3.0 were rated low extent.

The findings indicated the respondents interest in computers at (M=3.87, SD=1.274), the labor/job market (M=3.75, SD=1.180), the respondents view of computers, the geek factor and the respondents gender roles in society at (M=3.64, SD=1.199), (M=3.10, SD=1.182) and (M=2.43, SD=2.00) respectively.

From the findings, the female students' interest in computers had an influence of 24%. That means the remaining 76% did not feel that their interest in computers had an influence on their career choice in software development. The labor/job market and female students' view of computers were at close percentages of 23% and 22% respectively. The geek factor influence was at 18% while gender role in society stood at 13%.

From these findings the study deduces that the majority of the students felt that they were influenced by gender perceptions in their career choice of software development.

	View of computers	Gender role in society	Interest in computers	Geek factor	Labor/job market
Responses	89	88	87	87	89
Did not indicate	1	2	3	3	1
Mean	3.64	2.43	3.87	3.10	3.75
Percent (%)	22	13	24	18	23
Std. Deviation	1.199	1.276	1.274	1.182	1.180

4.4.2 Female Role Models

The respondents were asked to give their opinions on the extent to which female role models affect their career choice in software development. The findings are shown in Table 4.4.2.

Table 4.4.2 Female Role Models influence

With respect to female role models, the female students' career choice of software development was influenced by the fact that more female lecturers and female role models are needed in this industry with (M=4.49, SD=.827) and (M=4.47, SD=.740) respectively. The impact of existing female role models influence on career choice of software development was rated at (M=4.15, SD=1.012). The influence of the existence of successful/high achiever female role models was rated at (M=3.93, SD=1.175). From the findings we can deduce that the majority of the students felt that they were influenced by the fact that there is need for more female role models and the existence of female lecturers in this industry.

From the findings, the need for more female role models in software development and the existence of female lecturers in ICT accounted equally for 27%. This means that 73% of the respondents did bot feel that the need for more female role models and the existence of female lecturers had an influence on their career choice in software development. The impact of existing role models and existence of successful/high achievers in the software development industry were at 24% and 22% respectively.

From the findings we can deduce that the majority of the students felt that they were influenced by female role models in their career choice in software development.

	More female role models needed in software development	Respondents view on the impact of existing of female role models on software development	Respondents view on the influence of successful females on software development	Respondents view on the influence of female lecturers on software development
Responses	89	88	89	89
Did not indicate	1	2	1	1
Mean	4.47	4.15	3.93	4.49
Percent (%)	27	24	22	27
Std. Deviation	0.740	1.012	1.175	0.827

4.4.3 Cultural Norms

The respondents were asked to state the influence of cultural norms on their career choice of software development. The findings are shown in Table 4.4.3.

Table 4.4.3 Cultural Norms influence

The findings represented in Table 4.4.3 on cultural norms related factors indicate that the female students' self confidence in software development (M=3.66, SD=1.193) had an influence although with a lot of dispersion among the respondents. Other aspects such as effective existing networking relationships and forums (M=3.36, SD=1.078), the existence of networking relationships and forums (M=3.23, SD=1.008), social pressures (M=3.18, SD=1.167), women's contribution and value of ideas (M=3.03, SD=1.402), and family commitments (M=2.59, SD=1.310) also had an influence on the career choice in software development. From the findings we can deduce that the majority of the students felt that they were influenced by their self confidence.

From the findings, self confidence of the female students in software development accounted for 20%. This means that 80% of the respondents did not feel that their self confidence had an influence on their career choice of software development. Effective existing networking relationships and forums followed at 18%; existing networking relationships and forums stood at 17%, social pressures at 16%, women's contribution and value of ideas in software development stood at 15%, family commitments at a low of 14%.

From the findings we can deduce that the majority of the students felt that they were influenced by cultural norms in their career choice in software development.

	Existence of networking relationships and forums	Influence of effective networking relationships and forums	Influence of self confidence	Social pressures influence	Women's contribution and value of ideas influence	Family commitments influence
Respondents	87	85	88	87	88	88
Did not indicate	3	5	2	3	2	2
Mean	3.23	3.36	3.66	3.18	3.03	2.59
Percent (%)	17	18	20	16	15	14
Std. Deviation	1.008	1.078	1.193	1.167	1.402	1.310

4.4.4 Career Guidance

The respondents were asked to state the influences of career guidance on their choice of software development as a career. The findings are shown in Table 4.4.4.

