GENDER GAP IN COMPUTER SCIENCE EDUCATION:

EXPERIENCES OF WOMEN IN UGANDA

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BY

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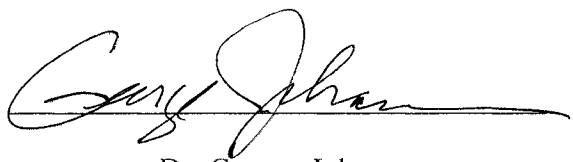

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CHAPTER ONE

Introduction

The real wealth of a nation is its people, both women and men. In spite of that, there is no single country in the world today in which women enjoy the same opportunities as men. Some telling examples of unequal access to opportunities are illustrated by the two indices developed by the United Nations Development Program (UNDP) in 1995 to measure women's status. The first, termed the gender related development index (GDI), measures achievements in life expectancy that is the opportunity for a long and healthy life, educational attainment as an approximate indicator of knowledge, and gross national product (GNP) per capita in terms of equality between women and men.

The second measure, termed the gender empowerment measure (GEM), is an attempt to assess women's ability to participate actively in economic and political life such as women's representation in parliaments, share of managerial and professional positions, participation in the active labor force and receiving a portion of the national income. According to the findings in the UNDP Human Development Report 1995 which used the two indices mentioned above, in all cases across countries throughout the globe, only nine countries in the high income developed regions of Europe, North America and Scandinavia had (GEM) values above 0.6, Sixty six had GDI above 0.6 and none reached 1, (The perfect score for GDI and GEM which indicates equality is 1). The GEM and GDI values were found to be lowest in the least developing regions of the world where they were below 0.3 and 0.4 respectively. Sub Saharan Africa had the same GDI and

GEM values as other least developed countries that is below 0.3 and below 0.4 respectively (UNDP, 1995).

A report by UNDP (2003) further illuminates the problem. According to the report the ratio of girls to boys attending primary, secondary and tertiary educational institutions (education being a variable that contributes to GDI measure) were again higher in the high income developed regions of the world and low in the least developed low income regions of the world.

A World Bank (2003) report also found that the percentage of women in decision making positions (women's participation being a variable that contributes to GEM measure) and the labor force gender parity index (this is the ratio of the percentage of women who are economically active to the percentage of men who are. Parity is reached if the ratio is 1) were higher in the high income developed regions of the world and low in the least developed low income regions of the world. For instance, high income countries had 13% of women in decision making position in 1994 and again in 1998, and a labor force gender parity index of 0.7 in 1990 and 0.8 in 2001. On the other hand, the less developed low income countries of the world, had 4% of women in decision making positions in 1994 and 6% in 1998, the labor force gender parity index in the region was 0.6 in 1990 and 0.6 in 2001.

The findings indicate that due to gender disparities women's potential is not being fully realized and their capabilities are not being fully developed to enable them to participate amply in the human development process. The "human development" paradigm as advocated by the UNDP contains four essential components that societies

should realize so as to include everyone in the development process without regard to gender. The UNDP (1995) sums up these elements as:

> Productivity, i.e., people must be enabled to increase their productivity and to participate fully in the process of income generation and remunerative employment; equity, i.e., people must have access to equal opportunities. All barriers to economic and political opportunities must be eliminated so that people can participate in and benefit from these opportunities; sustainability, i.e., access to opportunities must be ensured not only for the present generations but for future generations as well. All forms of capital: physical, human and environmental should be replenished; empowerment, i.e., development must be by people not only for them. People must participate fully in the decisions and processes that shape their lives. (p. 63)

Human development is thus impossible without gender equality, and as long as women are only partially participating in the development process, development will remain weak and imbalanced. Education is an avenue through which the gap in gender disparities can be reduced. It is true that after centuries of neglect, the past two decades have seen rapid progress in women's access to education.

Notwithstanding progress made in the world over the past decades in improving women's access to education, differences still remain. A UNESCO (2000) report indicated that disparities in gross enrollment ratios (gross enrollment ratio is the ratio of total enrollment, regardless of age, to population of the age group that officially corresponds to the level of education shown), between males and females persist at the primary, secondary and tertiary levels of education. The report showed a world total for

primary school gross enrollment ratios were 101.8% male/female, 106.9% male and 96.4% female. The secondary school gross enrollment ratios were 60.1% male/female, 64% male and 56% female. The gross enrollment ratios at the tertiary level were 17.4% male/female, 18.1% male and 16.7% female.

The high income developed regions of the world had the highest gross enrollment ratios for female. The primary school gross enrollment ratios were 103.5% male/female, 103.6% male and 103.4% female. The secondary school gross enrollment ratios were 108% male/female, 107% male and 109.2% female. The gross enrollment ratios at the tertiary level were 61.1% male/female, 56.8% male and 65.6% female.

On the other hand, the less developed regions of the world had low gross enrollment ratios for female. The primary school gross enrollment ratios were 101.7% male/female, 107.6% male and 95.5% female. The secondary school gross enrollment ratios were 51.6% male/female, 56.6% male and 46.3% females. The gross enrollment ratios at the tertiary level were 10.3% male/female, 12% male and 8.5% female

The report showed that Sub Saharan Africa is one of the regions with a large disparity in gross enrollment ratios. The primary school gross enrollment ratios were 76.8% male/female, 84.1% male and 69.4%; female; at the secondary level the gross enrollment ratio were 26.2% male/female, 29.1% male and 23% female and at the tertiary level the gross enrollment ration were 3.9% male/female, 5.1% male and 2.8% female. The gross enrollment ratio in Sub Saharan Africa at the tertiary level of 5.1% male and 2.8% female is well below the high income developed region average of 56.8% male and 65.6% female and the world average of 18.1% men and 16.7% female. Women in Africa thus formed only 33% of total enrollment at the tertiary level.

Enrollment thus continues to drop for women as the educational level increases. The question this situation raises is why are fewer women than men completing their education? Various reasons have been advanced for the low completion rates of females at all levels of the education pipeline on a global scale. These reasons might include: societal forces, economic barriers, cultural barriers, the educational and economic status of parents and institutional barriers.

Nowhere has women's access to education been as remarkably low as in the modern science and technology field, and especially in computer science education. (Rathgeber, 1998).

According to a United Nations Education Scientific and Cultural Organization (UNESCO) 1998 report, the number of women who enrolled for math and computer courses compared to men were very low from a sample taken throughout the world (see Table 1).

Table 1

Global Sample of the Percentage of Women Enrolled in Mathematics and Computer Science 1998

Country	Level 5			Level 6			Level 7		
	MF	F	%	MF	F	%	MF	F	%
Guyana	20	9	45.0	2	—	—	—	—	—
Paraguay	—	—	—	170	102	60.0	—	—	—
China	12141	—	—	12,520	—	—	—	—	—
Iran	666	203	30.5	1,788	670	37.0	208	28	13.5
Austria	38	12	31.6	634	155	24.0	83	16	19.3
Denmark	—	—	—	379	112	30.0	33	6	18.2
South Africa	4,394	2,138	48.7	1,065	386	36.2	587	200	34.1
Uganda	52	—	—	39	10	26.0	38	3	7.9
U. S. A.	17,389	8,611	49.5	38,127	13,369	35.0	16,617	4,796	28.9
Cuba	—	—	—	196	76	39.0	—	—	—
Nicaragua	22	14	63.6	292	139	48.0	—	—	—

Compiled from UNESCO 1998. MF = Male/Female; F = Female; – Magnitude nil.

Note: Level 5 means high school studies of not more than 3 years leading to an award of a certificate. Level 6 means higher studies at the university between 3 to 5 years which students who obtained a certificate at level 5 can pursue leading to an award of a first degree such as a bachelor's degree. Level 7 means post-graduate studies at the university

which students who obtained a first degree at level 6 can pursue leading to an award of a master's degree (UNESCO, 1998).

The UNESCO findings above are supported by an American Association of University Women (AAUW) report of 1998 which found that women received one in four of the computer science bachelor's degrees and only 11% of the doctorate.

According to a report commissioned by the American Association of University Women (AAUW) in 2000, even when women enroll in "computer science" courses, it has mainly been in courses on computer "tools" such as databases, page layout programs, power point, graphics, online publishing, and other "productivity software." The commission noted that while mastery of these "tools" may be useful, it is not the same thing as true "technological literacy" that requires a set of critical skills and concepts to use: abstract reasoning, to apply information technology in sophisticated innovative ways to solve problems across disciplines and subject areas; to interpret vast amounts of information with analytical skills, to understand basic principles of programming and other computer science fundamentals; and to continually adopt and learn new technologies as they emerge in the future (AAUW, 2000, p.18).

Above all, skills which women acquire by taking courses in areas such as database use, page layout, power point, graphics creation and online publishing leads to low-end jobs that generate low income and limit their opportunities.

The type of computer science education which the AAUW commission calls true "technological literacy," which is more problem solving oriented, is what most boys/men are taking. These are courses such as programming and networking which leads to the acquisition of skills that lead to high-income employment. The question this raises is why

are there continuing educational disparities between men and women? One answer to this question may be found in schools.

Globally, many popular notions of schooling portray schools as the sites of equal opportunity and places that strive to produce social equality. These notions reiterate Horace Mann's concept of schools as "the great equalizer" (Sadovnik, Semel & Cookson 1994).

In this traditional vision of schools, schools are seen as beneficial to students, providing the necessary education and skills that will enable each child to succeed. Schooling is seen as inherently meritocratic, and the success of each child is dependent on the child's innate abilities and on the willingness of the child to work hard. While schools may have problems (e.g., not enough money, poorly trained teachers, ineffective administrators), popular beliefs support the notion that a safe and well run school will help all students succeed regardless of race, class or gender (Sadovnik et al, 1994).

Social reproduction theory however challenges this popular view of schooling; it portrays schools not only as autonomous equalizers, but also as sites of the reproduction of unequal relations. Holland and Eisenhart (1990) sum up the social reproduction theory:

> According to the usual rhetoric, schools are the gateway to social and economic opportunity for those who are willing to study and learn. In the critical literature, the reverse is argued: schools maintain class, race and gender structures. They do this the argument goes, by differentially training students and by supplying ideologies that mystify the systems of privilege in this society. (p. 6)

An early influential feminist analysis of schooling was Rosemary Deem (1978). Writing from a general perspective of social reproduction, she argued that schools are central to the process of maintaining and reproducing the existing sexual division of labor. She emphasized that schools in their expectations of boys and girls, and in their authority structures so heavily dominated by men in position of power and authority transmit different cultures to boys and girls. Therefore the "choices" made by students in schools reproduce the existing sexual division of labor. Deem pointed out that schools do not create this division, but that they reinforce the present arrangement of society through their acceptance of the status quo in both class and gender terms she wrote:

> Education does not create the sexual division of labor, nor the kinds of work available in the labor market, or the class relationships of society, but it rarely does anything to undermine them (Deem, 1978, p.20).

Schools thus according to the social reproduction theorist are seen as agencies of socialization. It is generally agreed that education meant more than providing students with instructional goals and objectives, and that schools did more than teach students how "to read, write, compute, and master the content of such subjects as history, social studies and science" (Mehan, 1980).

Schools hence came to be seen as social sites with a dual curriculum, one overt and formal, the other hidden and informal. The nature of school pedagogy is to be found not only in the stated purpose of school rationales and teacher prepared objectives but also in the myriad beliefs and values transmitted tacitly through the social relations and routines that characterize day to day school experience. The linkages between schools and the social, economic and political landscape that make up the wider society, make it

appear as an institution inextricably linked to issues of power and control in the dominant society. Such links thus raises questions about the way schools mediate and legitimate the social and cultural reproduction of class, race and gender relations in the dominant society (Giroux & Penna, 1979).

Feminist scholars for their part argue that schools reinforce the exploitative nature of patriarchy which leads to women oppression. Schools they insist shape female identity and encourage subordinate roles for women. School experiences make women accept this inferiority. In addition, men control and define knowledge through the curricula and teaching methods that excludes women. Harassment in classrooms (sexist jokes, abuse and degradation of women) exacerbates the situation (Carnoy & Levin, 1976).

Both social reproduction and feminist scholars' theories have implications for gender oppression. According to feminist scholars, schools transmit values that not only produce social class but also maintain gender structures. The formal school system according to this view contributes to the reproduction of gender inequalities through such mechanisms as selective access to schooling, selective selection of content, and selective selection of who (boys vs. girls) receives what knowledge (Stromquist, Lee, & Brock-Utne, 1998).

The tool that schools use to legitimize education policies that maintain gender inequality is the curriculum. The curriculum in the broadest sense of the word includes both the formal and hidden curriculum. The formal curriculum, which is also known as the explicit curriculum, covers the knowledge and skills schools officially seek to transmit via their program of studies, courses and textbooks. Research done on education and gender in the developed world and some parts of the developing countries shows that

curriculum is commonly assumed to be value neutral, concentrating on the transmission of basic skills such as reading, writing and arithmetic. A closer scrutiny however, shows that these skills cannot be separated from the content they transmit. In most respects, the content of most schools portray a world with clearly demarcated feminine and masculine roles with women depicted in domestic and familial roles and men in professional public engagement.

One aspect of the formal curriculum that illuminates this demarcation is textbooks. Textbooks are surprisingly similar across countries in their definition of women as followers, passive and self-sacrificing individuals, having immense loyalty to their families but seldom involved in political and economic activities. Knowledge and subjects considered by feminists as necessary to gain a critical view of the gendered world we live in are seldom touched in school textbooks. In most cases such subjects are defined as "controversial" and are thus removed or ignored in the curriculum. In addition, the role of ideology in shaping social definitions of reality as it concerns women is first postponed because the students are "young minds" and later not covered at all because the curriculum "is already crowded" (Ministerio de Cultura Y Educacion, 1992).

The informal curriculum on the other hand refers to the "hidden" curriculum. That is those unstated norms, values, and beliefs embedded in and transmitted to students through the underlying rules that structure the routines and social relationships in schools and classroom. According to Vallance (1973), the term refers to those non academic but educationally significant consequences of schooling that occurs systematically but is not made explicit at any level of the public rationales for education. It refers broadly to the social control function of schooling.

The "hidden" curriculum thus functions not simply as a vehicle of socialization but also as an agency of social control, one that provides differential forms of schooling to different classes of students.

Bowles and Gintis (1976) in their celebrated *Schooling in Capitalist America* argued that the form of socialization, rather than the content of the formal curriculum, provides the chief vehicle for inculcating in different classes of students the dispositions and skills they will need to take their corresponding places in the work place.

A feature of the hidden curriculum is the expectations teachers have of boys and girls regarding occupational and family roles, the differential vocational advice given to boys and girls, the behavior norms and disciplinary sanctions enforced at school and the recreation within the school norms and values concerning masculinity and femininity by the peer group (Levinson, 1997). Hence occupational and educational stratification, based on gender, class and race, are quite visible beneath the cheery mainstream discourse of equal opportunity and individual achievement, and could be seen in the texture, social processes, and tensions that made the reality of school life.

The curriculum thus very often functions to legitimate the existing political order and curriculum changes also reflects the changing definitions of knowledge by the dominant group (Apple, 1997) that in most cases are men.

Statement of the Problem

Women throughout the world continue to be denied equal access to opportunities such as those enjoyed by men in computer science education. According to a UNESCO (1998) report (see Table 1 above) there were fewer women than men enrolled in computer science and mathematics at a global level. An AAUW (1998) report also found

that fewer women than men graduated with a bachelor's or doctorate degree in computer sciences. According to various studies (see Hewitt, 1997; Valian, 1998; Levin & Gordon, 1989; Sanders & Stone 1986; Margolis & Fisher, 2002; Huber & Schofield, 1998; Turkle, 1995; Shashaani, 1994; Sax, 1994) the low participation of women in computer sciences education might be attributed to factors such as computer culture, curriculum and teachers attitude, educational software, attitudes of male peers, societal forces, economic barriers, cultural barriers, institutional barriers and economic and social status of parents

In Uganda, a study conducted by the Female Education in Mathematics and Science in Africa Project (FEMSA, 1997a), found that women's performance in science subjects (which is the gateway to computer science studies) in the Uganda Certificate Examinations is very low compared to men (see Table 2).

Although there has been some rhetoric from politicians and educators in Uganda about improving the teaching of mathematics and science courses to women, not much has been done and the deficiencies and inadequacies continue. The concern this raises is that women are not participating fully in the sector, meaning that their potential is not being fully realized and their capabilities to participate in the development of the country in particular and in the human development process in general are being curtailed.

Purpose of the Study

The purpose of this study is two-fold: to investigate the nature of the gender gap in computer science education in Uganda and to understand the factors that influence gender differences in computer science education in Uganda. The information gained in this study will serve as a basis for a recommendation to policy makers to address the

issues/obstacles inherent in the low levels of women in computer science education. It will also contribute to the debate on giving women access to higher education, and especially in the sciences that could enable them to fully participate in the national development of Uganda.

Table 2

Performance of Students in Mathematics and Sciences on the Uganda Certificate of Education (UCE) in 1995

Subject	Men		Women	
Physics	16474	70.5%	6907	29.5%
Mathematics	34985	60.8%	22540	39.2%
Biology	31288	59.7%	21154	40.3%
Chemistry	16177	63.2%	9427	36.8%
Advanced Mathematics	125	92.6%	10	7.4%
Agriculture	17840	65.6%	9359	34.4%
Technical Drawing	492	92.3%	41	7.7%

Compiled from FEMSA 1997a.

Research Questions

The study seeks to answer the following research questions:

1. What is the nature of the gender disparity in computer science education in Uganda?
2. What factors promote/hinder women's education in computer science in Uganda ?

Significance of Study

Apart from seeking to empower women to participate in the national development of Uganda through the acquisition of high-level skills in computer science education that fully utilizes their capabilities; this study will broaden the debate on the significant role women play or can play in national development.

Specifically the study will augment that when women acquire high level skills such as in computer science education, their chances for getting high level paying jobs increases. And as women's income increases, their families become better off, so does their communities and nation.

Examples of countries that have enacted policies to end the depravation of women, and adopted gender equality and women's empowerment are Sweden, Finland, Norway and Denmark. In these countries, adult literacy rates are similar for women and men, and educational enrollment is higher for females. Life expectancy is on average, about seven years higher for women and earned income is around three fourths of men's income (World Bank, 2003; UNDP, 1995).

In addition the study will provide information that can guide policy-makers to intervene so as to improve the status of women in regard to computer science education. It will also provide statistics/facts to support further research in the area and provide information for women's organizations for further lobbying and advocacy work with the aim of addressing the gender imbalance in computer science education in Uganda.

Scope of the Study

The scope of this study will include both male and female students, and female faculty members at Makerere University's Institute of Computer Science involved in the

field of computer sciences. In addition, participants from Makerere University office for Gender Mainstreaming, the Forum for African Women Educationalist and the Technology Committee of the parliament of Uganda will also be interviewed.

Limitations of Study

The major potential limitation that I foresee in this study is that of gender bias. Feminists broadly question whether people can share experiences across cultural chasms. They claim that successful interviewing requires that there be a considerable shared culture between the interviewer and interviewee. Hence women should interview women (Rubin & Rubin, 1995). Since I am a man, women might be suspect of my intent in carrying out a study that is intended to improve the status of women in the area of computer science education and empower them.

I intend to cope with the issue of my gender (male), by recruiting a female research assistant. The research assistant will facilitate most of the interviews that involve women, although I will still be present during the interviews. I also intend to explain to the female participants that though I am male, I can still contribute to their struggles as an ally who shares their aspirations similar to how it was in past struggles were allies played major roles (e.g., whites participating in the civil rights movements meant to give equal status to black people in the United States; socialist countries in Europe, mostly inhabited by white people supporting independence for black African countries in the 1960's). However, I hope my gender will be an asset, when it comes to interviewing male participants.

The second limitation is that of having access to disclosures in government policy papers regarding computer science education in Uganda. This is mainly due to a resistance on the part of government bureaucrats to make such documents available.

Definitions of Terms

GDI: Gender Related Development Index measures achievement in the same basic capabilities as the HDI does, but takes note of inequality in achievement between men and women. The greater the gender disparity in basic capabilities, the lower a country's GDI. The GDI is simply the HDI discounted or adjusted downwards, for gender inequality (UNDP, 1995).

Gender Mainstreaming: The term refers to the process of assessing the implications for women and men for any planned action, including legislation, policies or programs in any area and at all levels. It is a strategy for making women's and men's concerns and experiences an integral dimension in the design, implementation, monitoring, and evaluation of policies and programs in all political, economic and societal spheres so that women and men benefit equally, and inequality is not perpetuated. The ultimate goal is to achieve gender equality (Economic and Social Council of the United Nations, 1997).

GEM: The gender empowerment index measure examines whether women and men are able to actively participate in economic and political life and take part in decision making. While the GDI focuses on expansion of capabilities, the GEM is concerned with the use of those capabilities to take advantage of life opportunities (UNDP, 1995).

HDI: The Human Development Index measures the average achievement of a country in basic human capabilities. It indicates whether people lead a long and healthy life, are educated and knowledgeable and enjoy a decent standard of living. It also examines the

average condition of all people in a country: distributional inequalities for various groups of society have to be calculated separately (UNDP, 1995).