Table 4.4.4 Career Guidance influence

Table 4.4.4 shows the respondents ratings on the influence of career guidance on the career choice of degree courses. Regarding career guidance shown in Table 4.4.4 show that, the respondents rated availability of career information as influencing the career choice of software

development with a mean of 3.47 and wide dispersion of SD of 1.109 while equipped career department was rated with a mean of 2.83 and SD of 1.090. The existence of trained career masters influenced the career choice of software development with a mean of 2.98 and dispersions of SD of 1.039.

From the findings also, adequate information to make career decisions on software development was at 38% of the total responses. This means that 62% of the respondents did not feel that adequate information to make career decisions had an influence on their career choice of software development. 32% was rated the influence of equipped career departments and 30% was rated the influence of trained career masters on the female students.

From the findings we can deduce that the majority of the students felt that they were influenced by career guidance in their career choice in software development.

	Adequate information to make career decisions influence	Equipped career departments influence	Trained career masters influence
Respondents	89	89	88
Did not indicate	1	1	2
Mean	3.47	2.83	2.98
Percent (%)	38	30	32
Std. Deviation	1.109	1.090	1.039

4.4.5 Other responses

Table 4.4.5 summarizes the descriptive data obtained from the respondents.

Table 4.4.5 Other responses

The percentage of the respondents who felt that government has made an effort to upgrade the skills for women in software development was 26% while 76% did not feel that the government has made an effort to upgrade the skills for women in software development.

The percentage of the respondents who felt that the current legal framework in ICT is favorable to software development was 44% while 56% did not feel that the current legal framework in ICT is favorable to software development.

The percentage of the respondents who felt that the prevailing economic atmosphere in regards to offering a supportive environment for women in software development is favorable for business was 46% while 54% did not feel that the prevailing economic atmosphere in regards to offering a supportive environment for women in software development is favorable for business.

The percentage of the respondents who felt that there is an effective network system in the economy that is geared towards empowering women in software development towards growth was 265 while 74% did not feel that there is an effective network system in the economy that is geared towards empowering women in software development towards growth.

Responses	Do you feel the government has made an effort to upgrade skills for women in software development?	Do you think the current legal framework in ICT is favorable to software development?	Do you think the prevailing economic atmosphere in regards to offering a supportive environment for women in software development is favorable for business?	Do you think there is an effective network system in the economy that is geared towards empowering women in software development towards growth?
Yes	26%	44%	46%	26%
No	74%	56%	54%	74%

Table 4.4.6 Governmental factors and career choice in software development

Table 4.4.6 summarizes the responses that were obtained regarding the extent to which governmental factors positively affect the growth of women in software development with the Likert scale of 1 – Very Little Extent, 2 – Low Extent, 3 – Neutral, 4 – High Extent, 5 – Very High Extent and 6 – Mean Score.

From the findings, 33.3% of the respondents felt that the positive influence of governmental factors on the growth of women in software development is neutral; 20% felt that to a low extent, governmental factors positively influence the growth of women in software development; 18.9% felt that to a high extent, governmental factors positively influence the growth of women in software development; 15.6% felt that to a very little extent, governmental factors positively influence the growth of women in software development, 7.8% felt that to a very high extent, governmental factors positively influence the growth of women in software development; 1.1% fell under the mean score category regarding the governmental factors positive influence on the growth of women in software development. 3.3% of the respondents did not give their opinion on this matter.

	Frequency	Percent (%)
1	14	15.6
2	18	20.0
3	30	33.3
4	17	18.9
5	7	7.8
6	1	1.1
Total	87	96.7
Did not indicate	3	3.3
Total	**90**	**100.0**

CHAPTER FIVE
SUMMARY OF FINDINGS, DISCUSSIONS, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This study was conducted to establish the factors which influence the career choice in software development among female undergraduate students at Jomo Kenyatta University of Agriculture and Technology. This chapter summarizes the research findings, provides information on the discussion, conclusions, recommendations of the study and suggestions for further research.

5.2 Summary of Findings

The findings on the factors influencing the career choice in software development are shown in the following sections.

5.2.1 Gender Perceptions

From the findings, the majority of the respondents felt that their interest in computers at 24% had an influence on the career choice of software development. The labor/job market and the respondents' view of computers at 23% and 22% respectively. The geek factor influence was at 18% while their gender roles in society had an impact of 13%.

From these findings the study deduces that the majority of the students felt that they were influenced by gender perceptions in their career choice of software development.