Computer science education: This means program of study for computer science majors at the tertiary level.

Patriarchy: Patriarchy is used here to refer to a social system that privileges males over females. It does not refer to a characteristic of each and every individual male and female. As Connell (1983) stated, "Though not all men oppress all women, it is true that there is a general oppression of women by men. This is precisely the defining point of patriarchy. All women live and act in conditions shaped by the structural fact of men's supremacy, even those women, the Thatchers and Ghandis, who are very powerful indeed" (p. 44).

Leaky Pipeline: The Leaky Pipeline is used here to refer to the steady attrition of girls and women throughout the formal science and technology system, from primary education to science and technology decision making (GST Gateway, 2001).

Organization of the Study

The dissertation will be organized in the following manner:

Chapter One will include an introduction, the statement of the problem, the research question, the significance of the study, limitations of the study, the definition of terms and organization of the study.

Chapter Two will review the literature on gender gap in formal education as well as computer science education in the World, Africa and Uganda.

Chapter Three will discuss in detail the methodology used for the study, including the selection of subjects and a description of the data collection process.

Chapter Four will include the data presentation and analysis of the findings.

Chapter Five will summarize and propose recommendations.

CHAPTER TWO

Review of the Literature

Introduction

This chapter provides an overview of literature on gender disparity in formal education as well as computer science education in the World, Africa and Uganda. The fore mentioned discourse would aid in the examination of gender gap in computer science education in Uganda.

Despite progress made at a global level over the past few decades in improving women's access to education, disparities whether in primary school enrollment, secondary school or tertiary/technical enrollment between males and females still prevail (UNDP, 1995; UNESCO, 1998 & UNESCO, 2000) (see Table 3).

The number of females enrolled that actually completed the level at which they were enrolled compared to males varies from region to region (see Table 3). For instance in Africa in 1996 there were 44282 females enrolled at the primary level compared to 53779 males, however, not all the females completed this level. The difference in completion is reflected in the Equal Attainment Index (the Equal Attainment Index is the percent of women enrolled divided by the percent of men. As this number approaches 1.0, gender parity in completion rates occurs) (Kaneko, 1987). Attainment index in the particular case of Africa was only 0.77. Attainment rates were also not at parity in Africa with regard to secondary and tertiary levels.

In the sample in Table 3 only Europe and America had an Equal Attainment Index (EA) closer to1.0 and above 1.0, meaning that there was almost gender parity in educational completion at primary and secondary levels; complete parity at the tertiary

Table 3

Educational Enrollment at the Primary, Secondary and Tertiary Levels and Equal Attainment (EA) Index by Region 1980-1996.

Region	Year	Total Enrollment Level 1			Total Enrollment Level 2			Total Enrollment Level 3		
Africa		M	F	EA	M	F	EA	M	F	EA
	1980	35131	26997	0.77	9061	5299	0.58	1124	417	0.37
	1996	53779	44282	0.82	17766	14456	0.81	2705	1622	0.60
America	1980	45096	4292953	0.95	20644	20241	0.98	9374	9074	0.97
	1996	57442	215	0.92	25099	25548	1.0	11381	12987	1.14
Asia	1980	190273	145795	0.77	88178	56575	0.64	9483	4783	0.50
	1996	219078	183186	0.84	128610	97559	0.76	19564	13018	0.66
Europe	1980	26909	25562	0.95	31899	39077	1.2	8280	8136	0.98
	1996	24257	23362	0.96	34938	34915	1.0	10312	11219	1.1

Source: Compiled from UNESCO 1998.

Note: (EA) Equal Attainment Index is the percent of women enrolled divided by the percent of men. As this number approaches 1.0 gender parity in completion rates occurs (Kaneko, 1987).

level. In Africa and Asia there was no gender parity in any level during the same period. Despite gender parity in Europe and America in educational attainments at the tertiary level and a near parity at the primary and secondary level, there is still a disparity between females and males at all levels of the educational pipeline on a global scale (UNESCO, 1998).

From the description above it can be deduced that enrollment is merely one part of the education story and what really matters more is the Equal Attainment (EA) index. The Equal Attainment (EA) index is low in Africa and Asia. This low index rate indicates that even though the enrollment rate is high in the two regions, women have a much lower probability of completing their studies.

A further examination of the developing areas of the world shows that the gender disparity in school attainment is still expected to persist in the future at all levels (see Tables 4 and 5).

Table 4

Gender Breakdown of the Estimated Numbers (in Millions) of Out of School Primary (Level 1) School Age Children in the World's Less Developed Regions 2000 and 2010

Region	2000		2010	
Sub-Saharan Africa	19 Males	24 Females	18 Males	24 Females
Southern Asia	13 Males	22 Females	12 Males	17 Females
Arab States	4 Males	5 Females	4 males	4 Females
Latin America/Caribbean	2 Males	3 Females	2 Males	2 Females
Eastern Asia/Oceania	* Males	* Females	* Males	* Females

Compiled from UNESCO 2000. Note. * Less than 1 million.

Table 5

Gender Breakdown of the Estimated Numbers (in Millions) of Out of School Secondary (Level 2) School Age Children in the World's Less Developed Regions in 2000 and 2010

Region	2000		2010	
Southern Asia	39 Males	58 Females	39 Males	55 Females
Sub-Saharan Africa	21 Males	27 Females	24 Males	30 Females
Eastern Asia/Oceania	28 Males	30 Females	20 Males	24 Females
Latin America/Caribbean	8 Males	7 Females	6 Males	6 Females
Arab States	6 Males	7 Females	6 Males	6 Females

Compiled from UNESCO 2000.

All levels are mentioned and yet the tables above only cover primary and secondary education. It is however the successful completion of primary and secondary education that leads to admission into the tertiary educational level. It therefore goes without saying that a larger number of females dropping out of school at the secondary level means only a few can get to the tertiary level, and yet getting to the tertiary level does not in itself assure Equal Attainment as there will be more females than males who leave school. The only exception in the region where the number of males and females out of school are expected to be almost the same are Latin America, the Caribbean and the Arab states (the Arab states tend to have women in single sex schools leading to a high retention rate).

It is clear from the analysis mentioned that at a global level there is a disparity between women and men in formal education, yet various studies have shown that the returns from educating women are rarely matched by any other investment because of the

measurable benefits for women themselves, for their families and communities and for society (Cochrane, 1979; Cochrane & Jamison, 1982; Floro & Wolf, 1990; Herz, Subbarao, Habib & Raney, 1991; King & Hill, 1993).

Educated women contribute immensely to society and human development in general, have more control over the time they spend in child bearing and child rearing and thus have more time for productive work outside the home and for leisure. Women who are educated are more likely to use contraceptives, have smaller families and fewer children who die in infancy. The surviving children of educated women are healthier and better educated than those of uneducated women (UNDP, 1995).

The question that needs to be asked is: Why is the Equal Attainment rate of females lower than that of males and why are more females likely to be out of school than males?

Female Equal Attainment rate is low and attrition rate is high due to a host of reasons namely, societal forces; economic barriers; cultural and religious barriers; the educational and economic status of parents and institutional barriers.

Societal Forces

National education policies in respect to primary and secondary enrollment set the tone of what happens in tertiary or higher education. Such policies however, are not set in a vacuum of the existing society. Consequently, the policies are a product of the society (Conway & Bourque, 1993).

All cultures carry images and values about men and women and the roles appropriate for them. Although these vary from country to country, they all point to the idea that women are inferior to men. This conviction of women's inferiority may be

conceived in physical, psychological or intellectual terms and is used to justify or explain the restrictions placed on women.

A society's views about women reflect the values of that society and shape the attitudes, values and self images of its women. Family structures which also reflect societal values then determine women's roles, responsibilities, degree of independence, their general status and their employment status. All these factors combine to produce stereotyped roles appropriated for each sex. Children unconsciously assimilate society's values and norms, which help to shape their attitudes, preferences and behavior and bring about certain expectations and beliefs about school subjects compatible with their perceived roles. The effect is then reflected in the different types of education provided for them and ultimately in their achievements.

For example, all countries have an agreed general curriculum that schools follow, nonetheless, sex differences have been observed in the type of curriculum and option arrangements offered. Stereotypes within society have helped to create "male" or "female' subjects so that when options are offered pupils are likely to choose subjects which are identified with their own sex. Girls tend to take the Arts and Humanities subjects (Kwesiga, 2002).

In addition, one of the ways in which images and values described above are detected is through kinship, lineage and inheritance systems. According to Taplin (1989), in patrilineal kinship units, the lines of decent, inheritance and authority pass through the male line, with the male being regarded as the most important member of the kin unit. In this system daughters are given away in marriage because the brothers are dependent on their sisters' bride wealth for their own marriage. Husbands and their male relatives

control women as wives and mothers. There is nothing in the system that encourages women to go to school or even consider it.

On the other hand, in matrilineal societies although authority is held by the male (husband), inheritance is through the female line. In this system the maternal uncle is supreme; examples of such systems are found in West Africa, East and Southern Africa. Granted that matrilineal systems in some ways mean increased woman power, recent studies Tumbo-Masabo and Liljestrom (1994) showed that matrilineal systems increases a woman's responsibilities and burdens, since uncles do not encourage nieces to continue with schooling or even to aspire to higher education because they looked more to the benefit of the bride wealth than education.

Economic Barriers

Lack of economic opportunities inhibits women's access to education due to discriminatory practices that exist. Women do not always command the same wage or even receive employment in the same occupations as men. Such labor market restrictions make the returns to education lower for females than for males. In addition, females spend a lot more time in domestic labor (this labor is not paid for) than males in most societies. They do such work as tending children, fetching fuel and water, cooking, farm work and marketing or selling produce. School attendance by females is thus seen by most families as taking time away from household work consequently creating a rather high "opportunity cost" for families (opportunity cost refers to the labor and income that are lost to the household when a child attends school) (King & Hill, 1993).

Because of the labor contributions that females make to their families as narrated, and since there is a greater expected earnings of males, household decision makers tend

to place the education of sons over the education of daughters. This is especially more pronounced during times of economic hardships when families forced to prioritized resources give more weight to a son's education than a daughter's. Various studies in the developing world have shown that poverty, debt crises and other stagnation of the economy disproportionately affect women. And in such times women are forced to terminate their education (Arizpe, 1993).

Cultural and religious barriers

Barriers from a culture or religion are elements that have led to the high rate of female attrition and low attainment rates. In many societies in developing countries, girls more than boys enter school at a later age and may reach puberty before completing primary education. Entering puberty brings a host of specific restrictions on girls and in most cases at that stage they are more often than not encouraged to consider entering marriage as an alternative to education. Such expectations push girls out of school.

In some instances girls are not encouraged to become too educated, lest their education become a social or financial liability in finding them appropriately educated husbands. India exemplifies such a case where a family with an educated daughter must have a large dowry because women are expected to marry men with equal or preferably greater education (Kahle, 1985).

Religion can be a barrier to girls' education, depending on its teachings and practices. Islam is seen to be more restrictive than other religions. Women and men are not supposed to mix wiping out completely co-educational schooling. In rich Islamic oil producing countries, expansion of girls' education has been realized some what because the countries can afford single sex schools and universities.

Religious leaders have at times used fear of moral laxity under a formal school system as a reason not to support girls' education. The restrictions placed on women by the Taliban fundamentalist Islamic regime in Afghanistan after assuming power is a case in point. Not only girls were prohibited from going to school, even qualified women were barred from working outside of their homes.

Some other religious practices also discourage girls' education for instance the Hindu religion which expounds that a wife should play a subordinate role to the husband or the Catholic tradition of glorifying a woman's role as a wife and mother. These religious practices do not encourage girls to achieve academically (Kwesiga, 2002).

The Educational, Social and Economic status of Parents

The status of parents is a factor that significantly determines whether a girl will pursue education. This is especially true because school fees and other educational expenses have to be paid by the parents. Even in countries where there is universal primary education (UPE), parents still have to pay for such things as uniforms, books, transport and other expenses.

According to Stromquist (1989), Biraimah (1989) children of educated and professional parents and particularly girls are more likely to attend school and go up to higher education than children of uneducated parents. The findings show that as parents earn more, their aspirations for their children regardless of sex rises.

Institutional Barriers

Institutional barriers are a major agent that limits female education. This situation is very prevalent in the developing world due to limited resources. Educational institutions such as schools, colleges and universities may either open up chances for

girls' schooling or present barriers. School facilities determine the quality of the school which in turn influences the achievements and attainments of its students. Availability of textbooks, reading materials, good classrooms and laboratories, school furniture and numbers of qualified teachers are important indicators of quality education.

Inadequate school facilities may lead to other shortcomings, the major one being increased failure and class repetition rates leading to high dropout rates. On average girls are less likely than boys to persist in school after they have failed an examination or done poorly. In addition, the lacks of privacy for girls such as the absence of or poor toilet facilities, contribute to periodic truancy, and ultimately lead to some girls drooping out of school (UNESCO, 1990).

Gender Disparity in Formal Education in Africa

By virtually any standard, education in Sub-Saharan Africa lags far behind most of the developing regions of the world, except South Asia. One reason is that the continent is the poorest, without large and growing economies; governments have very limited tax bases to finance public school systems while the bulk of African families cannot afford the high fees charged by private schools. Another reason is that Africa began to develop modern schools as distinct from traditional forms of education much more recently, to a limited extent during the colonial era, but more seriously with the achievements of independence in the 1960s (United Nations Department of Public Information, 2000).

Starting from a very low base, the rate of girl's/women's enrollment in Sub-Saharan African schools has steadily increased since the 1960's. The gross enrollment ratio in primary education in 1960 was 28.3% female to 49.8% male; 1965, 35.4%

female to 55.8% male; 1970, 42.3% female to 61.0% male (UNDPI, 2000). The progress that has been made in women's enrollment in the primary level has been mainly due to government subsidies and support from the international donor communities in increasing universal primary education.

Despite all the efforts, serious educational gaps remain between women and men across all levels of education, with the disparity in access being greatest at the secondary and tertiary levels. This gap can be observed in Table 3, where the Equal Attainment Index (with 1.0 being equal attainment) shows a persistent gender gap that ranges from 0.37 to 0.81 in Africa, and yet achieving parity at these levels would be a necessary pre-requisite for promoting gender equality in the educational system (UNESCO, 1998).

Status of Women in Africa

Gender disparity in formal education in Africa is closely linked to the status of women on the continent today. Status of women as used here is taken from Ruth Dixon's (1978) definition, as "the degree to which women can have access to, and control over, material resources such as food, land, income and other forms of wealth; and social resources such as knowledge, power and prestige within the family, community and society" (p. 6).

In order to understand the position of women in Africa today, it is imperative to look back in the past to assess how the current status of women evolved. The three stages that are critical in the debate are the pre-colonial, colonial and post-colonial periods.

Pre-Colonial Period

Many authors assert that prior to the arrival of the colonialists, African women enjoyed levels of status and prestige similar to those of men. However, there were

variations in the degree of prestige/status depending on whether a particular society was patrilineal or matrilineal. On a general level, the relationship between men and women in all aspects of life was primarily based on complementarity rather than values of inferiority/superiority (Boserup, 1970; Wipper, 1982; Duley & Edwards, 1986; Hunt, 1990). Women thus were central players in their communities and societies.

For instance, with regard to societal labor productivity, there was no distinction between productive and reproductive labor where the latter reinforced or subsidized the former (colonial rule changed this arrangement in labor productivity by making productive labor a male activity that was paid for and reproductive labor a non paid female activity). Both women and men engaged in productive activities that were necessary for the survival of the household, kinship and community. The complimentarity in relations between men and women is best exemplified by societies that were based on mixed economies: women were assigned the major responsibility for agricultural production, which is mostly food production, while pastrolism and control over the disposal of cattle was the province of men (Henn, 1984).

On the issue of women's access to land, there were distinctions from society to society: in matrilineal societies women were the custodians who had power and authority over land allocations. In patrilineal societies men had control and women's access was indirect and mediated through men: fathers, adult sons or husbands. These men acted as land supervisors and women generally possessed the right to dispose surpluses from their food gardens. On the other hand, in nomadic societies that were neither patrilineal nor matrilineal, land belonged to neither women nor men but to the community (Harris & Harris, 1964; Hay, 1982).

In other spheres of life, women's associations and organizations exercised legitimate authority and empowered women in political, economic, religious and family life. Activities of such organizations abounded throughout Africa. For example, in Ibo land the *umu okpu* or "daughters of the patrilineage" settled disputes between the men of the patrilineage (Amadiume, 1987). In addition, the Ibo women's war of 1929 in which thousands of women in eastern Nigeria marched on British police posts to protest the imposition of new taxes was coordinated by the women's organization *mikiri*. The *mikiri* among other things made rules about the markets, crops and livestock that applied to men as well as women (Allen, 1975).

In Kenya, the high ranking women of the *ndunda ya atumia*, the women's advisory council in Kikuyu land dealt with everything concerning the training of girls and other religious matters (Kenyatta, 1938).

A notable example of a pre-colonial women's association was the Bundu society of the Central West Atlantic region of Africa which today comprises countries like Guinea, Sierra Leone, Liberia and Ivory Coast (Bledsoe, 1990). The Bundu society was very influential in social, political and religious life. They guarded fundamental traditions venerating ancestors and spirits. They could make arrests and issue pronouncements. Their area of influence extended to the protection of women, family life, streams, waterways and the fertility of the land.

Bundu officials tended major shrines, regulated sexual behavior and enforced incest taboos. In the area of reproductive health, the Bundu society assumed full responsibility for sexual health and fertility. Even male fertility was the subject of its control and male transgressors could traditionally expect castration at the order of a high

Bundu official if they broke a law of the society (Alldridge, 1894; Little, 1951; MacCormack, 1977).

Indeed, the Bundu society was so powerful and empowered women such that missionaries who arrived with the conquest of Africa and the introduction of colonial rule went to considerable trouble to discredit and destroy the organization whenever they could. Missionaries recognized that the Bundu society instilled in its members a level of pride and self-confidence that went against all the values of female deference and domestic confinement of the Victorian mind that they were used to. A missionary George Thompson writing in 1840's expressed the resentment of missionaries towards the Bundu Society. He wrote that he was thoroughly disgusted by the "self importance" of the women who had gone through the Bundu ritual (known as Sande among the Mende ethnic group). "They seem to feel themselves better than other people and will not bear saucy, insulting words or even a contradiction from an 'unsandied' woman.They must be regarded and treated with peculiar respect" (Thompson, 1852, p. 315).

Colonial Period

The imposition of colonial rule brought in a new era for women, the era of discrimination, exploitation, marginalization and domination. From its inception, colonial rule was gendered that is, it had different impacts on men and women who consequently experienced them in dissimilar ways (Margot, 1986). In the quest to accumulate capital, the colonialist introduced cash crops throughout Africa and men were pressured to enter the labor market through policies such as the introduction of taxation. Men were also trained to work in the commercial economy such as mining and extraction of mineral resources and the civil service (Lerner, 1986; Rapp, 1977). Although the policies were

meant to support the colonial state, they favored men because they introduced new patterns in the sexual division of labor.

Whereas the pre-colonial sexual division of labor was based on complimentarity, the colonialists introduced a mode of capitalist accumulation in which production came to be gendered male while reproduction conversely became gendered female. What this reshaping in the division of labor meant was that women's labor was to subsidize capitalist production carried out by men, by contributing through daily reproduction of labor: such as caring for workers when ill and after retirement and raising children, the next generation of workers (Lourdes & Sen, 1981).

The colonial state thus enabled men to enter the money economy as producers of agricultural commodities and aided in denying women similar status, despite the fact that their labor more often than not had heavily contributed towards producing what was considered their husband's crop (Bryceson & Mbilinyi, 1980; Harris & Harris, 1964). Hay (1982) noted that the colonial state captured men earlier than women but in exchange, men acquired resources and used ascendance in state institutions to consolidate control over women.

The position of women as reproductive workers required that the capitalist colonialist state had to develop effective means of controlling women's activities and movements. It also determined that women's experiences in such matters as marriage, the application of customary law and access to land, a cash income and waged work would all contrast with those of men. Consequently restrictive laws were introduced to regulate the movement of women: their customary rights and areas of traditional freedom such as

autonomy in certain aspects of decision-making and their ability to travel were also curtailed (Boserup, 1970; Duley & Edwards, 1986; Hunt, 1990; Wipper, 1982).

A case in point is marriage: the colonial state created a new "customary" marriage law and seized upon the payment of bride wealth as proof of the existence of a legally recognized "traditional" marriage. The pronouncement indeed had the intended effect of increasing marital stability and served to bind women more strongly to their marriages (Chanock, 1977, pp. 172-182); and by extension made their labor available to support the colonial state's capital accumulation by rendering reproductive labor to their husbands who were providing productive labor to the state.

Women's movements were thus controlled, and they could only move with the consent of their husbands. However, as more and more men moved to work in urban areas and especially mines, the state was willing to allow non-married women, especially prostitutes, to carry out sexual activities in the urban areas because they considered such activities to reproduce male labor power on a daily basis (Jackson, 1987; Thornton, 1997).

In matters of access to land, the colonial state replaced collective property rights with individual ownership; land allotted to cash crop production under the control of men was of a greater proportion compared to land allocated for subsistence food production under women. They argued that agricultural development, meaning cash crop production, would only come about if security of land tenure was vested in the hands of individual men who consequently were able to transmit it to their sons (Boserup, 1970). Accordingly, men's supervisory rights over land in the case of patrilineal societies were transformed into ownership rights. Nonetheless, under the same conditions, women's

usufructuary and trusteeship (for their sons) rights in land under matrilineal societies became increasingly threatened and vulnerable (Bryceson & Mbilinyi, 1980).

In order to increase men's productivity in cash crop production, colonialists introduced ox-drawn plough technology and the tractor. Government farms and agricultural centers were established and it was mandated that men not women would be taught in the use of the new technology; even though women played a major role in food production (reproductive labor). The justification for excluding women from the economic opportunities the new technology would present was that the oxen needed to pull the ploughs were owned by men and presumably by extension ploughs were to be as well (Dixon-Fyle, 1983; Hermitte, 1974; Maxon, 1980; Muntemba, 1982).

Women apart from producing food and performing other reproductive labor activities were also expected to labor in their husband's cash crop field, they, however, had no control over the products of their labor, since husbands often retained sole rights to dispose of the income gained from cash crop sales. Once again wives/women had to function in a role somewhat analogous to that of unpaid laborers on their husbands' farm (Bryceson & Mbilinyi, 1980). In the eyes of the colonialist, they were just playing their normal role: that of reproducing men's productive labor.

By the end of the colonial period, the distinction between production and reproduction had finally become institutionalized and male control over female sexuality and labor was already a fact of life (Lerner, 1986). As reproducers, women subsidized capitalist production that underpinned those relations on which the colonial state based its rule. Men as producers were targeted for migrant labor and were the beneficiaries of the colonial state's effort to alter pre-colonial systems of land usage and tenure, while women

were denied both this status and corresponding opportunities to command a cash income. The actions and policies initiated by the colonial state thus set the stage of the current disparity in gender relations as it exists in Africa today. The colonial state favored men in all its policies and pronouncements in regard to capital production and hence elevated the status of men and lowered that of women by only regarding them as reproducers.

Post-Colonial Period

It is not easy to categorize states/nations that emerged in Africa following de-colonization, as there have been dramatic shifts from one regime type to another for example, repeated transition from civilian to military rule and single party to multi party and vice versa. The genesis of African states/nations goes back to the colonial period: the colonialist divided Africa and hence framed the outcome. According to Rapp (1977), African states were formed on "the bloody laboratory of colonial penetration." What that implies is that there was no regard for the views and interests of the populations who occupied the states formed. Nor were there any recognition regarding the composition of the states in the form of ethnic groups that occupied it or even whether it would be economically viable. African states are in essence built on a tradition and foundation of heavy-handed statism or what Young (1988) terms "the robust trunk of colonial autocracy" (p. 57).

The combination of colonial rule, based on patriarchal domination coupled with the reality that men rather than women were provided with training and education during the colonial era, enabled men to dominate state power in post-colonial Africa.

In addition, the adoption by African's ruling elites of the colonial tradition of heavy handedness has ensured that their rule is marked by authoritarianism, brutality, violence and lack of hegemony (Hirschmann, 1981). Central to the discussion on the status of women in Africa today is the question of hegemony: it is the lack of hegemony that consequently leads to authoritarianism, brutality and violence. The concept of hegemony as used here is taken from Gramsci's (1971) definition as:

> The "spontaneous" consent given by the great masses of the population to the general direction imposed on social life by the dominant fundamental group; this consent is "historically" caused by the prestige and consequent confidence which the dominant group enjoys because of its position and function in the world of production. (p. 12)

Hegemony is not merely about material possessions; it is also about a politics of moral and intellectual leadership. In order to assert its hegemony, the ruling class must be able to defend its own corporate interests by universalizing them and by ensuring that these interests can "become the interests of the subordinate groups" (Gramsci, 1971, p.181).

Hegemony does not entail the absence of the ruling class's capacity to exercise domination or coercion. What it does signify is that domination is legitimate and eclipsed by the politics of consent and leadership. Hegemony thus crystallizes when consensual politics becomes so powerful that subordinate classes accept the rule of the ruling, the given social reality, and their place within it as tolerable, legitimate and just (Gramsci, 1971).

Conditions of hegemony as mentioned above are non-existent or embryonic in Africa and the male-dominated states do not take seriously into account the interests and aspirations of those groups, especially women, on whom they seek to, impose their domination and authority. Compliance in most cases is the result of coercion and not consensus. The state, thence, is a systematic concentration of man's power: it codifies, institutionalizes and legitimizes patriarchy. MacKinnon (1983) wrote:

> [The] State is male in the feminist sense. The law sees and treats women the way men see and treat women. The ...state coercively and authoritatively constitutes the social order in the interests of men as a gender, through its legitimizing norms, relations to society, and substantive policies. It achieves this through embodying and ensuring male control over women's sexuality at every level, occasionally cushioning, qualifying, or de jure prohibiting its excesses when necessary to its normalization. Substantively, the way the male point of view frames an experience is the way it is framed by state policy. (p. 644)

Because of the patriarchal ideology that the post-colonial regimes/states in Africa adopted, plus the lack of hegemony, women have not been able to play a significant role in the state system on the continent. And state policies towards them have ranged from varying degrees of discrimination, domination, exploitation, marginalization and coercion (Henn, 1984). Some illustrations will clarify the point.

According to an African Development Report (2002-2003), although women make up over 51% of the total population in Africa, in 2000 they made up only 9% of parliamentarians. During the 1995-97 periods, they occupied 8.3% of ministerial level

positions, 7% of sub-ministerial level positions and 11.6% of administrative and managerial level positions (African Development Bank, 2002-2003).

In most instances women's appointments to the positions as discussed above are at best token in nature with no power to influence policy, pass legislation and advance the women's agenda. They also have minimal representation and in- effective participation in areas such as the judiciary, the executive branch, the private sector and civil society organizations when compared to men. In addition, the existence in most African countries of customary laws alongside modern legal systems means that in reality, the majority of African women remain legal minors all their lives: first under their fathers, then under their husbands and finally under a son or male guardian (UNDPI, 2000).

In addition, states/nations in Africa use women as a way to seek legitimacy, but end up marginalizing them in the process. Political parties in most of Africa, in a quest to seek legitimacy, give a semblance of female participation by setting up a women's league under its wing, however the primary role of such a body is to provide support for male politicians. Though theoretically linked to party policy formulation organs, women have difficulty persuading the party to nominate them as candidates for elections nor are they allowed to argue for a women's agenda within the party. They are merely expected to support those "women's issues" that are consistent with party policy, regardless of its importance to women (Steady, 1975).

Even in so-called single party socialist states, which are/were supposed to be more progressive and give women better representation, women still have to struggle. Urdang's (1979) remarks that women in Guinea-Bissau fought "two colonialisms," Portuguese domination and the African patriarchy is a telling comment on the

confrontation of gender ideology, which is relevant across the continent. Whether in single or multi-party system, women have limited leverage in mainstream parties in Africa, and their interests are always relegated to that of men who control the party (Steady, 1975).

In some instances women have been victimized by being made scapegoats for masking systematic failures and illicit political practices (Parpart & Shaw, 1988). Robertson's (1984) observation concerning Ghana is illustrative of a continental trend:

> [G]ender identity is increasingly used by the government of Ghana in an ideology, which objectifies women traders into a class, which can be blamed and persecuted for causing the enormous economic problems.... The persecution heightened during the first Rawlings government. In a symbolic act of August 18, 1979, soldiers bulldozed [the women traders] Makola No. 1 market and reduced it to a pile of rubble. "That will teach Ghanaian women to stop being wicked," a soldier said. (pp. 243-244)

In other instances, women's resolve in their quest for emancipation and economic independence has been mollified by the patriarchal ideology of Africa's ruling elites, as Roberts (1984) pointed out:

> Women who struggle to maintain some economic independence from men may be accused of making their husbands impotent, or of prostitution or of neglecting their children and "causing" juvenile crime. Similarly, women who vigorously dislike polygamy are confronted with claims that it is the natural birthright of the African (man). While there has been scope for individual acts of resistance, the exercise of individual strength often increases a woman's personal vulnerability.

> Those who are not deterred by male fantasies of female aggression encounter the moral crusades, the denigration and the violence against women who force their way out of male control. (p. 181)

Thus the lower status of women vis-à-vis men in Africa today is a result of patriarchal prejudices that have contributed to persisting and pervasive discriminatory state polices. For instance, women in most African states cannot inherit property/assets left by their deceased spouses, and even when their spouses are alive the property/assets belong to the men. The lack of having title or ownership to such assets makes women dependent on men, as they cannot sustain themselves economically. Secondly, because most African governments lack legitimacy, women are not well represented in the crucial organs of state power such as the legislature and judiciary. Being well represented in such institutions/organs would enable them to advocate and enact legislation that would empower and improve their situation.

Since women's representation in politics is minute, many who feel that they are being marginalized and their issues de-politicized withdraw or are alienated from contemporary politics. They prefer to "exit" and manage their own affairs autonomously. Such autonomy nonetheless magnifies gender participation gaps in conventional politics and women's continued marginality in those politics (Staudt, 1987).

The gap in formal education in Africa is without a doubt a reflection of the fact that women do not have much say in the educational policies that are enacted in African countries. They also lack the economic wherewithal to support themselves or their daughters because of the obstacles discussed above. Thus, whilst women continue to struggle for equality and equity in the distribution of the national resources, access to

capital, land, credit, education, employment opportunities and laws that recognize them as citizens; African states have failed to enforce new and more egalitarian rules of conduct. They continue to subscribe to laws that consistently favor and enhance the power, interests, and status of males.

Barriers to Women's Access to Formal Education in Africa

There are confluences of factors that impinge upon women's participation in formal education. Many if not most of these factors are not unique to Africa and are also prevalent in other regions. These are: level of a country's development, policy factors, academic factors, and cultural and societal expectations of gender roles.

Level of a Country's Development

The overall level of a country's development is a major factor that influences the access to formal education for girls. According to Adams and Kruppenbad (1987), rich countries have higher levels of female enrollment than poor countries. This point is particularly relevant to Africa, according to a World Bank (2004) estimate, poverty levels rose in Africa from 41% in 1981 to 46% in 2001.The issue of poverty as it relates to education is exacerbated by the continuous increase in population growth in Africa. In 1980, Africa South of the Sahara had a population of 381.7 million that increased to 673.9 million by 2001 (World Bank, 2003). Because of this high population increase, coupled with competing budgetary priorities in economies that are not performing well, governments have not been able to provide education for all and especially not for girls.

A variable that is associated with the level of economic development and is an obstacle to girl's education is the percentage of the labor force engaged in agriculture (Wood, Swan & Wood, 1986). This is especially true in areas still using traditional

farming methods as is the case in most of Africa. Parents need more hands to work the land. Although this situation applies to both boys and girls, it affects girls more since labor is divided on gender lines. African societies expect girls/women to be responsible for growing food crops. These tasks are not only burdensome but they also make heavy demands on women's time.

Closely related to agricultural labor is household labor that falls heavily on girls. In Islamic societies such as Northern Nigeria, women in purdah (seclusion or confinement of their households during daylight) depend on their daughters or young female relatives to sell their produce/products in the street or the market place. They also rely on girls to collect raw materials and help with production and sales. Sending girls to school would curtail the income generating activities of such women (Fapohunda, 1978).

Policy Factors

Policy factors refer to direct and indirect government and multilateral initiatives in education and training. Gender disparities in formal education continue because of educational policies that foster or perpetuate gender imbalances in the system. Although these policies may not be "consciously" framed to produce inequality, some of the indirect/direct consequences resulting from them constrain women's ability to access and perform equitably within the educational system. Among the policies are those initiated by African governments and multilateral development agencies such as the World Bank. The policies can be categorized under the following, school location, poor quality education, single sex versus coeducational schools, enforcement of civil laws and foreign development assistance.

School location: this is a concern in the case of Sub Saharan Africa because the majority of the population lives in the rural areas. The issue of location has direct consequences for women's access to education, since parents may be unwilling to risk the safety of their daughters by sending them unaccompanied to distant schools. A number of studies (Akande, 1987; Assie, 1983; Bedri & Burchinal, 1985; Chernichovasky, 1985) have shown that the area of residence and the location of a school are predictive of enrollment and attainment at all levels of education.

Another study by Lockheed and Verspoor (1990) also indicated that for every kilometer of distance a pupil had to walk to school, the likelihood of attendance dropped by 2.5%. Examples, in Egypt, 94% of boys and 72% of girls enrolled whenever a school existed within one kilometer. When the school was two kilometers away the percentage dropped to 90% boys and 64% for girls. The study also found that pupils who live a long way from school are also prone to absenteeism and fatigue and some are even afraid to walk through forests and overgrown areas to school. This particular situation increases constraints for girls.

Poor quality education: schools of poor quality inhibit the educational attainment of girls. A case in point is a study done in Kenya (Eshiwani, 1985). Girls were overrepresented in secondary schools of low quality (so called Harambe schools in Kenya), which are not supported by the state (these schools are mostly private or missionary managed). The schools have poor equipment, less qualified teachers and more limited curricula than the government or government aided schools. Boys on the other hand were mostly enrolled in state maintained schools that tend to provide a higher quality education at lower costs. The poor quality of education that is typical of non-state

supported schools limits girls' success in examinations; poor performance in examinations, in turn, reduces their attainment of the necessary prerequisites to enter institutions of higher learning and the university (Eshiwani, 1985).

Single sex versus coeducational schools: the issue of girls' education especially at the secondary level is complicated by the tendency for African secondary schools to be coeducational rather than single sex. Cross-national research done in Kenya and Nigeria on the effects of single sex versus coeducational schools suggest that single sex schools provide particular advantages and benefits for their constituents, especially girls. Girls who attend single sex schools have higher educational aspirations and improved performance levels than they do in coeducational schools (Boit, 1986; Eshiwani, 1985; Forge, 1989; Obisodun, 1991).

Other studies also found that the relative pass rate in science for girls in single sex schools were the same as boys in coeducational schools (Lockheed & Komenan, 1988; Wheldon & Smith, 1986). Girls in single sex schools were also more likely to choose mathematics and the "hard" sciences other than the physical sciences. This is important since mathematics and other hard sciences are a gateway to many courses, further education and career opportunities.

Enforcement of civil laws: the lack of enforcement of civil laws and/or formulation of laws to protect women's rights in most African countries with respect to protection from sexual harassment or violence against their person is a major impediment to women's education (Nammudu, 1993). A case in point is the occurrence and a fact of life of sexual harassment on most university campuses and institutions of higher learning. Women are not always in a position to protect themselves for fear of victimization from

male peers, male professors or male administrative staff. Linked with this is the issue of political instability and violence in many African countries that is often associated with strikes, violent political changes and school and university closures. Although these happenings affect both males and females, they are more dangerous for females, as they can be raped and sexually harassed. Such happenings make it unsafe for women to proceed with studies (Perlez, 1991).

Foreign Development Assistance: due to the level of poverty in Africa, the continent is increasingly looking to outside sources of financial assistance to help support poor performing economies as well as build the human capital. It is in this regard that international development agencies have emerged as major players in the formation of educational policy in Africa via policies they advocate or impose on Africa countries as conditionality for the assistance they receive. Some of these policies have enormous impact on girls/women's education.

Most development agencies seem to formulate policies with a bias against women. A typical case is that of the World Bank. Although the Bank appears sensitive to the problems women face in Africa as they enter and move through the education system, one cannot reconcile these "sensitivities" with the actual policies that the bank advocates. An instance is reflected in a World Bank document Entitled Education in Sub-Saharan Africa (1988). The document offers 120 pages of texts of which only two pages are devoted to women. Although the section calls for gender equity for women, its arguments for doing so are stereotypical: "the proven links between mothers' education and the health and educability of their children, and the connection between education and reduced fertility" (p. 61). This line of argument does not consider women's education on

the basis of their right as women and human beings, but only that it will make them better mothers.

The document notices matter-of-factly that African parents usually prefer to send sons to schools and remarks that women with more education may command a higher bride price. "This is an example," the authors conclude, "of how families try to capture for themselves the returns to their educational investments" (p. 62). As solutions to these problems, the document indicates "there are policy measures that will increase the willingness of families to allow daughters to attend school" (p. 62).

Among the solutions, the World Bank proposes setting up small community based schools, which reportedly tend to be more appealing to girls; providing girls with free books; charging them lower tuition fees; offering more school meal programs for girls than boys; and charging families less for boarding and welfare services for girls than boys. Missing from the document is any reference to the existence of patriarchal ideologies supporting differential gender treatment, as well as the absence of an explicit recognition of patriarchal ideologies shaping the sexual division of labor. It leaves one wondering why these "solutions" should work, let alone be implemented.

The lack of interest in considering gender is also mirrored in the Bank's neglect of equity and being overly concerned with efficiency: an approach intended to integrate women from the margins of development into mainstream by recognizing their productivity as a valuable resource that could not be wasted. The approach however, focused merely on women's productive capacity without taking into account their unpaid workload within the household (Kabeer, 1994).

Although the concept is appealing, the discussion of efficiency is both inaccurate and misleading. On the one hand, when the defense for attention to women is based on the principle of efficiency, such an argument downplays the fact that women are productive but exploited under existing conditions. The call for "utilizing women's resources in development" often translates into giving them double and triple working duties (Stromquist, 1998, p.36).

On the other hand, the indicators of educational efficiency in use tend to ignore gender. According to the World Bank (1988), these indicators include the proportion of a given cohort reaching its final grade, the cost per completer, and repeaters as a percentage of the total enrollment. A closer look at the indicators reveals that no concern is expressed as to whether these indicators show differential rates by gender and class.

In addition, the package of policies known as structural adjustment that were advocated by the World Bank and the International Monetary Fund for many African countries in the 1980's, have led to negative consequences for women's education. These policies included a shrinking of the public sector, which is a large employer of women, especially in the education sector, hence eroding the already low labor market returns to education for women. In addition, the policy advocated for a decrease in educational budget and the privatization of the public sector, including education. This led to the increased role of the private enterprise in the provision of education/schooling and the accompanying increase in user's fees (World Bank, 1988). Although these policies affect both males and females, it is felt more by females than males: the advocacy of user's fees has led to greater expenses for parents forcing them to make school choices for their children. Such choices have been detrimental to the education of females from low-

income families, as it has tended to widen the chasm between females who get an education and those who do not.

It is due to such practices as narrated that feminist scholars began to question whether institutions like the World Bank are committed to support education in Africa and the developing world as a vehicle to liberate women from patriarchy or as a way to include "Women in Development" (WID). Criticisms leveled against the Women in Development (WID) paradigm is that as good as it sounds; it is only right as a political symbol because it is based on the existing social structures, instead of examining why women had been marginalized. It only focused on how women could be better integrated into development initiatives under existing social structures. In this way the origins of women's subordination and oppression went unchallenged, even unquestioned (Rathgeber, 1991).

Kelly (1987) argued that "Women in Development" far from being a useful concept to transform the condition of women, is a model that pushes the western patriarchal nuclear family and the sexual division of labor appropriate to it. She wrote:

> The women in development paradigm directs study away from patriarchy since it looks at women and their education as divorced from patriarchal structures that oppress women. Education and development become vehicles to incorporate women into male-dominated status hierarchies and institutions; education has not become a vehicle to liberate women from them. (p. 4)

Indeed the World Bank or any multilateral body which is serious about ending inequality in education in Africa, should adopt a holistic approach that seeks to eradicate

gender inequities as away to unleash women's un tapped vast potential human resources to participate in the development challenges Africa faces today.

Academic Factors

The academic structure determines how well women and men perform educationally. Women's formal education is hindered due to lack of proper preparation, curriculum, teacher's attitude, and text books.

Lack of preparation: there is a lack of preparation at the primary and secondary level and it is an area that hinders women's advancement to higher levels of the educational system in Africa. According to studies by Eshiwani (1982) and Weis (1980), there are significant gender differences in secondary level education when it is assessed in terms of students' level of preparedness for qualifying examinations for university entrance. This is especially true for science and mathematics that are the gateways for entrance into various disciplines at the university level. Females/girls do not perform well because the scientific instructional programs they receive are generally poor due to the poor schools they attend. Boys/males on the other hand, have greater access to schools with better quality programs in science and mathematics. The lack of proper preparation thus hinders girl's performances, which, in turn, limits their chances of further education (Eshiwani, 1989).

Curriculum: the curriculum in Africa is still structured to reinforce societal perceptions of women's role in family life that is activities restricted mostly to the household and subordinate to the role of males. In most instances, the curriculum is not very sensitive to the different pedagogical needs of female students. For example, in science classes and laboratory sections, girls/females prefer to work in groups and prefer

courses that emphasize the practical applications of science. They show more interest in subjects like biology, nursing and pharmacy, which show a concern for living things and a desire to put one's talents at the service of others. Teachers, instead of taking into account the pedagogic need of girls/females and encourage them to take such science subjects with practical applications as mentioned above as an alternative, channel them to subjects which society considers "soft" and "more feminine" such as home economics, arts and crafts (Eshiwani, 1985; Manthorpe, 1982; Okeke, 1986; Whyte, 1984).