5.2.2 Female Role Models

Among the female role model factors investigated by the study, the existence of female lecturers and the fact that more female role models are needed in the software industry equally stood at 27%. The the impact of existing role models and existence of successful/high achievers in the software development industry were at 24% and 22% respectively.

From these findings the study deduces that the majority of the students felt that they were influenced by female role models in their career choice of software development.

5.2.3 Cultural Norms

From the findings of this study, majority of the respondents felt that their self confidence influenced their career choice in software development at 20%. According to the respondents, other aspects such as effective existing networking relationships, existing networking relationships and forums, social pressures, their contributions and ideas being valued, and family commitments were at 18%, 17%, 16%, 15% and 14% respectively.

From these findings the study deduces that the majority of the students felt that they were influenced by cultural norms in their career choice of software development.

5.2.4 Career Guidance

Career guidance had an influence on the career choice of software development. The existence of adequate information to make career decisions in software development was found to have an influence within this category of 38%. 32% was rated the influence of equipped career departments in the university and 30% was rated the influence of trained career masters on the female students career choice of software development.

From these findings the study deduces that the majority of the students felt that they were influenced by career guidance in their career choice of software development.

5.3 Discussion

The study focused on studying aspects of gender perceptions on the career choice of software development. Gender perceptions were derived from the cognitive appraisal of information from five sources: 1) view of computers, 2) gender roles in society, 3) interest in computers, 4) the geek factor and 5) the labor/job market (Handcock, 2004). The study findings on gender perceptions indicated that the respondents' interest in computers had an influence on the career choice of software development of 24% followed by the labour/job market at 23%. Other factors like the respondents' view of computers, the geek factor and gender roles in society trailed in ratings.

Within the female role models category, the majority of the respondents felt that the existence of female lecturers in software development and the need for more female role models in this

industry at an equal of 27% had an influence on their career choice in software development. The impact of these female role models and existence of successful/high achievers was at 24% and 22% respectively.

The cultural norms were studied so as to know their influence on the career choice of software development. This is because cultural norms affect learners in Kenya in different ways. The findings of the study indicated that respondents' self confidence had an influence of 20% on the career choice of software development. The effectiveness of existing networking relationships and forums in software development also influenced their career choice at 18%.

The career choice of software development was also affected by the career guidance one gets. Career guidance can help a student pursue the right courses, in the right colleges or institutes and can guide one in choosing a suitable career. Education, of course, plays an important role in getting one the right job in the chosen field. The stepping stones or pre-requisites for choosing a dream career are, of course, the qualifications required to achieve it. With the right qualifications, the top careers are open to any individual and the power of choice would be with him (Tumuti, 1985). The study found that the majority of the respondents felt that adequate information to make career decisions had an influence on their career choice of software development at 38%. Equipped career departments in the university followed at 32% and trained career masters was at 30%.

5.4 Conclusions

The study has found out that, gender perceptions have an impact on the career choice of software development by female undergraduate students at Jomo Kenyatta University of Agriculture and Technology, based on their interest in computers, the labor/job market, their view of computers, the geek factor and their gender roles in society as well. Majority of the respondents chose software development as a career based on their interest in computers.

The majority of the respondents felt that the existence of female lecturers and the need for more female role models had an influence on the career choice of software development among the

female role models factors investigated. The need for more successful/high achievers in the software industry had an influence as well.

The study has found that cultural norms, as compared to the other factors investigated had low means with wide dispersions of the standard deviation and thus cultural norms as a factor had an influence on the career choice of software development. The study indicates that female students' self confidence, contributions and ideas being valued, social pressures and family commitments have an influence on the career choice of software development in spite of popular opinion to the contrary.

The influence of adequate information when making career decisions had the majority of respondents. Despite challenges involving availability of quality career information, a larger number of respondents were influenced by career guidance. Equipped career departments at the university also play a significant role in the career choice of software development as evidenced by the findings.

According to the findings of the study, all the independent variables investigated had influence on the career choice of software development by female undergraduate students of the Jomo Kenyatta University of Agriculture and Technology. The study however indicated that career guidance, female role models, gender perceptions and cultural norms, in that order have an influence on the career choice in software development among female undergraduate students at Jomo Kenyatta University of Agriculture and Technology.

5.5 Recommendations of the Study

Given the findings and limitations of the study, the following are the recommendations suggesting areas for further research.

1. One of the findings of the study was that 74% of the respondents felt that the government has not made an effort to upgrade skills of women in software development. Only 26% of the respondents thought otherwise. The study thus recommends that the stakeholders in

the ICT sector map out strategies aimed at equipping women with more skills and training in software development from university level to the job market.