The "hidden" curriculum which is described as those non academic but educationally significant consequences of schooling that occurs systematically but is not made explicit at any level of the public rationales of education also work to thwart girls education. A study by Masemann (1974) in a girls' school in Ghana clearly expresses the effect of this type of curriculum on girls. The study revealed that, in spite of the fact that the stated goal of both parents and students was completion of secondary schooling, there was also a 'finishing school' aspect which prepared girls for marriage. This was done through extra curricular activities conducted by married female teachers living with their husbands. The messages that were passed to these students were gender biased and it cemented the perceptions and expectations of these girls and their roles as women. This type of 'finishing school' aspect of the "hidden" curriculum is typical of girls' schools throughout the region.

Teacher's attitude: teachers are influential on the development and performances of students. This is especially true because they are viewed as role models. Teachers effectively communicate what they consider to be societal expectations of roles for men and women. For example, both male and female teachers have been shown to express the

familiar stereotypes: they believe that only boys can study the sciences and typically learn lessons well, raise their hands, give good responses, and manifest ambition, whereas they see girls as well behaved but timid and not as hard working as boys. Because of the stereotypes, teachers hold greater expectations of boys than of girls and treat them differently in class, with boys receiving more attention and intellectual challenge (Biraimah, 1980, 1989; Hyde, 1989; World Bank, 1990).

In some instances, the influence of female teachers is an important motivating factor. As role models, female teachers motivate girls to enroll and to increase their attendance and persistence rates. Nonetheless according to UNESCO (1990) Sub Saharan Africa has the lowest percentages of female teachers especially at the secondary and higher levels. In addition, female teachers are not so well regarded and respected as male teachers and their potential as positive role models is weakened by the generally lower status of women. New ways of making them credible models for girls ought to be explored.

Textbooks: the bias against women is also found in textbooks and other scholastic material that schools use. Research on women has shown that textbooks used in Africa and other developing countries persistently portray strong negative sexual stereotypes about women (Tembo, 1984). In most instances, textbooks tend to be male oriented and too often exaggerate and perpetuate the unrealistic idea that a woman's role is confined to that of a wife and mother.

An example can be seen from A UNESCO project in Zambia that surveyed a number of primary and lower secondary school textbooks on gender stereotypes. The project used a simple methodology: the numbers of occurrences of male and female

characters were tallied and their activities and characteristics noted. The results were informative. The books contained many more male than female characters, and those female characters that appeared did so primarily in domestic roles and were presented as passive, stupid and ignorant. Men's activities were admired; women's ignored (Tembo, 1984).

The construction of these gendered expectations, beliefs, and stereotypes does not necessarily begin in the classroom; indeed in some instances it has roots beyond national boundaries. As the discourse continues, it is amplified in the political, workplace and media leaders that girls/females and society see. These images are simply compounded in schools when teachers reinforce stereotypes in classes by drawing on examples that reflect the experiences of men rather than women (UNESCO, 1994; United Nations Economic and Social Council, 1994).

Because of these stereotypes, one can infer that the probable educational and occupational aspiration of girls/females will be that of wife and mother when those roles are depicted as the only appropriate ones for women. Thence, if girls/women are to make recognizable accomplishments in the educational process, social stereotypes that exist in textbooks must be corrected and more girls/females must be encouraged to take subjects of their choice, with proper curricular pedagogical support.

Cultural and Societal Expectations of Gender Roles

Cultural and societal factors are also major impediments to the educational advancement of women. These are societal expectations, early marriages, parental attitude, and socio economic background.

Societal expectations: in many African societies women are expected to participate in agricultural production (food production) and to take responsibility for domestic labor and care giving. Normally, girls are either taken out of school or distracted from their schoolwork to undertake these tasks. According to a study done in Burkina Faso (see McSweeney & Freedman, 1980), no matter how much flexibility is exercised in scheduling school timetables, girls/females find it difficult to keep up with their studies because of household responsibilities.

Early marriage: this practice is especially true in Africa due to the early age at which marriage takes place: a study done by Newman (1984) in a number of African countries found that girls/females married at an early age of 17, while men married at an early age of 22. The young age at which girls/females get married, therefore makes marriage an important reason why they do not enter institutions of higher learning or having entered, leave before completing the cycle.

Although it is not uncommon for married students to be enrolled, pregnancy and childbirth usually ends an educational career. Marriage also does affect primary school children where there are significant numbers of overage (those over the age of 15 years) children or where betrothal takes place at an early age. A case in point is a study done in Ethiopia: Biazen and Junge (1988) found that 20% of primary school students surveyed were promised, married or divorced. Although both boys and girls were affected, it was the most common reason given for the non-enrollment of girls.

Socioeconomic background: the discussion under here is the same as under the global level.

Parental attitude: Parents for a host of reasons that are religious or moral in nature have made decisions that impede the education of their daughters. Although there are considerable variations between and within countries as discussed above, Muslim countries and regions tend to have more rigidly defined gender role norms and practices, which affect access and attainment rates for girls in the educational system. A UNESCO report likewise noted that the predominance of male teachers in the classroom is a deterrent to parents who prefer their daughters be taught by female teachers (most parents think their daughters are at great risks of being involved in a sexual activity with male teachers) (UNESCO, 1994).

Lastly, educational attainment of mothers plays a major role in girl's/women's participation in formal education. Evidence from a number of countries indicates that women bear a large part of the burden of educating children (see Robertson, 1977; Tripp,1988). A mother's ability to pay school fees and to provide encouragement to her children to continue attending school is thus important. Various studies in Africa have recorded that households headed by educated women/females are more likely to send both boys and girls to school and to keep them there longer, than households headed by uneducated females or males (Chernichovsky, 1985; Kossoudji & Mueller, 1983).

Gender Disparity in Formal Education in Uganda

Uganda has made tremendous improvements in expanding formal education. According to a UNESCO 1998 report, the gross enrollment ratio (the total population in school as a percentage of the population of the specific age group) in 1980 was 50% male/female, 56% male and 43% female for primary; 5% male/female, 7% male and 3% female for secondary and 32% male/female, 37% male and 27% female for tertiary.

However, in 1995 it had increased to 73% male/female, 79% male and 67% female for primary; 12%, male/female, 15% male and 9% female for secondary and 48%, male/female, 53% male and 43% female for tertiary.

The improvement in education received a tremendous boost in 1997, when the government declared a policy of universal primary education (UPE). This had the effect of boosting enrollment from a 1996 figure of 3.1 million students to 5.3 million in 1997. By 1999 the number had risen to 6.6 million and the Ministry of education expects it to reach 6.8 million by 2003 (UNDPI, 2000).

Even with the boost in enrollment due to Universal Primary Education (UPE), disparities still remain. Then Vice President Specioza Wandira Kazibwe noted in June 2000 that despite the introduction of UPE, "the percentage of females enrolled in primary schools is still lower than that of boys" (UNDPI, p.21). Females account for 47% of total enrollment in primary schools, 32% at the secondary level, 35% in the universities and 13% in the polytechnics (UNDPI, 2000).

Status of Women in Uganda

As in other parts of Africa, a full understanding of the status of women in Uganda today requires an examination of the country's history in the pre-colonial, colonial and post colonial periods.

Pre-Colonial Period

The position of Ugandan women in the pre-colonial period was not as it is today. Even though their status was by no means equal to that of men, they were not as marginalized. Men dominated positions of political, economic and social power but the intimate inner workings of different cultures and historically distinct arrangements

between the sexes allowed for women to participate in all kinds of activities on both a formal and informal basis (Kandiyoti, 1988).

Politically women were never confined to the private or domestic sphere. They did not participate in political discussions directly, however, their opinions were valued and sought before political decisions were made. Women thus wielded social and political influence through indirect methods (Driberg, 1932; Schiller, 1990; Lebeuf, 1963). For example, in the monarchical systems of Buganda, Bunyoro-Kitara and Toro, queen mothers and the king's classificatory sisters played important political roles. Not only did these women share political power with the kings but in some cases they even exercised judicial powers, collected taxes and condemned their own people to death (Lebeuf, 1963).

In the segmentary societies of the Luo speaking people of northern Uganda, women assumed the role of divine-mediator that is they were the link between the living and the ancestral spirits. A divine-mediator carried considerable power and influence because she possessed the skills to heal the sick, avert evil, predict war etc. Due to the role they played in society, female mediators often did politically mobilize the populace with ease (Tosh, 1978). A classic example can be found in the person of Angwen of Ngai, a female war leader of Lango who commanded an army in battle and later established her own chieftaincy. She also had vast influence across the northern region of Uganda (Driberg, 1932; Lebeuf, 1963).

Gender relations during this time period took on a form that was more complementary than hierarchical (Pulme, 1963; Okeyo, 1980). Gender relations as used here refer to the interaction that occurs between men and women as they carry out their

different roles in society. Such relations are a reflection of the roles/activities that males and females perform in society and the relative value/meaning attached to those roles by the wider society (Brydon & Chant, 1989).

For instance, in the area of production, although there was a sexual division of labor during this time; the dynamics of such a sexual division of labor were different from what became with the introduction of colonial rule. Ugandan society then did not defame women's work the way it did in the colonial and post colonial period (Pulme, 1963; Okeyo, 1980).

Men generally built houses, hunted, herded and milked, fished and fought. Women on the other hand, cultivated, processed and marketed crops, collected firewood and water, cared for the children, the sick and the elderly, made pottery, cleaned and washed. Despite the division of labor, there was no negative evaluation attached to these different roles. Driberg (1932) observed "A women carrying out her duty [was] held in just as high esteem as a man carrying out his and the nature of the occupation [was] of no moment" (p. 409).

In the realm of traditional customary marriages, although there was the payment of bride wealth (marriage gifts such as live stock or some special symbol of wealth offered by the groom to the bride's family before, at, or after marriage), it was a means of cementing the relationship between all the families concerned rather than a commercial transaction meant to demean women. Indeed the parties involved were largely free partners within the context of societies that emphasize communitarian ideals in contrast to individual autonomy. In addition, a woman was free to walk out of an abusive marriage and return to her parents and relatives (Burman, 1990; Obbo, 1986).

The advent of colonial rule in Uganda, similar to the situation in the rest of Africa, thus set in motion, a set of factors that fundamentally changed the status of women and upset the complimentary nature of gender relations then in existence.

Colonial Rule

The introduction of colonial rule in Uganda in 1894 meant that capitalism was in situ. Capitalism sharpened the relationship between men and women, since that relationship was greatly influenced by women and men's relationships to capital. Upon taking control of Uganda, the British introduced cash crops such as cotton, tobacco, coffee and tea etc; as a source of cheap raw materials to supply factories in the colonial motherland (Britain). Ugandan men had no choice but to engage in the production of these primary products in order to meet their tax obligations to the colonial government (tax was mandatory for every male that owned a hut) (Jamal, 1978). Men thus cultivated cash crops from which they earned an income, while women cultivated food crops and cash crops. However, women did not get paid either for their productive or reproductive labor because the colonialist considered female labor to belong to their male relatives, that is, their husbands and fathers.

The fact that women were not paid for their productive and reproductive labor meant that they provided a subsidy to the capitalist production. In addition, such exploitation of their labor lowered their status relative to that of men. Furthermore, the "right" which men had over their wives' labor was strengthened. They had a firmer grip on women's productive and reproductive labor since the financial benefits from it accrued to them further causing the subordination of women. Roberts (1984) summarized

the reasons why capitalism increased the subordination of women in non capitalist sectors:

> The intensification of female labor in peasant economies released male labor for the production of cash crops...Their [women's] productive labor was intensified to ensure the subsistence basis of labor reserve areas while their reproductive labor ensured the maintenance and reproduction of labor power at no cost to the capitalist wage. (p. 176)

Ugandan women were further marginalized and subordinated by the customs and policies the British introduced. Where there had been no distinction between private and public life in pre-colonial Uganda; the British brought their own ethnocentric version of male domination. Their structures and policies focused on delineating a clear distinction guided by an ideology that perceived men as public actors and women as private performers. The colonialist worked hand in hand with the African patriarchs to develop inflexible customary laws that evolved into new structures and forms of domination (Mama, 1996; Schmidt, 1991)

Reflecting upon the male dominated politics that completely ignored women's political roles, Smock (1977) noted:

> Colonial policies had a rather important influence on sex roles, definitions and opportunities for women. Christian missionaries and colonial administrators brought with them Victorian conceptions concerning the place of women in society. Generally they did not appreciate the significant contributions frequently made by women and their sense of independence. (p. 181)

The same policy above was also applied in the arena of education. According to Graham (1971), Smock (1977), and Weis (1980), colonial policy in education was among the most potent factors which adversely affected the relative position of women in Africa. As in Victorian Europe, educational opportunities were disproportionately provided to males (Staudt, 1981).

In Uganda, missionary education for women such as that provided at the prestigious all-girl school like Gayaza High and Namagunga was primarily geared towards providing educated men with good wives and homemakers. In the words of Miss Allen who was the Headmistress of Gayaza, printed in a 1930 Uganda Church Review "My staff will do their best to teach domestic science, house-wifery and hygiene as it is taught in England" (as cited in Musisi, 1992, p. 115). This type of education denied women the intellectual skills needed to participate in governance and public service. It also introduced new gender roles that altered gender ideology resulting in significant modifications in gender relations. Women for the most part were relegated to a redefined, subordinated domestic capacity while the status of men was elevated.

Post-Colonial Period

The state of Uganda that emerged in 1962 as a consequence of independence was based on the British model and characterized by male dominance (Ugandan men and not women had been trained by the British to take over the administration of the country at independence). The country inherited a structure whose ideology was designed to systematically promote male privilege and power while solidifying women's subordination. The gendered quality of the state is clearly seen in the participants in its

institutions: a male dominated cabinet, parliament, judiciary, army and civil service (MacKinnon, 1989; Staudt, 1989).

Women were granted full suffrage at independence, it nonetheless meant little since they only played marginal roles in decision making and the same right was also curtailed by dominant husbands who did not only dictate whether or not she/they could vote but also who to vote for. In short, successive regimes that ruled Uganda from the time of independence 1962 to 1986, did not do much to empower women or indeed change the nature of gender relations that had been introduced by the British. It was only in 1986 when the National Resistance Movement (NRM) government of Yoweri Museveni assumed power that steps were taken to empower women and improve their status. Until that time, the total number of women in any given post independence legislature never exceeded four (Byanyima, 1992).

President Museveni's introduction of affirmative action policy in 1989 guaranteed women a minimum of 31 seats in Uganda's law making institution: parliament. Women had earlier on in 1986 been accorded mandatory seats at all levels of the grassroots people's resistance council (village, parish and district levels). A ministry of women in development was created; the directorate of women's affairs was set up within the NRM secretariat, a women's studies program was instituted at Makerere University (Tripp, 1994).

Although Museveni's NRM government has taken a proactive measure to include women in the governance and politics of Uganda, beyond the affirmative action policies there is very little evidence to suggest the NRM is different from other regimes before it

in showing a real commitment to women's emancipation. There are various examples that show that NRM policies only pay lip service to women's emancipation.

For instance, since its inception, the ministry in charge of women's affairs has always received the smallest portion of disbursements from the government coffers. Although it is true that all ministries are under funded due to the fledging economy; the fact that women constitute the mainstay of the economy would dictate that the ministry in charge of uplifting their status should be accorded priority ranking. Another example to illustrate the NRM's deference to male authority can be found in the post-1996 election cabinet appointments. Only 6 out of 62 members were female, although women were a major part of Museveni's constituency and played a major role in his re-election (Byanyima, 1996).

Such actions by the NRM has disillusioned women and made them question the motives behind the policy of affirmative action. Museveni's (1997) statements added to the disillusionment. Using a parable to explain his government's policy towards women he stated:

> A subject ....did a distinguish service for [a king] and the king asked his subject how he could reward him. He said to the king: 'Your Majesty, I don't want any gift from you. All I want is that when we are in a public place you should just call me by my name'. The king was baffled... Your Majesty, it will help me very much because if the king calls me by my name in front of so many people, everybody will wonder who I am and they will all come to me and help me. (p. 191)

The paternalism inherent in this parable is fairly evident and it shows that Museveni's government did not/does not consider women the equal of, but merely the "subject" of, men. Nor does the king "reward" the subject with full recognition of her status as an equal human being. The recognition given as such is bestowed at the "pleasure" of the king and can be easily removed.

Seen from the perspective above, re-distributive policies that make use of affirmative action as away to increase the representation of women in the legislative assemblies only without a fundamental change in the social and political structures are not good enough. Such policies only work as "a means of incorporating potential political protests into a manageable form," or is used as a form of "political expediency" (Howard, 1985, p. 293).

Feminists have criticized such policies which tend to "add women and gender" to the existing social and political structures without questioning their hierarchical and political regressive agendas. Young (1990) pointed out in her criticism:

> The terms of the affirmative action debate define a set of assumptions that accept the basic structure of the division of labor and the basic process of allocating positions...To the degree that the affirmative action debate limits public attention to the relatively narrow and superficial issue of the re-distribution of positions within an already given framework, that debate serves the function of supporting the structural status quo. (p. 200)

Segers (1983) cautioned women not to view affirmative action as a panacea to the problem of discrimination and oppression. She stated that affirmative action is "a single policy.... A lonely policy, a voice in the wilderness" that can achieve little without the

support of other policies directed at reducing the disparities in wealth, status and power (p. 96).

Despite the shortcomings with affirmative action in Uganda today (it is only in the realm of politics and not supplemented by other policies), at the very least it provides women with a platform from which they can advocate for change. It is also clear that the clock cannot be turned back as Ugandan women seem more than ever before determined to continue the struggle for emancipation and empowerment.

Gender Disparity in Computer Science Education in the World

It is essential to mention at the onset that although the discussion here covers the "world," most of the literature discussed is from the western world where the study of computer science education is at a higher level compared to other parts of the world.

The computer was initially described as a revolutionary technological advancement that would benefit all members of our society equally; as well as a means for developing a non-discriminatory learning environment for everyone. However, after more than over two decades of computer enhancement, gender based differences still exists in the study of computer sciences. A United Nations Educational Scientific and Cultural Organization (UNESCO, 1998) statistics illustrate the differences (see Table 1). The difference is further shown in a UNESCO (1999) statistics, a sample of which is represented in Table 6 below. The percentage of women who took natural sciences, which include mathematics and computer science, is low on a world-wide basis (UNESCO, 1999).

Most women shy away from mathematics and science courses due to their nature: that nature is underscored by a western philosophical thought based on the masculine

projects of reason and objectivity that emerged during the scientific revolution of the sixteenth and seventeenth centuries. In addition, the nature of computer science is characterized by a conceptual dichotomy that is distinctly masculine: culture vs. nature, mind vs. body, reason vs. emotion, objectivity vs. subjectivity, the public realm vs. the private realm. In each dichotomy, the former is considered to dominate the latter and the latter in each case is systematically associated with the feminine (Wajcman, 1991).

According to historians of science (e.g., Bordo, 1987; Haraway, 1986; Keller, 1984; Merchant, 1980) Western scientific thought have gained legitimacy because they reflect and reinforce certain aspects of men's historical experiences. Thence, today's science is grounded on masculine experiences. It is therefore not value free, since women's experiences and values are excluded. Hence, a science that is constructed on the basis of gender is contentious for women. Keller (1983) wrote:

> In a science constructed around the naming of object (nature) as female, and the parallel naming of subject (mind) as male, any scientist who happens to be a woman is confronted with a priori contradiction in terms. This poses a critical problem of identity: any scientist who is not a man walks a path bounded on one side by in authenticity and on the other by subversion. Just as surely as authenticity is the cost a woman suffers by joining men in misogynist jokes, so it is, equally, the cost suffered by a woman who identifies with an image of the scientist modeled on the patriarchal husband. Only if she undergoes a radical dis-identification from self can she share masculine pleasure in mastering a nature cast in the image of a woman as passive, inert and blind. Her alternative is to attempt a radical redefinition of terms. Nature must be renamed as not female, or,

> at least, as not an alienated object. By the same token, the mind, if the female scientist is to have one. must be renamed as not necessarily male, and accordingly recast with a more inclusive subjectivity. This is not to say that male scientists cannot claim similar re-definition (certainly many have done so) but, by contrast to the woman scientist, his identity does not require it. (pp. 174-175)

Nonetheless, having a neutral science that incorporates female experiences and values would enhance science and lead to its positive growth, as it brings in a completely new perspective.

The story of the emperor as told by Millman and Kanter (1975), illustrates how female values and experiences would benefit science:

> Everyone knows the story about the emperor and his fine clothes: although the towns' people persuaded themselves that the emperor was elegantly costumed, a child, possessing an unspoiled vision, showed the citizenry that the emperor was really naked. The story instructs us about one of our basic sociological premises: that reality is subjective, or rather subjective to social definition. The story also reminds us that collective delusions can be undone by introducing fresh perspectives. (p.7)

Keller (1983) expands on the same point in her biography of Barbara McClintock, a Nobel Prize winning geneticist. Keller describes her as a scientist who merged subject and object in her feelings for the organisms, and her work was imbued with a holistic understanding of, and reverence for nature. Keller concludes by stating that McClintock's work provides us with a glimpse of what a gender free science might look like, by combining so called "masculine" and "feminine" characteristics.

Table 6

Selected Global Sample (percentage) of Female Students in Each Broad Field of Study at the Tertiary Level of Education

Country	Year	Education	Humanities	Social Sciences	Natural Sciences	Medical Sciences
Uganda	1996/97	29.1%	38.3%	40.4%	16.7%	31.0%
Togo	1996/97	27.9%	20.0%	16.5%	6.6%	21.2%
Cuba	1996/97	76.0%	62.8%	61.6%	29.8%	72.3%
Mexico	1996/97	63.6%	57.6%	54.1%	28.4%	58.0%
Guyana	1996/97	78.3%	68.2%	67.9%	27.4%	61.4%
Colombia	1996	67.1%	53.0%	56.2%	33.5%	69.8%
Cambodia	1996/97	20.8%	24.4%	12.4%	11.0%	19.0%
Indonesia	1996/97	43.7%	42.1%	36.8%	23.8%	48.5%
Austria	1996/97	75.1%	63.2%	48.6%	25.6%	60.2%
Sweden	1996/97	75.4%	64.7%	57.9%	31.0%	76.9%

Sources: Compiled from UNESCO 1999.

Note: Education refers to education science and teacher training. Humanities refer to humanities, fine and applied arts, and religion and theology. Social Sciences refers to law, social and behavioral sciences, commercial and business administration, home economics, mass communications and documentation, and services trades. Natural Sciences refers to natural sciences, engineering, mathematics and computer sciences, architecture and town planning, transport and communications, trade, craft and industrial

programs, and agriculture, forestry and fisheries. Medical Sciences refer to medical and health related sciences.

The grounding of science on masculine values and experiences naturally extends to computer science, since science and mathematics are the gateway and foundation of computer science studies.

Barriers to Women's Computer Science Education at the Global Level

Barriers to women in computer science education and the continual "leaks" in the pipeline are due to a host of reasons such as, science and mathematics anxiety, teachers' attitude and curriculum, educational software, male peers attitude, computer culture, parental attitude and influence, and parents social and economic background.

Science and Mathematics Anxiety

Since the grounding of science and mathematics, which is the gateway to computer science studies, is in masculine values and experiences, women who choose these subjects are often viewed as unusual (Burlin, 1976; Fennema, 1980; Peden, 1975). Even though women persist and resist the male 'mould' imposed on science and mathematics, the anxiety it builds on them leads to an erosion of confidence. Seymour and Hewitt (1997) observed that "within a relatively short time of their entry to college, women who felt intelligent, confident in their abilities and prior performance levels, and who took their sense of identity for granted, began to feel isolated, insecure, intimidated, to question whether they belonged in the sciences at all and whether they were good enough to continue" (pp.255-256).

The same view is reinforced by Sax (1994). She found that self concept declines for both men and women in college math classes but that the "magnitude of the decline is

greater in more selective schools" and that "the decline in math self confidence in selective colleges is more pronounced for women than men" (p.149). It is the anxiety, which the male 'mould' impose on science and mathematics that women transfer directly to the study of computer science and it is what often discourages them from the subject leading to attrition (Collis, 1987; Hawkins, 1987).

Teachers Attitudes and Curriculum

The discussion on teachers' attitude and the curriculum as discussed above applies here too. The discussion under is only in respect to computer science.

According to Barton & Walker (1983), gender identity is profoundly important to people's perception of themselves. Valian (1998) writes about perceptions of gender differences and how they accumulate in professional life, so that men tend to be overrated and women underrated. She wrote: "People's expectations of us lead us to perform in a way that meets those expectations" and that "even when no one is approving or disapproving of us at the moment, our conception of ourselves is based in part on a history of other people's views" (p. 145).

With regard to computer science studies, women internalize the belief that it is a masculine subject as meaning men poses something they lack. For example, studies by the American Association of University Women found that teachers tend to define computer "interests" in terms of a "flair" for computing which is in turn equated with the inclusion (more often male) to "tinker" with computers (AAUW, 2000, p. 24).

Although in one study male and female students received similar high marks on exams, teachers attributed girls' success to their diligence and methodical work, where-as even under-achieving boys were thought to have an intuitive interest in or "flair" for

computers. Women take such gender differentiation from teachers as signifying their inferiority in relation to men, and computers are seen as belonging to the realm of machinery that is daunting for women (AAUW, 2000; Clarricoates, 1980).

Educational Software

The formal curriculum (explicit) also transmits the gender stereotype described above. Most textbooks and materials used in computer science education portray men and women in a manner consistent with masculine and feminine images. Indeed, popular computer magazines often portray women using computers in a stereotypical manner. Women appear in illustrations with computers less frequently than men, and when they do appear, they are often depicted as clerical workers and sex objects. In contrast, men are more often depicted as managers, experts, technicians, and in active "hands-on" roles (Levin & Gordon, 1989; Sanders & Stone, 1986; Ware & Stuck, 1985).

Nowhere is the gender stereotype more pronounced in the curriculum than in computer educational software and games. According to AAUW (2000), most computer games today are designed by men for men. They often have subject matter of interest to boys. A review of popular math computer programs also showed that only 12% of the gender identifiable characters were female, and that these characters played passive traditional roles, such as "princesses" (AAUW, 2000).

Other studies (e.g., Birahimah, 1993; Hodes, 1995-96; Levin, 1997), found that a review of 30 randomly selected software programs used in the United States revealed that of the 3,033 characters noted in the graphics and texts, only 30% were female. In addition, women appeared more than men only in the categories of "domestic work" and "manual labor" and 80% of all characters featured in "adventure" or "leadership" roles

were male. Male characters also had a broader range of roles, appearing in 90 separate activities, in comparison to 55 activities in which female characters appeared.

An earlier study by Biraimah (1989) also supports the findings of the studies above. In her evaluation of software, she found that 63% of the 1,942 characters she examined were males. In addition, males were represented in a greater variety of professions and played more active roles than females.

Attitudes of Male Peers

Male peers also contribute immensely to women's discouragement in computer science education. A study by Margolis and Fisher (2002), found that most women interviewed at Carnegie Mellon University where the study took place reported hearing comments from fellow male peers implying that the only reason they were admitted was because of their gender. When a female student was asked about her experiences as a woman involved with computer science, she said, "The guys rub it in.... you know, they come in and say 'just because you are a girl you got accepted', she went on: "I guess they are just pulling your legs or something, but it still does not feel good when they come back and say things like that." Another woman talked about a male peer who said something like, "Girls... they just bring you girls here to make our computer science department look better...they don't really expect you to be able to code, but if you need help, you got the goods to get help from any guy you want" (p. 84).

A fascinating example of the way male peers/students think about women in computing comes from a study done by Huber and Schofield (1998) in Costa Rica. When they interviewed a schoolboy who was a skilled computer user himself and asked if any students knew more about Logo than the female teacher, he replied, "There are no

students who know more than the lab teacher because Maestra Victoria has more experience and took a course. We [students] didn't. In comparison to us she's a 'superman'" (p. 123). Interestingly, the teacher's prowess on the computer conjured up a prototypically male image of superman. In addition, the teacher's skill was clearly attributed to her training rather than any particular outstanding aptitude in this domain.

Research from other universities reveals similar environments for women in computer science, in which comments from male peers accumulate to make women feel undervalued and ultimately unwelcome. Spertus's (1991) report on MIT women in computer science concludes that male peer comments and behaviors are "the symptoms of a more fundamental problem: lower expectations for females" (p. 14).

Computer Culture

Computers were first developed during the Second World War. In the post war years, it became a male preserve, viewed as requiring technical rather than mechanical skills (Kraft, 1979). Since it required technical skills, it was built by electrical engineers, and embodied engineering occupational culture. However, Turkle (1995) points out that since the 1980's there have been two computer cultures, namely calculation and simulation. The culture of calculation is rigorous and engineering in approach. It requires a "hard" programming style in which programming must be done in a mathematical, structured manner, following strict rules and top down procedures. The hard programming styles are what more men than women are comfortable with, as they find it consistent with hegemonic masculine values of power and discipline.

In contrast, the culture of simulation supports a "soft" programming style. Programming under this style can be done flexibly and non-hierarchically, by trial and

error, jumping between large and small approaches to the problem at hand (Turkle, 1995). The soft style is what more women than men are comfortable with as they find it consistent with female values of negotiation and compromise (Turkle, 1984).

Today, however, it is the culture of calculation that dominates computing and it is the culture that is antithetical to women and has turned many women off computing. Kiesler, Sproull, and Eccles (1985) described it as "more than a set of skills, it is embedded in a social system consisting of shared values and norms, a special vocabulary and humor, status, and prestige ordering, and differentiation of members from non members" (p. 453). He continued the system has a distinctly masculine culture, defined by the practices, norms, and values of its male practitioners, young and old:

> [T] he adult world of computing is heavily dominated by males and transmitted to children by males. Primarily, it is men who design the video games, write the software, sell the machines and teach the courses...[T] he culture of computing may be a reasonable explanation for the apparent differences in girls' and boys' attraction to computing. It is a world of electronic pool halls and sport fields, of circuits and machines, of street-corner society transmuted to a terminal room. This is hardly the kind of world girls find enticing. (pp. 454-459)

Grundy (1998), in an exploration of what lies behind computer science, supports Kiesler's view. She argued that "pure" computing (such as analysis of algorithms and complexity theory) has historically been considered more prestigious than applied computing because male theoreticians, who are the "inner circle" of computer science, define what "real computer science." is She believes that while "in fact, everything done

on a computer requires some abstraction...abstraction by itself is not enough; we must be able to set results of our task back into the real world" (p. 50).

Brunner (1997) argued that "the feminine take on technology looks right through the machine to its social functions, while the masculine view is more likely to be focused on the machine itself" (p. 55). Women thus have interests in computing that go beyond the technical aspects. They want to connect it to other fields and work within its human and social contexts. In short, women's orientation to computer science education is based on the concept of "computing with a purpose."

A study by Margolis and Fisher (2002) confirmed the assertion above. 44% of computer science students interviewed subscribed to the concept of "computing with a purpose" discussed above. For instance, Deborah, one of the study participants, stated that she wanted to use computing to study diseases to "solve the problems of science." (p.52). She said:

> I think with all this newest technology, there is so much we can do with it to connect it with the science field, and that [studying diseases] is kind of what I want to do ... use all this technology and use it to solve the problems of science we have, the mysteries. (p. 52)

Phyllis, a student who took part in the study, agreed. She stated that she is determined not to let herself get detached from society but instead to connect computer science to real world problems:

> The idea is that you can save lives and that's not detaching yourself from society. That's actually being part of it. That's actually helping, because I have this thing in me that wants to help. I felt the only problem I had in computer science was

> that I would be detaching myself from society a lot, that I wouldn't be helping- that there would be people in third world countries that I could not do anything about. I would like to find a way that I could help. That is where I would like to go with computer science (pp.52-53).

Jessica, another student who also took part in the study, noted that computer science must "make a contribution": "just...making video games" is not "worth the energy and talent that it takes." (p.53). She related her interests in computer science to her concern for her grandmother's medical condition:

> I do not think science- just for making video games- is worth the energy and talent that it takes, but I think it's important if it makes a contribution. So part of that would be a contribution in medicine. My Grandma had a pacemaker, a renal dialysis machine... I have seen the contribution in my family in my life...medicine has always fascinated me, so I just always wanted to apply my sciences there. And I see the opportunities now, with the computer technology to apply there and that's what I want to do. (p. 53)

Thus computing, as it exists, alienates many women and they are left questioning whether computer science has a place for them. And yet according to Martin (1992), an integrated approach to computer science education would attract more female students if its culture included female values and "purposes in computing." She suggests that "greater attention to values, human issues, and social impact as well as to mathematical and theoretical foundations of computer science" would redress the balance (p. 1).

Turkle (1984) supports the idea of an integrated approach. She wrote that girls and boys tended to use two distinctive styles of computing, which she calls 'hard' and

'soft' mastery. Hard masters are overwhelmingly males, imposing their will over the machine by implementing a structured, linear plan. The goal is to control the machine. Girls tend to be soft masters, having a more 'interactive,' 'negotiating' or 'relational style.' They relate to the computer's formal system as a language of communication rather than a set of rigid rules.

She draws a parallel with Claude Levis-Strauss' distinction between western science and the science of preliterate societies in terms of the contrasts between planning and tinkering. 'The former is the science of the abstract; the latter is a science of the concrete. Like while the hard master thinks in terms of global abstractions, the soft master works on a problem by arranging and rearranging these elements, working through new combinations' (p. 103). However, neither of these styles is superior for they are different and diverse, or 'epistemological pluralism,' which should be celebrated.

Parental Expectations and Encouragement

Children's attitudes are shaped first by social expectations and then by their abilities, talents and interests. Through interactions with parents, relatives, peers and teachers, children select activities that determine both the quality of their school experiences and subsequent careers.

Parents may convey their expectations in a variety of ways. For instance, they may express the difficulties or drawbacks of studying a subject to their daughters but press the importance of that same subject to their sons. They may acknowledge their sons' ability more than their daughters' ability in specific courses their children take. They may also provide positive or negative feedback to their children. A consequence of such parental expectations is that boys and girls internalize varying degrees of these

norms, values, and social roles and use them to develop their self-concept (Eccles, Adler & Kaczala, 1982; Eccles, Adler & Meece, 1984).

According to advocates of socialization theories, sex differences in attitudes towards computer science have originated in the way that males and females are brought up. They argue: there is a perception among men and women at different educational levels that computing is a male domain. This stereotypical view is conveyed to children by parents and it affects children's course selection and achievement when they get to school. Fathers' sex-typed views positively affect their sons, but negatively affect their daughters in all aspects of computer attitudes. Likewise, mothers' beliefs that "the computer is more appropriate for males than females" contribute positively to their sons' computer interests but negatively affect their daughters' interests in computers (Canter, 1979; Davies & Kandel, 1981; Eccles, 1987; Houser & Gravey, 1985).

The assertion above is supported by Margolis and Fisher's (2002) study. They found that parental attitudes and expectations influenced girl's/women's interests in computers. Looking back on her family, Suzanne, a student who participated in the study noted "I think I wish I did pull apart a computer more than I did." She continued that she, however, found it difficult to hang around with kids who were doing that because of her family expectations. She described her family's attitude as "you are not supposed to be interested in that type of thing, and that should not be so important or interesting to you" (p.30). She stated:

> I think maybe because it's primarily thought of as a male field, even in my family itself. The women kind of do women-type things and the men kind of do technical type things. I found it difficult trying to be a girl and also be technical at the same

> time. I had to pick between if I wanted to talk about cooking or recipes or that type of thing or if I wanted to go out with guys and pull apart computers because I did do that. (p. 30)

Suzanne's story is consistent with Carole's, another student who was also part of the study. She stated that her father would not let her touch the machine to get hands-on experience she so much wanted. She said he was "always the maintainer of our computer"; it would be like, "Ok I'll do it and you watch" (p. 30). This was frustrating because it denied her hands-on experience.

There is also considerable evidence (Busch, 1995; Siann, Macleod, Glissov & Durndell, 1990; Wilder, Mackie & Copper, 1985; Woodrow, 1994) that parents by placing a computer in a son's room, allowing a son's extracurricular activities such as attending computer camps, playing computer games, help to foster their skills and put their daughters at a relative disadvantage.

On the other hand, where parents are found to be encouraging, girls' orientation towards computing is positive. A case in point is a study by Ames and Archer (1987), who found that parental encouragement, could overcome the negative impact towards computers. The findings showed that even where there were no computers at home and schools did not offer a large amount of computer experience parental encouragement is still a positive motivator for daughters to learn computing.

The study by Margolis and Fisher (2002) also found that when the parents were supportive, girls' orientation towards computers was positive. Kathryn, one of the study participants, stated that she considered herself "lucky" because her father and brother were "computer geeks" who expected her to participate right along with them:

> I must be lucky just because I lived with my brother and my dad for the longest time, and both of them are computer geeks, and they're just kind of like "Oh, well you should be a computer geek too. Hey, if you are going to act fuzzy like a chick and all, we're just not going to talk to you." (p. 31)

Vera was another study participant who had a positive parental attitude leading to her positive orientation towards computers. She stated that she always had a computer in her house and "you never had the feeling that 'you can't do that, you are a girl.'" Vera continued that her mother would always buy her and her sisters "guy's" toys like Legos and transformers because "she actually liked to play with that stuff herself"(Margolis & Fisher, 2002, p. 31).

The findings above show that parental attitudes and encouragement play a very important role in shaping children's computer science orientation. Where parents contribute to gender stereotyped views that construct a social definition of computing as a male's job, girls/ women then shy away from computer science. It therefore explains the validity of the classic statement of the interactionists Thomas and Thomas (1928), who asserted that, "If men define situations as real, they are real in their consequences" (p. 41). That is, when the significant persons in the family environment define the computer science education as a male domain, the outcome will fulfill the initial definition.

Social Economic Status of Parents

The discussion on the social and economic status of parents as discussed above applies here too. The discussion under is only in respect to computer science.

Of particular reference to women in computer science education, studies by Alexandar and Eckland (1974), Hauser (1971), and Hout and Morgan (1975) showed that

socio-economic background has a greater effect on the educational aspirations and expectations of females than males. When the effect of social economic status (as measured by fathers'/mothers' occupations) on sons' and daughters' attitude towards computing was examined, the higher the fathers' occupational status and educational level the more interested their sons were in computing. Fathers' socio-economic status had a significant effect on daughters' attitudes too. Girls whose fathers had higher occupational prestige and educational level expressed more interest in computer science than girls whose fathers were from a lower social economic status.

When socio-economic status was measured by mothers' occupation and education, high socio-economic status contributed positively to daughters' computer attitudes but not to sons'. The higher the mothers' socio-economic status, the more interested daughters were in computers and the less likely they were to have a stereotyped view of computing (Shashaani, 1994). The results of the studies above show that children, and specifically girls from low socio-economic status families, are less interested in computing than those from high socio-economic status families. This is consistent with Kohn's (1977) study, which suggested that parents in different social classes teach different values and have different expectations for their children.

Gender Gap in Computer Science Education in Africa

All subjects, including mathematics and sciences, taught in primary schools in most African countries are compulsory for all students, and every student is therefore expected to participate fully in every subject. The rate of participation as far as girls are concerned is mainly based on girls' access to firstly, primary education which is the arena where the foundation of all educational success is laid. This is later followed by access to

secondary and tertiary education. The gender disparity at the primary and secondary level has already been discussed above and will not be repeated here. The discussion here will focus on girl's participation in sciences which impacts their participation in computer science.

According to a study carried by the Female Education in Mathematics and Science in Africa Project (FEMSA, 1997a), the performance of girls in all four countries in which the studies took place (Ghana, Uganda, Tanzania and Cameroon) were generally poorer than boys in mathematics and science subjects in both the primary and secondary levels of education.

Girls were found to perform poorly due to a number of factors such as, the perceived 'masculine' nature of science and mathematics subjects, poor self concept, socialization and gender roles, parental and teachers' attitudes, poverty, perceived irrelevance of science and mathematics curriculum, poor remuneration for science and mathematics careers; and lack of parental involvement.

The Perceived 'masculine' nature of Mathematics and Sciences

As discussed above, science as it exists today is based on western scientific thought, which is grounded on masculine values and experiences. Science and mathematics that are taught in African schools are also based on the same western thought, since most of the educational systems and curricula are modeled or adopted on that of the west due to the legacy of colonialism.

Most African societies consider science and mathematics subjects and careers to be difficult and more suited to boys and men. In the study carried by FEMSA (1997c), girls who excel in science and mathematics subjects were considered deviants and treated

as such. Because of this reason, and because girls are considered "less capable", they receive considerable direct and indirect discouragement from peers, teachers, parents and society in general. For instance male students in a class in Ghana declared that physics and chemistry were subjects suitable for boys, and that girls should do more feminine science like biology. Also in Ghana, girls who excel in science and mathematics were called "witches", or referred to as "men-women" (p.11).

Socialization and Gender Roles

According to FEMSA (1997b), many parents consider girls and women to be physically weaker and less capable than men, they are therefore often over protected and supervised to keep them from what is considered to be a threat to their safety that is, their physical, sexual, mental and emotional safety.

Girls are also perceived as nurturers and supporters rather than leaders, are expected to play the roles of mothers and wives and are socialized to be obedient and non-aggressive. Many parents, who took part in the study above, had the attitude that educating girls/women is a waste of time and money, because they will eventually be married off and their education would therefore only benefit their husbands and the families they marry into. Parents made statements such as, "No matter how much education you give to a woman, she will one day end up in someone's kitchen and all her needs will be catered for" (FEMSA, 1997b, p. 4).

The issue of marriage is also seen as a major deterrent to girl's participation in science and mathematics. This is because training in mathematics and science careers usually take longer than Arts based careers, and many parents and girls alike were of the

opinion that the delay would reduce their chances of finding husbands and make it difficult for them to have children.

Girl's socialization at home therefore sometimes creates a dilemma for girls as it conflicts with the expected behavior at school, which enhances learning. For instance, the type of socialization that keeps girls in seclusion interferes with their ability to take part in group work with boys, and interact with especially male teachers. All this affects girls' ability to fully participate and perform well in school. It also makes it difficult for girls to benefit fully from the type of participatory, discovery approaches, which are inherent in science and mathematics courses.