2. While female role models were found to have a great influence on the career choice of software development, the role of female lecturers charged with encouraging hence increasing self confidence of female students was found wanting from the findings of the study. The whole education sector must therefore urgently work towards making the influence of female lecturers greater as far as the career choice of software development is concerned. This is more crucial as education is one of the pillars of vision 2030 and given that teachers are major players in the sector. They should be equipped with the necessary software development skills and competencies so that their students may look up on them for guidance confidently.

3. The Government of Kenya has for a long time implemented a gender affirmative action policy to ensure that the girl-child gets access to quality education and is able to undertake any career of her choice. This affirmative action has been implemented by the Joint Admissions Board of the public universities by lowering entry requirements for girls in order to increase their' access to universities. While the effort has been commendable, the results of this study showed that, gender and consequently aspects of gender such as societal expectations for women, culture and traditions and perceived female careers had little or insignificant influence on career choice of software development while factors such as female role models had great influence. This leaves us with food for thought: have the objectives of the gender policy affirmative action been attained as far as female students in software development are concerned? Has the time come for a review of this policy?

4. Career guidance plays an important role in shaping the destiny of a student. The evidence of dissatisfaction in careers being pursued by students as brought out by the findings of the study calls for a more comprehensive approach by all stakeholders to career guidance in universities.

5. 56% of the respondents felt that the prevailing economic atmosphere in regards to offering a supportive environment for women in software development is not favorable for business. The various stakeholders need tow work together to create a conducive atmosphere for women in software development to thrive so as to have a greater impact on the ICT sector in Kenya. The creation and strengthening of networking relationships and forums can go a long way towards building better working environments for women in software development.

5.6 Suggestions for Further Research

This study's intention was investigating the factors which affect the career choice of software development among the female undergraduate students at Jomo Kenyatta University of Agriculture and Technology of Agriculture and Technology. The study relied on the information from the female students who were in session by the time the study was being done. The study was centered on data from a sample of female university students only. Hence, it has not addressed the factors affecting the career choice of software development choice among the male students. For a deeper knowledge on the factors affecting the career choice of software development, a further study on male students is necessary.

The researcher therefore recommends that further research be undertaken in order to analyze systematic and regular reviews taking into account the changing career needs of the students in line with the current and dynamic ICT trends. The researcher further recommends that research be done to ascertain whether the gender policy affirmative action is still relevant as it is currently being applied.

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APPENDICES

APPENDIX I: LETTER OF INTRODUCTION AND INFORMED CONSENT

Alice Chemtai Muraguri
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Cell Phone: +254 723538184/ +254732538184

20th June 2013

Dear Sir/Madam,

RE: TO WHOM IT MAY CONCERN

My name is Alice Chemtai Muraguri, a student researcher from the University of Nairobi. I am conducting research about the factors influencing the career choice in software development among female undergraduate students at Jomo Kenyatta University of Agriculture and Technology (JKUAT).

In my schedule, I will be visiting and distributing questionnaires to female undergraduate students at Jomo Kenyatta University of Agriculture and Technology (JKUAT).

I will be grateful for any assistance in this regard.

Yours Sincerely,

ALICE CHEMTAI MURAGURI

APPENDIX II: SURVEY QUESTIONNAIRE

Filling Instructions

Kindly spare a few minutes to complete the questionnaire below.

Please read carefully and systematically and fill in answers to questions as honestly as possible by putting down your answers in the spaces provided or by ticking where applicable. Any information you give will be used purely for academic research purposes only.

SECTION A: PERSONAL DETAILS

General background Information of Respondent

1. Name:……..……..……...……**(Optional)**

2. Age:…….

3. Gender:……

4. Marital Status: Single ( ) Married ( ) Separated ( ) Widowed ( ) **(Optional)**

5. Degree program:……

6. Year of Study: ……

SECTION B: GENDER PERCEPTIONS

Please rate as per the table below factors that may affect your choice of software development as a career.

Statement	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Does your view of computers affect your choice of software development as a career?					
Does your gender role in society affect your choice of software development as a career?					
Does your interest in computers affect your choice of software development as a career?					
Does the Geek Factor affect your choice of software development as a career?					
Does the labor/job market affect your choice of software					

development as a career?					

Additional comments

……..……

……

SECTION C: FEMALE ROLE MODELS

Please rate as per the table below factors that may affect your choice of software development as a career.