Poor Self-Concept

Most girls in Africa suffer from "inferiority complexes" when it comes to academic matters. This can be attributed to the way girls are socialized by families and society in general. According to FEMSA (1997c), as discussed earlier, societies in Africa in general consider females as being less capable than males. Because these messages are communicated to them, directly and indirectly from birth, they become internalized. This in turn results in girls' having poor self esteem and self-concept. The poor self-image touches on every aspect of girls' lives including education.

For example many parents do not allow their daughters to play outside, and while they do not hesitate to send their sons out to do things like shopping, they are reluctant to do the same with their daughters for fear of their safety. This denies girls the opportunities that boys have to observe experience and experiment with material, objects and situations, which are useful in mathematics and science.

In addition, girls spend considerably more time doing household chores than boys. This leaves them with little time and energy to study. The divisions of labor when it comes to chores favor boys. Boys do such chores as herding cattle that allow them time to study at the same time. Girls on the other hand do chores like washing clothes, cooking; fetching water and firewood, which make it very difficult for them to do the same.

The fact that household chores are usually performed in the mornings and late in the evening is one reason given for the frequent incidences of school tardiness and even deficient math skills among girls. According to the FEMSA study above, science and mathematics are normally taught in the mornings, because it is the time when students are thought to be most alert and ready to learn. Thus girls when delayed at home in order to carry out chores in the morning are more likely to miss these lessons. Since science and mathematics learning is hierarchical, missing one step disadvantages students in the learning of subsequent lessons. This affects performance and with it motivation and self-concept.

Parental and Teachers' Attitudes

Parents and teachers attitudes impact girls performance and motivation in mathematics and sciences subjects. For instance the FEMSA (1997c), study found that many teachers were of the opinion that girls are less capable of performing well in science and mathematics although they provided no scientific evidence to support this opinion. This kind of attitude influenced the way the teachers taught and reacted to boys and girls. Teachers tended to use positive reinforcements more frequently for boys than girls. The quality of the reinforcement also differed. Boys were more likely to receive a

more enthusiastic and stronger reinforcement when they answered questions correctly. Teachers in such cases, would use phrases like 'very good' and 'excellent,' while girls most of the time received responses like, 'good' or received no reinforcement at all (p. 12).

A teacher was also observed to ask one girl who happened to be good in science whether she really believed that apart from a very few girls like herself, girls could really do science, implying that he did not believe it himself. Teachers' attitudes towards girls' abilities in science and mathematics become a critical factor because when it comes to subject specialization at secondary level, teachers often advise or force students into those subjects they feel students should be doing.

The study also found that parents were of the view that girls' were/are academically less capable than boys and that they were less interested in academic issues and more easily distracted and were more interested in unrelated issues like romance and physical appearance. An explanation given for parents' not wanting their daughters to study sciences or mathematics subjects is that these subjects were considered 'masculine' and 'unladylike' (FEMSA, 1997c, p. 7).

This kind of attitude has a negative impact on girls' participation in education and especially science and mathematics in a number of ways. Firstly, in a situation where parents have to make a choice, those who uphold this belief will choose to educate boys at the expense of girls. Secondly, because girls are considered less capable, they often receive less encouragement from parents and are rarely challenged at home or school to succeed in their academic work.

Poverty

Poverty, according to FEMSA (1997c), is a major factor hindering girls' education in mathematics and sciences. The issue of poverty as it affects women's education has already been discussed above and will not be repeated here.

Perceived Irrelevance of Science and Mathematics subjects and Poor Remuneration for Science and Mathematics careers

Since the curriculum of science and mathematics taught in schools does not address the practical needs of the communities, most parents feel that the lessons learnt are not practical enough and do not relate to real lives, especially for girls. They therefore do not encourage their children, especially girls, to take science and mathematics courses. Parents also believe incorrectly that there is a shortage of employment opportunities in the science and mathematics field, and that the majority of these careers, especially the technical ones, are poorly paid. They are therefore reluctant to encourage their daughters to further their education in these subjects (FEMSA, 1997b).

Lack of Parental Involvement in Schoolwork

Teachers interviewed in the study above indicated that one of the reasons for girls' poor participation in science and mathematics subjects is the lack of parental interest, support and involvement in their daughters' academic work. They felt that if parents were involved then girls might be motivated to work harder in the subjects. Lack of parental involvement is attributed to the attitude of most parents that academic work is the preserve of the school and teachers, and parents are therefore reluctant and unwilling to become involved. Secondly, many parents often have little time to spare from their daily schedules to devote to helping or following up on their children's schoolwork.

Other parents on the other hand, have little or no education themselves and therefore do not have the knowledge or skills required to help or monitor their children's academic work (FEMSA, 1997b).

Barriers to Women's Computer Science Education in Africa

Barriers to women in computer science education in Africa are due to a number of factors. However, since the computer science subject as taught in Africa and indeed in other parts of the world is based on the western model some of the factors that are barriers to women's computer science education at the global level are also applicable in Africa (science and math anxiety, and computer culture). Those factors will therefore not be repeated here.

The only other known factor in Africa, then, is the lack of infrastructure. Perhaps other African gender specific barriers exist, but little research has been done in Africa to examine computer science education.

Lack of Infrastructure

A barrier to women's participation in computer science education which also affects men is the lack of computer hardware or computers. According to the World Development Indicators (2003), Sub- Saharan Africa had 10 personal computers per 1000 people in 2001, compared to a world total of 86 per 1000 people. What this means is that only a few people have access.

Gender Gap in Computer Science Education in Uganda

It is important to describe the educational system in Uganda in order to allow for a better understanding of the discussion that follows. Primary education is the first educational cycle in Uganda and it consists of seven years. At the end of the seventh year,

students sit for the primary leaving examination, which allows them to enter secondary level education.

Secondary education in Uganda has two distinct levels. The first is the lower or 'Ordinary' or 'O' level which lasts four years. Students at this level must take a minimum of 8 and a maximum of 10 subjects. While science has not been compulsory at this level until recently, many schools offer either pure science subjects or health science depending on the physical facilities they have. Mathematics is compulsory till the end of this level while science has, until recently, only been compulsory for the first year of secondary school. At the end of this level, there is an examination known as the Uganda Certificate of Education (UCE), which determines whether students proceed to the next level.

The second level of secondary education is two years long and is referred to as the upper or higher or 'Advanced' 'A' level. Students at this level have to choose between Sciences and Arts subjects and take a minimum of 3 or a maximum of 4 subjects. The basic combinations of three subjects being either Sciences or Arts. At the end of this level, there is an examination in the subjects specialized in which leads to the 'Uganda Advanced Certificate of Education,' (UACE) which is a major pre-requisite for direct entry into the tertiary level of education (FEMSA, 1997a)

As in other parts of Africa, the genesis of the gender gap in computer science education in Uganda can be traced to where the foundation of educational success begins, that is, the primary level of education. As discussed above there has been a continual increase in the number of girls enrolled in the primary level of education, however, despite the increment disparity still remains (see UNESCO, 1998).The disparity is further

aggravated by other factors (already mentioned under gender disparity in computer science education in Africa which also applies to Uganda), that hinders' girls performance in science and mathematics (gateways to computer science education) at the primary level. It is the disparity that sets in at the primary level that later reveals itself at the tertiary level.

Barriers to Women's Computer Science Education in Uganda

Like in other parts of Africa, not much is known about barriers to women's education in computer science education since not much research has been. In addition, like in other parts of Africa, the lack of infrastructure i.e., computer hardware is definitely a barrier that hinders both men and women's computer science education. According to World Development Indicators (2003), Uganda had 3 personal computers per 1000 people compared to a Sub-Saharan number of 10 personal computers per 1000 people and a world number of 87 personal computers per 1000 people. There are no statistics for the number of computers in educational institutions in Uganda.

Summary

The literature reviewed shows that there is gender disparity in computer science education on a world wide level. The literature also revealed that various factors contribute to the disparities. The factors range from the role schools plays to reproduce the social order to societal expectations of the roles females and males play.

Although the literature revealed a gender gap in computer science education at a global level, no study has been done in respect to Uganda. This study is therefore crucial in order to understand the situation in Uganda.

CHAPTER THREE

Methodology

Are women under represented in computer science education? A review of the literature indicated that at the global level there is a gender gap in computer science education. However, the nature of women's representation in computer science education in Uganda has not been studied. This study sought to investigate the gender gap in computer science education in Uganda. Questions to be addressed are:

1. What is the nature of the gender disparity in computer science education in Uganda?
2. What factors promote/hinder women's computer science education in Uganda?

Research Design

This study utilized a combined quantitative and qualitative methodology also referred to as 'triangulation' (Babbie, 2004; Creswell, 1994). Flick (1998) defended the appropriateness of using the triangulated approach to data inquiry. He stated:

> The use of multiple methods, or triangulation, reflects an attempt to secure an in-depth understanding of the phenomenon in question. Objective reality can never be captured. We can know a thing only through its representation. The combination of multiple methodological practices, empirical materials, perspectives, and observers in a single study is best understood then, as a strategy that adds rigor, breath, complexity, richness, and depth to the inquiry (p.231)

The qualitative research approach consisted of in depth face to face interviews and focus group discussions. The quantitative approach on the other hand consisted of a survey method which employed open-ended and closed-ended questions.

Participants

The participants for the study consisted of three clusters. The first cluster which participated in the survey was composed of all 600 undergraduate students in computer science. The second cluster which participated in the qualitative interview was made up of two representatives each from Makerere University's Office for Gender Mainstreaming (this office is supposed to champion gender equality in education), the Forum for African Women Educationalist (this organization has been at the forefront in advocating for women's involvement and increased participation in science and mathematics), the Technology Committee of the Parliament of Uganda, which is the body responsible for formulating technology policies in the country and 5 women faculty members from Makerere University's Institute of Computer Science. The third cluster which participated in the focus group discussion was made up of 5 male and 5 female undergraduate Bachelor of Science majors in computer science and 5 women graduates in computer science.

The selection of participants is termed "purposeful sampling". This method of sampling selects individuals for study participation based on their particular knowledge of a phenomenon for the purpose of sharing that knowledge. According to Patton (1990), the standard used in choosing individuals and sites is whether they are "information rich", "information rich cases are those from which one can learn a great deal about issues of central importance to the purpose of the research" (p.169). In addition, purposeful

sampling also denotes a commitment to observing and interviewing people who have had experience with the culture or phenomena of interests (Lincoln & Guba, 1985). In this study, the participants qualified as an appropriate sample given their knowledge and immediate and personal experience of computer science education in Uganda.

Since this study involved human subjects, approval was granted from Ohio University's Institutional Review Board (IRB).

The Site of the Study

The main study site was Makerere University Institute of Computer Science. Located in Kampala, Makerere is Uganda's premier institution of higher learning. It has a student population of over 20,000 and ranks as one of the largest in East and Central Africa. The university was established in 1922 as a technical school and became a university college in special relationship with the University of London in 1949. It became an independent national university of the Republic of Uganda offering undergraduate and graduate courses on July 1st 1970.

Makerere University Council established the Institute of Computer Science in 1986. It offers courses leading to the awards of certificate in computer science applications (CCA); bachelor of science in computer science (B.Sc.CSC); master of science in computer science (M.Sc.CSC) and postgraduate diploma in computer science (PGDCS). The institute in the 2003/2004 academic year had about 25 faculty members, 300 graduate students and over 600 undergraduate students (Makerere University Institute of Computer Science, 2004).

In addition, various locations within Kampala were visited to interview representatives of the Office for Gender Mainstreaming; Forum for African Women Educationalist; and the Technology Committee of the Parliament of Uganda.

Data Collection

Data collection for the study was done in three stages. In the first stage all the 600 male and female undergraduate Bachelor of Science in computer science students were surveyed during a six-week period from June 15th to July 30th 2004. Contact was made early in April 2004 with the director of the institute to gain permission for the study.

The development of the survey questionnaire was based on the analysis of the literature review. It was particularly designed to elicit information about students' background, history, experiences and interests. Special attention was focused on the role these factors may have contributed to the promotion and or hindrance of women's education in computer science and the nature of the gender disparity that exists in computer science education in Uganda.

The questionnaires consisted of open-ended and closed-ended questions which took approximately 15 minutes to complete. The survey was administered by the researcher and a research assistant in class to all male and female undergraduate Bachelor of Science in computer science students from June 15th to July 30th. The six week period was required because of the many classes and class periods that had to be covered. Two weeks prior to the administration of the survey, on June 1st, an introductory letter was given to participants informing them of the study and survey questionnaires. A consent form asking participants for their permission to participate in the study was given out on the day the survey was administered.

Efforts were made to have a good response rate by requesting lecturers who teach computer science courses to assign the last 15 minutes of their class session to the survey.

The instrument (Appendix A) consisted of:

1. Close-ended questions about participants characteristics (i.e., demographic questions)
2. Closed and Open-ended questions asking participants about their background (i.e., educational attainment levels of parents, social economic status etc)
3. Closed and Open-ended questions asking participants about their experiences (i.e., in high school, teachers, parents, peers etc)
4. Closed and Open-ended questions asking participants about their interests (i.e., in sciences, computer science).
5. Open-ended questions asking participants about their participation in computer sciences and what hinders their participation

Pilot Study

No design is so complete that it cannot be improved by a prior small scale exploratory study. To pilot the questionnaire implies giving the survey a "test run" under the same conditions which the researcher intends to conduct the whole survey on a larger scale (Alston & Bowels, 1998). This process of pre-testing may reveal deficiencies which were previously not apparent to the researcher. The results from a pilot study may be used to revise or eliminate weak items which may result in increased and a better survey response rate (Tucker, 1999).

The pilot was conducted at Oberlin College, Oberlin in April of 2004. The intent of the study was to achieve the following objectives:

1. To check the questionnaire design, including the wording of the questions and the flow of the questionnaire.
2. To obtain feedback on the perceptions of the survey from the interviewees.

30 undergraduate students from a computer science class participated in the pilot study. The participants provided very useful feedback in revising the questionnaire, including such comments as:

1. The survey questions 2.3 and 2.4 should be open ended in order to allow the respondents to respond correctly to their parents' area of employment.

2. Survey questions 3.1, 3.2, 3.3, 3.6, 4.1, 4.2 and 4.3 needed to be re-structured to give the respondents more options in answering.

Based on the feed back above, appropriate revisions were made to the questionnaire. For instance; questions 2.3 and 2.4 were restructured to be open ended as were questions 3.1, 3.2, 3.3, 3.6, 4.1, 4.2 and 4.3. Changing questions in such a manner, made it easy for the respondents to answer.

Qualitative Interviews

The second stage of data collection consisted of a series of qualitative interviews. Participants were selected based on purposeful sampling from Makerere University's office for Gender Mainstreaming, the Forum for African Women Educationalist, the Technology Committee of the Parliament of Uganda and Makerere University Institute of Computer Science.

The purposes of the interviews were to gain a greater depth of understanding about the issue being studied which would not be possible only by use of a survey.

The selections of participants were based on the following criterion: participants from the Office for Gender Mainstreaming were selected based on their work as advocates for gender equality in education. Participants from the Forum for African Women Educationalist were selected based on current placement as advocates for the participation of women in the sciences and computer science. Participants from the Committee of the Parliament of Uganda were selected based on their work as formulators of technology policy. Lastly participants from the Institute of Computer Science were selected based on their knowledge and experience as teachers of computer science. Knowledge means the years of training/education in the field of computer science, which then qualified them to be teachers in the discipline.

Two weeks prior to the interview, an introductory letter was sent to the participants. Guiding questions were also sent at the same time, in order to allow participants to prepare to address the questions, and assemble supportive documents and materials prior to the interview. Consent to interview and tape record was obtained from the participants on the day of the interview.

Semi-structured interviews using open-ended questions were conducted. Open-ended questions allows the researcher to encourage the participant to talk in the area of interest and then probes more deeply, picking up on the topics and issues the participant initiates. The participant plays a stronger role in defining the content of the interview and the direction of the study in this kind of interview (Aron & Aron, 1997).

Questions asked were mostly related to education policy and specific to gender and computer science education in Uganda. The interview protocol (see Appendix B) consisted of interview questions.

The interview ended when the participants had exhausted their description. That is when saturation had been achieved and no new themes emerged from the participants and the data was repeated. Following each interview, the researcher immediately listened to the tapes, to check whether the interview made sense and verified the need for follow up interview. Follow-up interviews were conducted where necessary to give the researcher an opportunity to expand and verify issues raised by the participants. It was also meant to give the participants the chance to clarify and expound on inadequate descriptions.

Focus Group Discussion

The third stage in data collection consisted of focus group discussions. A focus group is less structured and exploratory. It offers a more in-depth understanding of the participant's perspective or opinion and allows the researcher to capture the comments and evaluate them. The variations of focus groups used were mini focus group which consisted of five participants per group. There were three mini focus groups: all male undergraduate students of computer science, all female undergraduate students of computer science and all female graduate students of computer science. Having more than one focus group ensured the best representation of the sample and allowed for comparisons between the groups (Edmunds, 1999).

The recruitment of participants was done two weeks prior to the discussions. Volunteers were asked from within the computer science student population. Once the participants were recruited, they were briefed about the topic to be discussed. They were

also given detailed directions to the site where the discussions were to take place. Consent to tape record was obtained from the participants on the day of the discussions.

A discussion guide which included specific questions were used (see Appendix C) this was meant as a guide to keep participants on track. Although the researcher was present during the discussions, the two all female focus groups were moderated by the research assistant who is female. This was meant to allow for the comfort level of participants. The researcher moderated the all male focus group.

Data Analysis

According to Banonis (1989), the purpose of data analysis is to preserve the uniqueness of each participant's experience while permitting an understanding of the phenomenon under investigation. Data analysis in this study involved both quantitative and qualitative techniques as described below:

Analysis of Survey Questionnaires

The data obtained from the survey were analyzed using the Statistical Package for Social Sciences (SPSS). The analysis of quantitative data was determined by three factors: the number of variables, the level of measurement and the purpose of the statistics whether descriptive or inferential. Quantitative data analysis may also depend on the level of measurement of the variables, nominal, ordinal, interval and ratio (Alston & Bowels, 1998). The survey was analyzed using descriptive statistics. According to Aron and Aron (1997), descriptive statistics can be used to summarize, describe and make a group of numbers easy to understand. Descriptive statistics were computed to obtain frequencies, cross tabulations and bar graphs for closed ended survey questions 1, 2, 3 and 4.The open ended parts of questions 2, 3, 4 and 5 were answered by using a

system of coding (Lindolf & Taylor, 2002). The information obtained was then categorized into groups. The codes were then analyzed for common themes. The themes that emerged were added to that under the qualitative interviews.

Analysis of Interviews

Interviews were conducted to answer questions 1, 2, 3, 4 and 5 in the interview protocol. The process of analyzing the interviews involved listening to the participants' verbal descriptions, and was followed by reading and rereading the verbatim transcriptions. Significant statements that emerged were identified, ordered and coded according to conceptual themes. Coding was done manually and was based on the groupings of the responses from the participants for similarities and differences.

Analysis of Focus groups

The process of analyzing the focus group discussions involved listening to the participants' verbal descriptions, and was followed by reading and rereading the verbatim transcriptions. Significant statements that emerged were identified, ordered and coded according to conceptual themes.

Triangulation

Lastly, triangulation was done across the data by combining the results from the methodological practices, which are survey, qualitative interviews and focus group discussions to answer the research question.

CHAPTER FOUR

Data Analysis and Presentation

The findings of this study are based on data obtained following the triangulated approach used. While quantitative data were analyzed using descriptive statistics and a system of coding for the open ended part of the survey questions, the analysis of qualitative data took the form of organizing the responses of the interviewees into themes.

Quantitative Data Analysis

Quantitative data were analyzed using descriptive statistics involving frequencies, cross tabulations, tables and bar graphs. In addition, a system of coding was used to analyze the data that emerged from the open ended part of the survey questions. The data were analyzed in three ways. In the first stage analyses were performed through the use of descriptive statistics to assess the distribution of the sample. Frequency distributions were obtained for the number of times each variable occurred in the sample. For instance frequency distributions reported the number of males and females and also gave the number of responses in any particular question.

In addition, data that emerged from the open ended part of the survey questions were coded and categorized into groups and then analyzed for common themes. The second stage involved using cross tabulations to understand the relationship between gender and their responses to the survey questions. Thirdly, the data were organized and presented mainly by using bar graphs. The use of bar graphs and tables as visual aids helped to explore the differences and similarities between the samples. It also helped to explain their responses to the survey question.

Quantitative Data Results

200 out of 600 undergraduate students enrolled in computer science responded to the survey yielding a 33.3 percent response rate. The response rate is low because some classes did not participate as planned that is, the researcher and research assistant were supposed to give out the questionnaires inside the classes where the students would complete and return it back, however, some lecturers were not cooperative in giving the researcher access to their classes.

The researcher and research assistant therefore gave the questionnaires outside the classrooms in which they were denied access. This resulted in few questionnaires being returned upon completion. Despite receiving permission from the director of the institute, some lecturers thought that the researcher was carrying out the research in order to apply for a teaching position there. They therefore looked at the researcher as a possible threat to their jobs. One lecturer asked the researcher "what position are you vying for here"?

Gender of Participants

Students were asked to indicate their gender. This question was asked in order to understand the gender composition of the sample. The data as shown in Table 7 and Figure 1 indicates that of the 200 students, who responded to the survey, 75.5% were males and 24.5% were females.

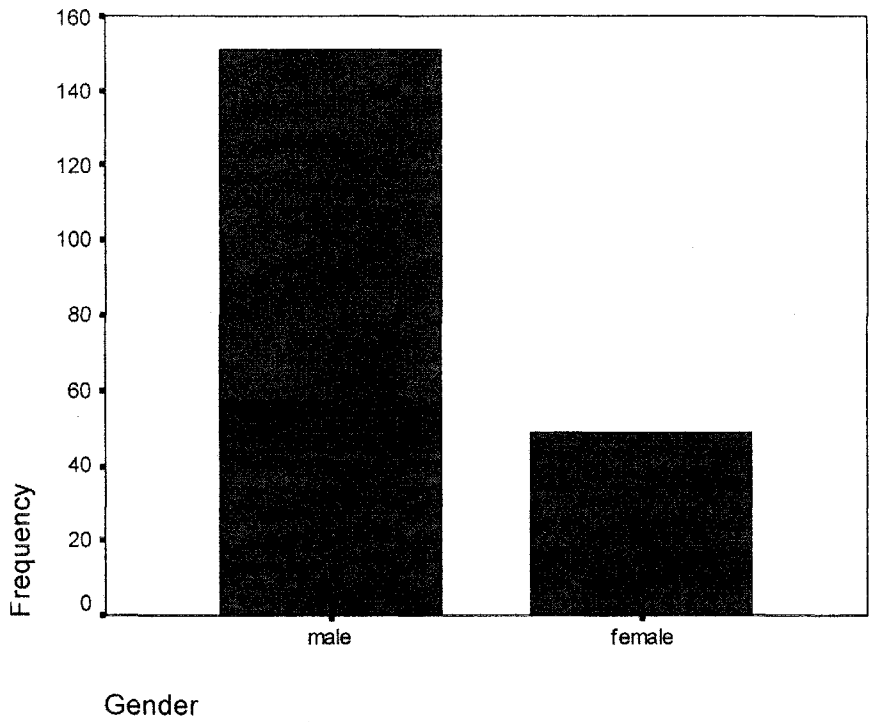
Table 7

Gender of Participants

		frequency	Percent	Valid Percent	Cumulative Percent
gender	male	151	75.5	75.5	75.5
	female	49	24.5	24.5	100.0
	total	200	100.0	100.0	

Figure 1

Gender of Participants



Class Rank

The students were asked to provide their class rank. The data as presented in table 8 and figure 2 revealed that of the 200 students who responded to the survey, 198 provided their class rank. There were 32.8% (n = 65) first year students:19.2% (n = 38)

males and 13.6% (n = 27) females; 23.7% (n = 47) second year students:20.2% (n = 40) males and 3.5% (n = 7) females; 42% (n = 83) third year students:35.9% (n =71) males and 6.1% (n = 12) females and lastly 1.5% (n = 3) fourth year students, no male and 1.5% (n = 3) females.

There is a disproportionate representation in class rank with regard to the fourth year. This seems to have occurred due to lack of participation that is, failure to return the survey questionnaire by mostly male students and especially those in the fourth year. This observation is supported by an official list which was given to the researcher. The list showed the composition of the undergraduate program to be a total of 600 students, 27% (n = 162) first year students: 20.3% (n = 22) males and 6.7% (n = 40) females; 20% (n = 120) second year students: 15.7% (n = 94) males and 4.3% (n = 26) females; 35.3% (n = 212) third year students: 33.3% (n = 200) males and 2% (n = 12) females; and lastly 17.7% (n =106) fourth year students: 15.8% (n = 95) males and 1.8% (n = 11) females.

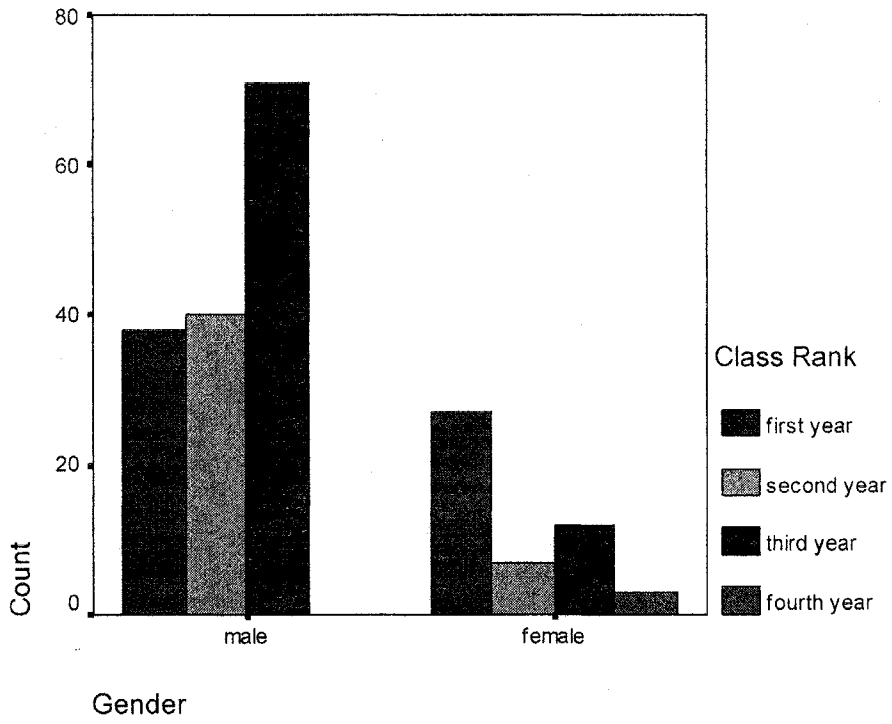
Table 8

Gender and Class Rank

		first year	second year	third year	fourth year	total
gender	male	38	40	71	0	149
	female	27	7	12	3	49
total		65	47	83	3	198

Figure 2

Gender and Class Rank



Parents' Educational Attainment

Students were asked to provide their parents' highest level of educational attainment. This question was asked in order to understand the relationship between parents' educational attainment and the likelihood of a daughter taking computer science. As far as mothers educational attainment is concerned, the data as shown in Table 9 revealed that of the 200 students who responded to the survey, there were a total of 75.5% (n = 151) males and 24.5% (n = 49) females. The data as depicted in figure 3 also showed that there is a relationship between the number of male and female students taking computer sciences and the mothers' level of educational attainment. As the mothers' educational attainment is primary level there are few males and females taking

computer science that is, 8% (n = 16) males and 2.5% (n = 5) females. However, when the mothers' level of education rises to University degree, the number of males and females taking computer science also rises to 28.3% (n = 56) males and 13.1% (n = 26) females. This result seems to suggest that mothers' with a high educational attainment tend to support their children's participation in computer science without regard to sex.

Figure 3

Gender and Mothers' Education Level

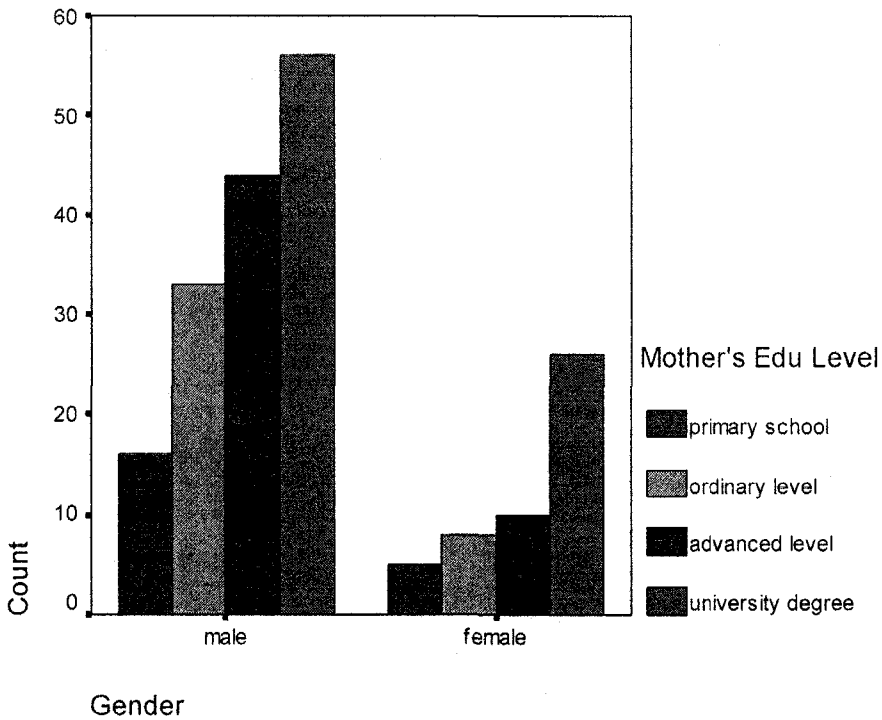


Table 9

Gender and Mother's Education Level

		primary school	ordinary level	advanced level	university degree	total
gender	male	16	33	44	56	149
	female	5	8	10	26	49
total		21	41	54	82	198

With regard to their fathers' level of education, the data as presented in table 10 revealed that of the 200 students who responded to the survey, 194 provided their fathers level of education. 74.7% (n = 145) males and 33.8% (n = 49) females. The results as depicted in figure 4 also further showed that there is a relationship between the fathers' educational attainment at the primary level and university degree and the number of females and males taking computer sciences. That is there were 2.6% (n = 5) males, 2.6% (n = 5) females and; 47.9% (n = 93) males, 18.5% (n = 36). However, when the fathers' educational attainment is at ordinary and advanced level, there are more males than females taking computer science. That is, 10.3% (n = 20) males, 1.5% (n = 3) females; and 13.9% (n = 27) males, 2.6% (n = 5) females respectively.

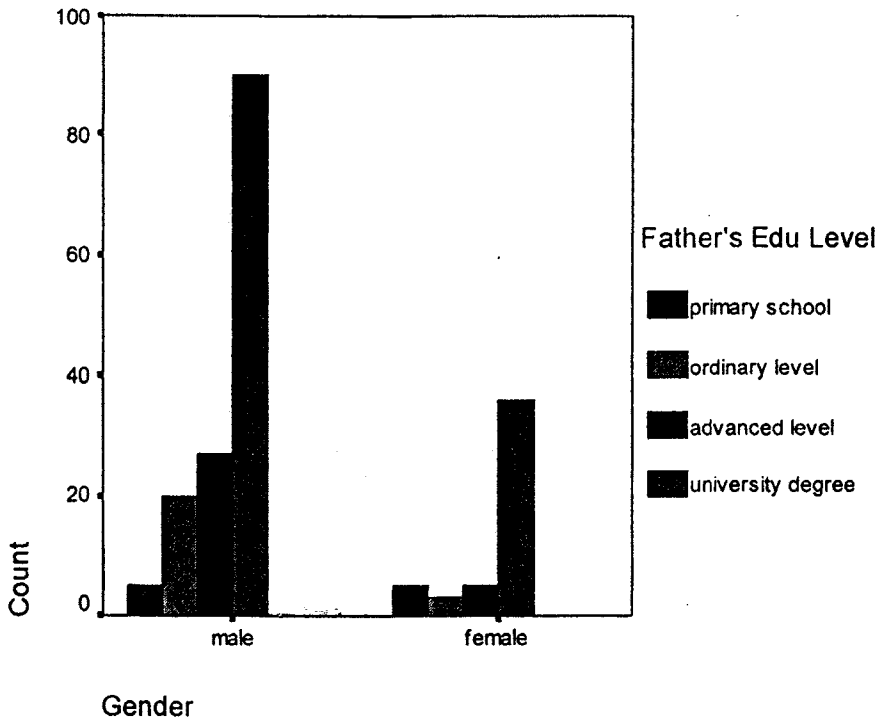
Table 10

Gender and Father's Education Level

		primary school	ordinary level	advanced level	university degree	Total
gender	male	5	20	27	93	145
	female	5	3	5	36	49
total		10	23	32	129	194

Figure 4

Gender and Fathers' Education Level



The result thus suggests that fathers with a low that is, primary and a high that is university degree tend to support both sons and daughters taking computer science. But when a fathers' level of education is intermediate that is ordinary and advanced level, the tendency is to support sons more than daughters to study computer science

Parents Income Level

Students were asked to provide their parents income level. There is no criterion for level of income; it is based on self reporting by students. This question was asked in order to understand the relationship between parents' level of income and the likelihood of a daughter taking computer science. With regard to their mothers' income level, the data as presented in Table 11 revealed that of the 200 students who responded to the

survey 171 provided their mothers' level of income. 77.8% (n = 133) were male and 22.2% (n = 38) were female. The data also as depicted in figure 5 also showed that there is an association when the mothers' income level is middle and the number of females and males taking computer science. That is 45% males and 15.8% females compared to 29.2% males and 4.7% females when the mothers' income is low and 3.5% male and 1.7% female when the mothers' income is high.

Table 11

Gender and Mothers Income Level

		low	middle	high	total
gender	male	50	77	6	133
	female	8	27	3	38
total		58	104	9	171

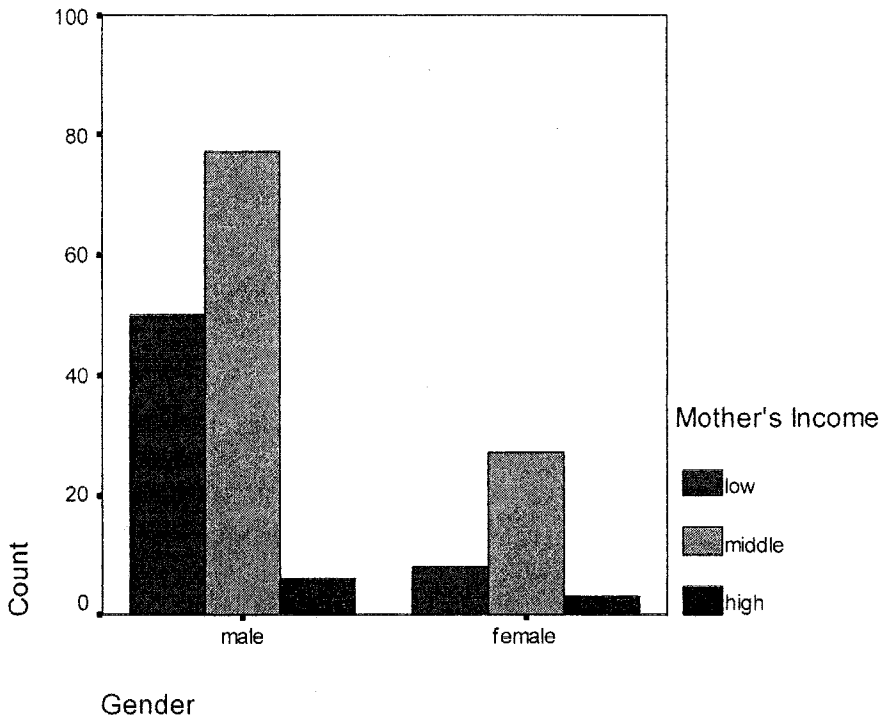
Table 12

Gender and Fathers' Income Level

		low	middle	high	total
gender	male	34	68	31	133
	female	8	17	15	40
total		42	85	46	173

Figure 5

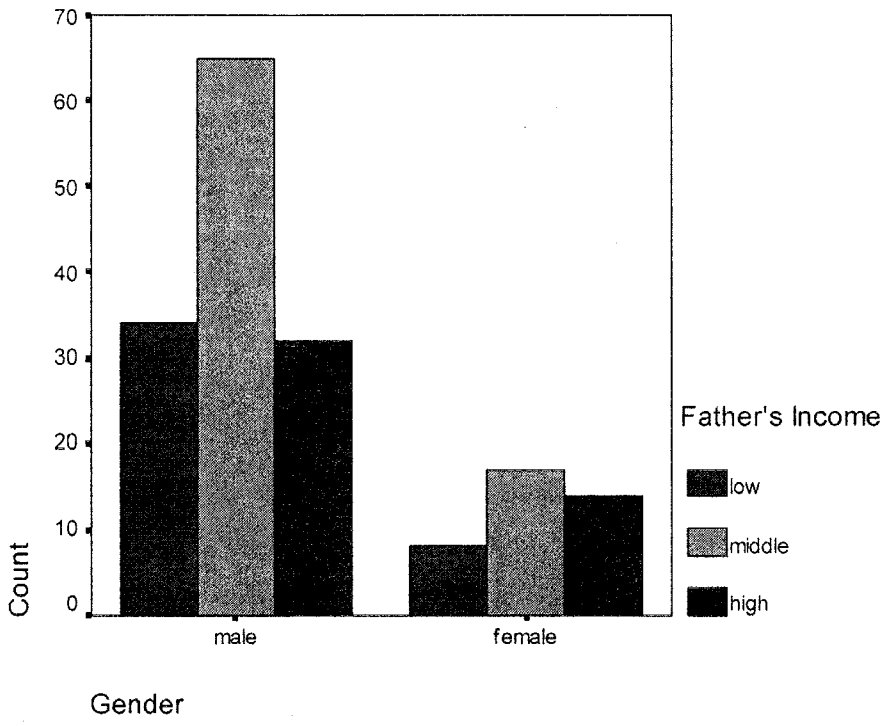
Gender and Mothers' Income Level



With regard to their fathers' level of income, the data as reported in Table 12 revealed that of the 200 Students' who responded to the survey, 173 reported their fathers' income. 76.9% (n = 133) were male and 23.1% (n = 40) were female. The results in Figure 6 further showed that there is an association when the fathers' level of income is middle and high. That is 39.3% (n = 68) males, 9.8% (n = 17) females; and 17.9% (n = 31) males, 8.7% (n = 15) females, the number of males and females in this case are both high. However, when the fathers, income is low, there are more males than females taking computer science. That is, 19.6% (n = 34) males, 4.6% (n = 8).

Figure 6

Gender and Fathers' Income Level



Gender and Computer at Home

Students were asked whether they had a computer at home. This question was asked to understand the proportion of male and female students who had a computer at home. The data as shown in Table 13 revealed that out of the 200 students 195 responded to the question. 71.7% (n = 140) reported that they had a computer at home and 28.2% (n = 55) reported that they did not have a computer at home. The result as depicted in Figure 7 also showed that 66.7% of female respondents own computers at home compared to 73.5% of males.

Table 13

Gender and Computer at Home

		yes	no	total
gender	male	108	39	147
	female	32	16	48
total		140	55	195

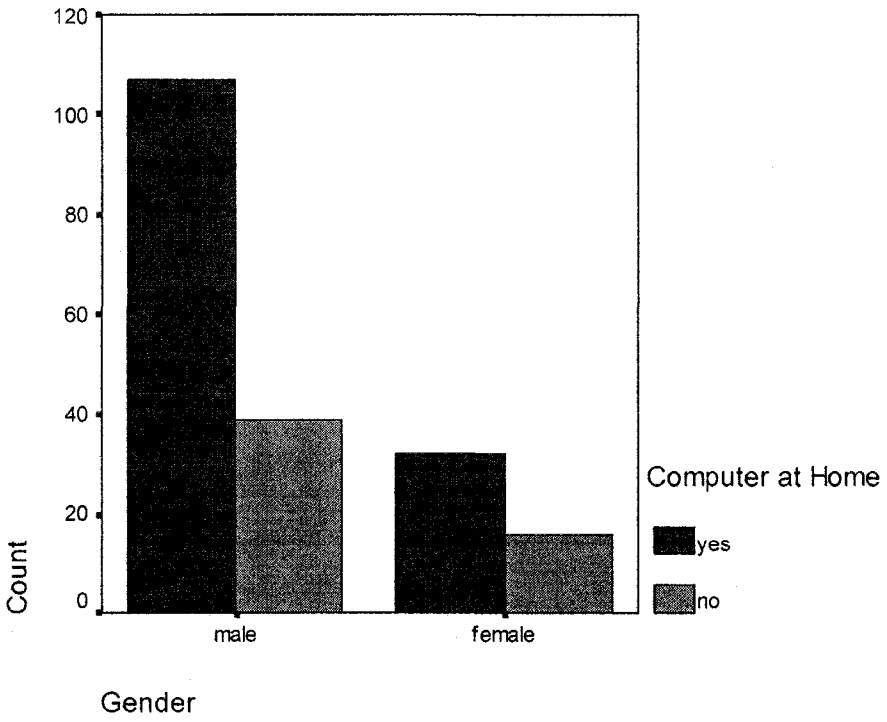
Table 14

Gender and Computer Use at Home

		most of the time	sometimes	not at all	total
gender	male	32	35	13	80
	female	17	7	2	26
total		49	42	15	106

Figure 7

Gender and Computer at Home

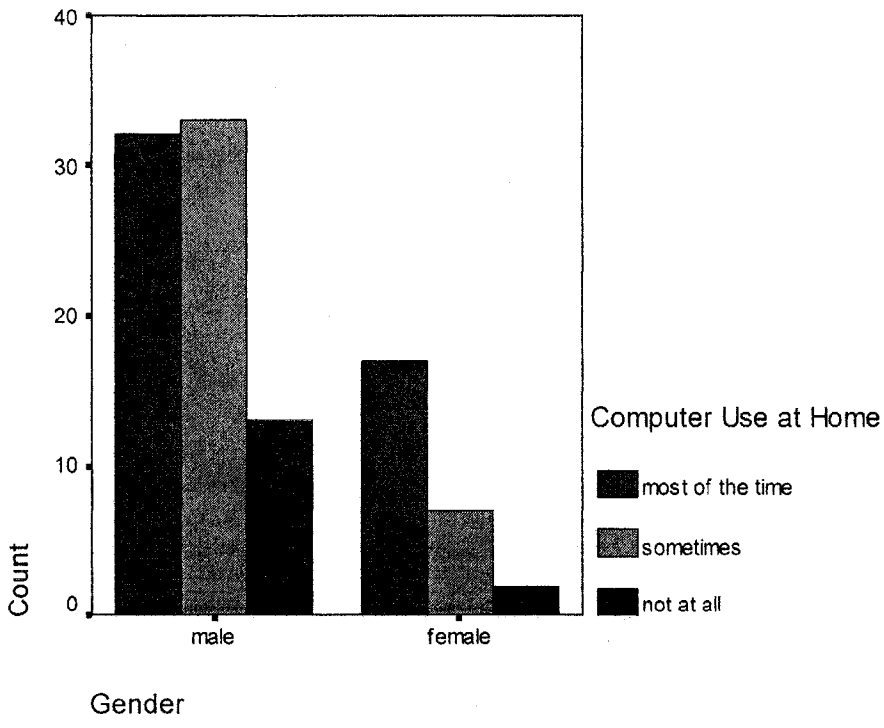


Gender and Computer Use at Home

Students were asked whether they use a computer at home. This question was asked to understand the proportion of male and female students who use a computer at home. The data as shown in Table 14 revealed that out of the 200 students 106 responded to the question, 75.5% were male and 24.5% female. The result as depicted in Figure 8 suggests that almost equal numbers of male respondents used computers most of the time and sometimes, that is 30.2% and 33% respectively. Most females on the other hand used their computers most of the time. That is 16% (n = 17) compared to 6.6% (n = 7) who use it sometimes and, 1.9% (n = 2) who do not use it at all.