Statement	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Do you feel that more female role models are needed in the field of software development?					
Does the existence of female role models inspire you to choose software development as a career?					
Does the existence of female lecturers inspire you to choose software development as a career?					
Does the existence of successful females (high achievers with rewarding career paths in ICT) inspire you to choose software development as a career?					

Additional comments

……..……

……

SECTION D: CULTURAL NORMS

Please rate as per the table below factors that may affect your choice of software development as a career.

Statement	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Do you feel that networking relationships and forums exist among women in software development?					
Do existing networking relationships and forums among females affect your choice of software development as a career?					
Do women face more crises of self confidence over their performance in software development than men do?					
Do general social pressures (e.g. expectations from friends and family) affect your choice of software development as a career?					
Women don't have as much chance as men to contribute ideas in software development classes and forums and their contributions are undervalued when they are made.					
Women feel more strongly than men do that they want to raise a family, but that a career in software development is incompatible with this goal.					

Additional comments

……..……

……

SECTION E: CAREER GUIDANCE

Please rate as per the table below factors that may affect your choice of software development as a career.

Statement	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Do you feel that you have adequate information for you to make a decision on software development as a career?					
Do you feel that the career department at your university is equipped with information to guide you on making a decision on software development as a career?					
Do you feel that the career department at your university has trained career masters who are able to advise you on the choice of software development as a career?					

Additional comments

……..……

……

SECTION F: GOVERNMENT POLICIES

10. Do you feel the government has made an effort to upgrade skills for women in software development? Yes ( ) No ( )

If yes, explain briefly

……..

11. Do you think the current legal framework in ICT is favorable to software development?

Yes ( ) No ( )

If yes, explain briefly

……..……

12. What do you think about the prevailing economic atmosphere in regards to offering a supportive environment for women in software development?

Favorable to business [ ] Unfavorable to business [ ]

If favorable, explain briefly

……..……

13. Do you think there is an effective network system in the economy that is geared towards empowering women in software development towards growth? Yes ( ) No ( )

If yes, explain briefly

……..……

14. To what extent do you feel governmental factors affect the growth of women in software development?

	Very Little Extent	Low Extent	Neutral	High Extent	Very High Extent	Mean Score
Positively						

Explain briefly

……..……

……

APPENDIX III: FEMALE STUDENTS ENROLMENT IN POLYTECHNICS IN AFRICA

Name of Polytechnic	All programmes		Technical programmes	
	Total students	% Female	Total students	% Female
Yaba College of Technology, Nigeria	8,510	25	3,862	12
Kenya Polytechnic, Nairobi (now Technical University of Kenya)	3,488	24	2,627	17
Accra Polytechnic, Ghana	2,498	30	1,083	1
Malawi Polytechnic	1,033	14	664	3
Dar es Salaam Technical College, Tanzania	955	7	955	7
Botswana Polytechnic	621	5	621	5
Uganda Polytechnic	566	9	566	9
Technical Training Institute, The Gambia	532	40	265	11
Northern Technical College, Zambia	195	2	495	2

APPENDIX IV: WOMEN IN SOFTWARE DEVELOPMENT IN AFRICA

Country	**Degree Program**	**Percentage of females**	**University**
Botswana	BSC Computer Science	10%	University of Botswana
Eritrea	BSC Computer Science	< 10%	University of Asmara
Madagascar	Other	11.1%	National
Kenya	BSC Computer Science	11.1%	University of Nairobi
Libya	BSC Computer Science	35.7%	Alfateh University
Nigeria	BSC Computer Science BSC Computer Science BSC Computer Science	31.3% 20%-30% 32.6%	Ogun State University University of Benin Nigeria Polytechnic
South Africa	BSC Computer Science and BSC Information Technology	32.1%	National
Tanzania	BSC Information Technology	20%	University of Dar-es-Salam
Uganda	BSC Computer Science	27%	Makerere University
Zimbabwe	BSC Computer Science	40.7%	Technical Colleges

APPENDIX V: DISTRIBUTION OF TEACHING STAFF IN SOFTWARE DEVELOPMENT IN AFRICA

Name of Polytechnic	All programmes		Technical programmes	
	Total staff	% Female	Total staff	% Female
Yaba College of Technology, Nigeria	284	19	179	16
Kenya Polytechnic, Nairobi	270	22	203	6
Malawi Polytechnic	117	12	72	1
Dares Salaam Technical College, Tanzania	119	15	104	11
Botswana Polytechnic	120	3	114	0
Uganda Polytechnic	100	3	100	3
Technical Training Institute, The Gambia	40	5	34	0
Northern Technical College, Zambia	58	2	57	0