Figure 8

Gender and Computer Use at Home



Gender and Computer Science Subject

Students were asked whether they thought computer science is a masculine or feminine oriented subject. This question was asked to understand how male and female students viewed computer science. The data as shown in Table 15 revealed that 199 out of 200 students responded to the question. The results as depicted in Figure 9 also showed that although some males 10.5% (n = 21) considered computer science to be a masculine subject none of the females considered it to be so.

Figure 9

Gender and Computer Science Subject

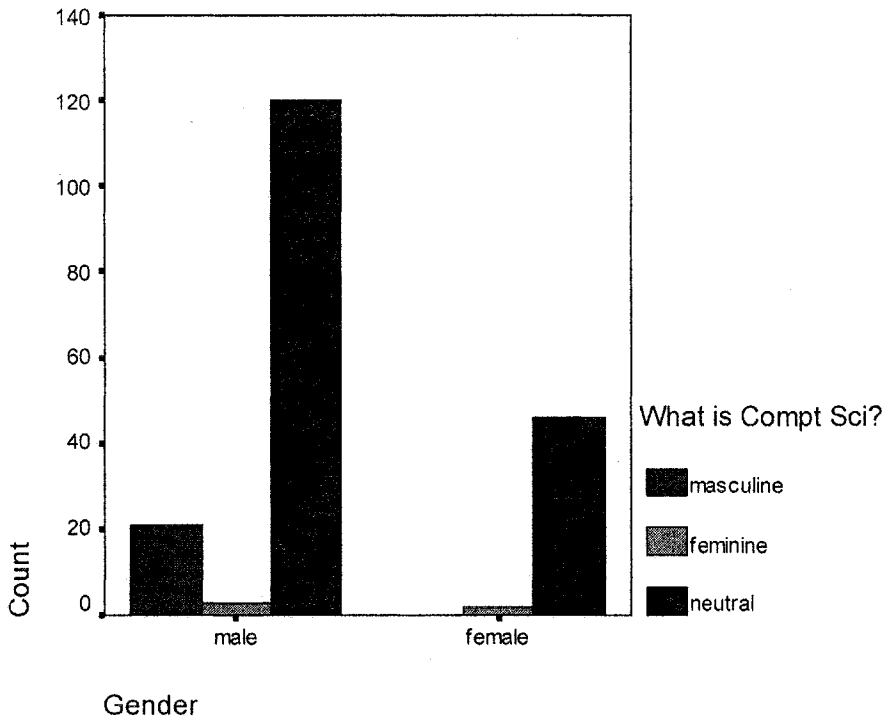


Table 15

Gender and Computer Science Subject

		masculine	feminine	neutral	total
gender	male	21	3	127	151
	female	0	2	46	48
total		21	5	173	199

Gender and Experiences Leading to Computer Science

Students were asked what experiences made them major in computer science. This question was asked to understand who influenced males and females to take computer science. The data as shown in Table 16 revealed that 200 out of 200 students responded to the question. The data as depicted in Figure 10 also further showed that there is a relationship between males and females, and the influence of parents and teachers. The data thus seem to suggest that both parents and teachers were influential in getting female students to take computer science.

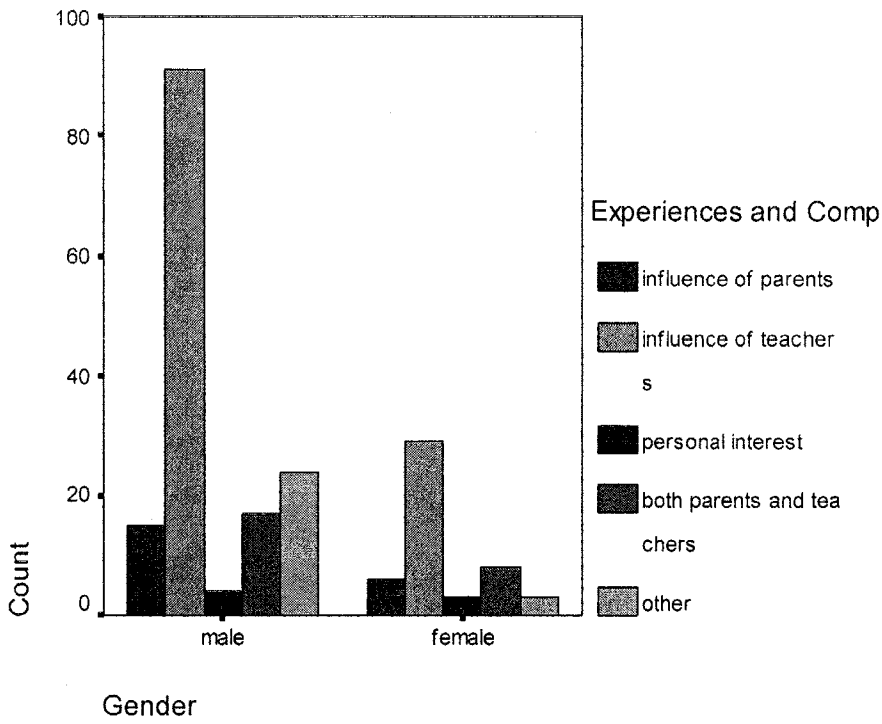
Table 16

Gender and Experiences Leading to Computer Science

gender	influence of parents	influence of teachers	personal interest	both parents and teachers	other	total
male	15	91	4	17	24	151
female	6	29	3	8	3	49
total	21	120	7	25	27	200

Figure 10

Gender and Experiences Leading to Computer Science



Gender and Educators in Computer Science

Students were asked whether they though educators brought in different experiences between women and men in the teaching of computer science. This question was asked to understand whether males and females thought the experiences of teachers' impacted them in computer science. The data as shown in Table 17 revealed that 195 out of 200 students responded to the question, 74.9% were males and 25.1% were females. The data in Fig 11 also further showed that there is a relationship between males and females and the no and yes responses. In both cases the numbers who agreed and dis-agreed are high. That is 32.3% (n = 63) males and 8.7% (n = 17) females agreed that educators brought different influences between men and women in the teaching of

computer sciences. However, 42.6% (n= 32) males, 16.4% (n = 32) females dis-agreed. The result suggests that a high percentage of both male and female students agreed and dis-agreed that teachers brought in different influences between males and females in the teaching of computer science.

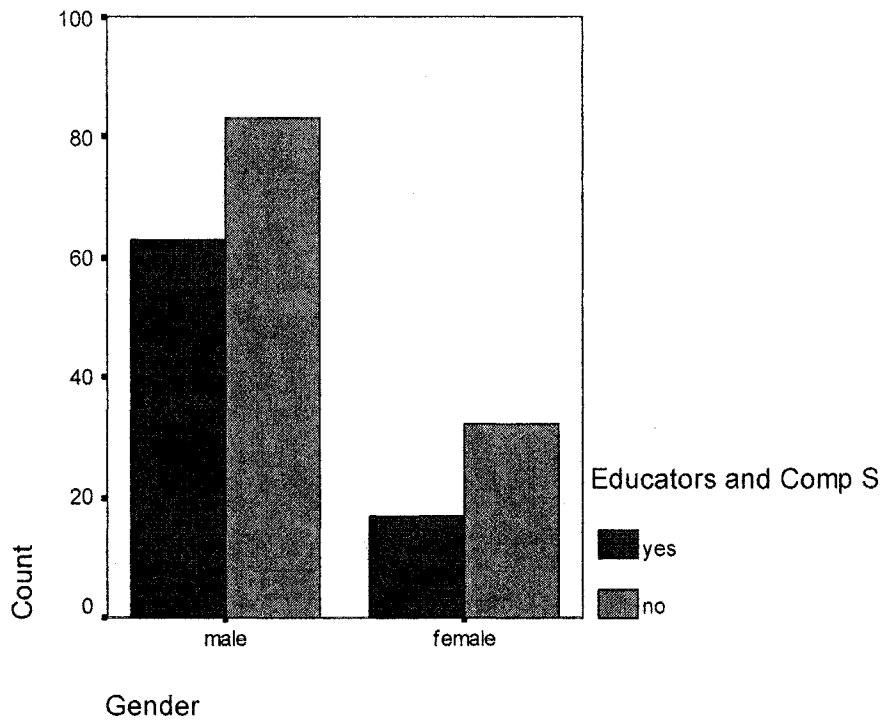
Table 17

Gender and Educators in Computer Science

		yes	no	total
gender	male	63	83	146
	female	17	32	49
total		80	115	195

Figure 11

Gender and Educators in Computer Science



Students were asked whether their confidence had increased or decreased since they had been in the program. This question was asked to understand the confidence level of male and female students. The data as shown in Table 18 indicates that 198 students out of 200 responded to the question, 75.3% were male and 24.7% were female. The result as indicated in Figure 12 further showed that there is a relationship between the number of males and females and the increase in confidence level. That is, 67.7% male and 23.7% female agreed that their confidence level increased after they joined the program compared to 7.6% males and 1% females who disagreed that their confidence level did not increase. The result thus suggest that both males and females agreed that their confidence level increased since they had been in the program.

Figure 12

Gender and Confidence in Computer Science

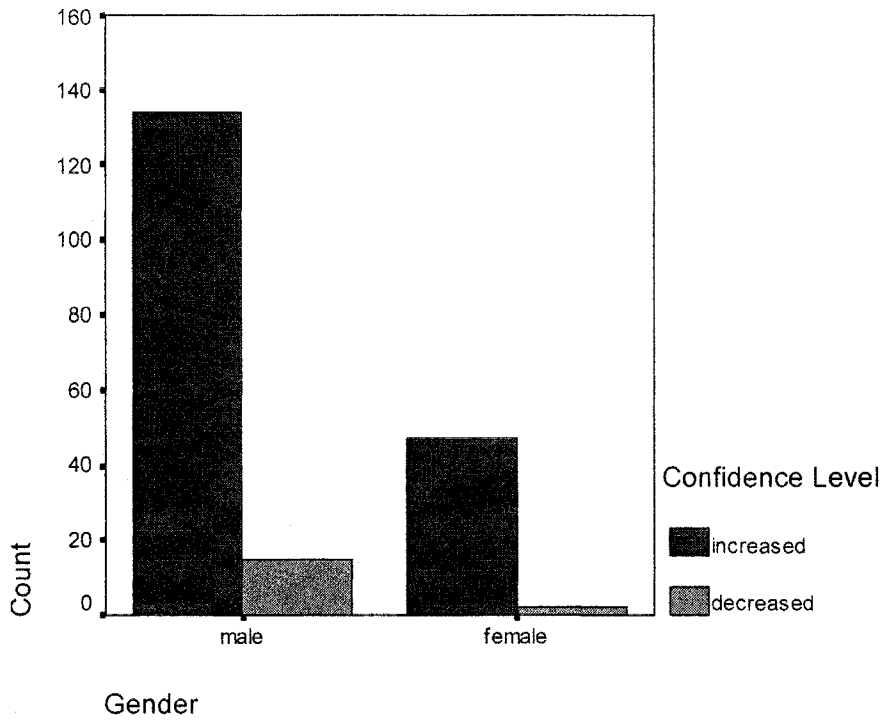


Table 18

Gender and Confidence in Computer Science

		increased	decreased	total
gender	male	134	15	149
	female	47	2	49
total		181	17	198

Qualitative Data Analysis

11 participants were interviewed and 15 participants took part in the focus group discussions. The recorded discussions and interviews were transcribed and the large quantity of information was organized in relation to the research questions asked. The following are the themes that emerged from the undergraduate male and female focus

group discussions, graduate focus group discussions and interviews with faculty, FAWE, Gender Mainstreaming and Technology Committee of parliament representatives.

Themes that emerged from the undergraduate focus group discussion are:

Lack of counseling; societal influences; discouragement by society; lack of educational materials; lack of properly trained computer science teachers; employment opportunities in computer science field; lack of employment opportunities in computer science field; encouragement from teachers and parents; playing computer games; interests in the internet; interests in engineering; help from peers; nature of computer science education; lack of support from peers; lack of proper preparation at the secondary school level; lack of mentors and role models and lack of scholarships.

Themes that emerged from the graduate focus group discussion are:

High tuition costs; lack of support from spouses; lack of coordination from women's advocacy groups; lack of information about educational resources; nature of computer science education; lack of counseling, urban/rural differences; challenges of finding jobs in computer science field; lack of role models; lack of proper preparation in secondary schools and lack of science background; lack of educational materials; lack of properly trained computer science teachers.

Themes that emerged from the interviews with faculty and staff members from FAWE, Office for Gender Mainstreaming and Technology committee of Parliament are: Lack of encouragement from teachers; lack of science background; urban/rural differences; initiative to sensitize parents; lack of mentors; societal factors; lack of role models; lack of scholarships; lack of government policy in the sciences; lack of

counseling and career guidance; lack of proper preparation at the secondary school level and discouragement by society.

Themes that emerged from the open ended part of the survey questions are: Technical jobs; non technical jobs; negative reaction from peers, support from parents; parents not supportive; employment opportunities in computer science field; playing computer games; surfing the internet; lack of properly trained computer science instructors.

Upon grouping the responses from the interviewees for similarities and differences, a system of coding was used to mark the margins of the text for common themes. Particular attention was paid to contradictory exemplars to see if they might be instructive in rounding out emerging patterns or explaining contradictory evidence. In addition to organizing the data into themes, it was also useful to include relevant quotations of the interviewees to particularize the context and tone in which the interviewees responded to the questions. To minimize the possibility of misrepresentation, direct quotes are used whenever appropriate. Likewise, in the process of organizing words of individual interviewees into themes, each interview was compared to others in search of commonality, consistency or even differences.

Discussion of Research Questions

The first question that this study sought to answer is: what is the nature of the gender disparity in computer science education in Uganda?

The data revealed that 200 undergraduate students responded to the survey. There were 75.5% (n = 151) male and 24.5% (n = 49) female. The Director of academic affairs also gave the researcher the list of students enrolled in the computer science

undergraduate program for the 2003/2004 academic year. The list showed that there were 89 female students out of a total of 600. This list thus shows that there is a gender disparity in the discipline.

When a representative of the university's office for gender mainstreaming was asked to comment on gender and computer science at the university, she stated "I know there is a problem but our office has not looked deeply into it since we have been very busy working on other urgent matters". A first female faculty interviewed at the institute of computer science was asked what she thought of gender and computer science education she stated:

> We have a problem and the disparity in the discipline starts with us the teaching staff. When you take women as opposed to men who are teaching here, there are about fifteen faculty members and out of that only five are women. And all of us women here are in low level positions such as assistant lecturers and teaching assistants. All the top senior teaching positions are occupied by men. If you look at what is happening generally, the number of women with science backgrounds is low compared to men, and therefore the numbers who come here to study computer science are also naturally low. If you take my personal experience, I did physics and mathematics in my undergraduate. We were 10 girls out of a class of 150 students. Now supposed all of us 10 girls joined computer science at a graduate level, how would that compare to 140 boys who would also qualify since they would have the background in science? There would be no match since the gap would be wide.

She noted that the disparity that was being observed at the institute had origins elsewhere. She stated:

> The problem should be addressed at the primary and secondary level, because once a girl has the necessary background of mathematics and science; motivation and encouragement, by the time she is in senior secondary school, she may start looking at herself as a scientist of some sort. Such a girl would be able to battle out things despite problems that may arise.

She explained that in her early years of teaching, she taught at the primary level and found that both boys and girls had the same exposure to mathematics and sciences initially, but that somehow at a certain point the girls shy away. She wondered aloud whether it was due to factors such as the young age at which these girls would be, or pressure from the community. She thought this was the level and time when most girls needed help to overcome the problems they were encountering.

A second female faculty member interviewed in explaining the disparity observed:

> When I came here I use to hear people talk so much about gender, but not in relation to computer science and it never bothered me. But since I started teaching I have changed my attitude because I really see it. For example, when I was a student in my computer science class we were about 34 students and only 5 of us were girls. I had not seen it so much before because I went to a girls' school in my secondary level education. So it did not matter to me since I was surrounded by girls, in a girls' school and we were performing well. But when I came to university, it stood out for me and I really see it now. Actually when you do a

> general sampling of most women at the university here you find that a majority of them are doing social sciences or Arts.

She continued that her experience as a lecturer at the university made her realized the importance of talking about gender and computer science education. She stated:

> In one of the courses I teach (net working), the institute wanted to have at least 30% of women taking the course, but we have been struggling to get women to fill the slot.

She argued that it is difficult and almost impossible to have a gender balance in a discipline such as computer science, when the university where students go for degree studies is seen as a place to correct the imbalance. According to her:

> The starting point should be at the lower level, at the primary and secondary level of education. That is where I think the intervention should start. Once women have a through understanding of the background at the primary and secondary level, they'll be able to compete effectively with men, when it comes to the university level.

When a male student who took part in the focus group discussion was asked what he thought of gender and computer science he responded:

> When you are at the primary and secondary levels, you just know from people that the boys are cut out for sciences. You know it is like that because most of the engineers you know are men, the electricians are also men. So as a boy you think that if I have to do something that is recognizable, then I have to go to sciences. Maybe that is why we have more boys than girls here doing computer science.

It can be deduced from the students comment that at the primary and secondary levels, both boys and girls are exposed to the sciences. However, boys at that age have a positive attitude towards the sciences than girls because they can identify with earlier achievers that is, role models in the discipline who happened to be men. In addition, they are encouraged by society to feel that they are "cut out" for sciences, while girls are made to feel that they are "cut out" for Arts.

A graduate female student who was part of the focus group added to the discussion by stating that the gap existed because most girls were not informed at the primary and secondary level about the important part mathematics and sciences played in taking any course or pursuing any career at the university level. She argued "most girls are not informed about the importance of sciences at the lower level so they do not take it seriously, and when they get to higher levels of education, they find that they cannot take those courses and careers which require science courses."

The second question that the study sought to answer is: what factors promote/hinder women's computer science education in Uganda?

The study identified various factors that have been taken to promote women's participation in computer science education in Uganda. Of significance is the work being done by the Forum for African Women Educationalist (FAWE) Uganda branch in collaboration with the Ugandan ministry of education (the education ministry is an important stake holder since most primary and secondary schools are under its control). According to a FAWE staff that oversees projects, "FAWE has established a scholarship program which is given to girls in secondary schools". The schools where these scholarships are granted, are identified by FAWE as "core schools", that is girls (single

sex) schools that are performing well in the sciences. To date there are 49 "core schools" in 49 districts out of the 56 districts in Uganda.

The girls that are the recipients of these scholarships are mostly from low income poor families. They are selected on the basis of their performance at the primary level examination, and are seen as bright but lacking the financial support to continue further studies. This point was illustrated by the FAWE staff:

> The scholarships we provide are for the needy. We believe that if you put these girls in schools that perform well, they'll be able to pass well and get scholarships to institutions of higher learning.

FAWE has also equipped the core schools with science books and laboratory equipments to build their capacities in sciences. Some teachers in these schools have also been trained in career guidance, to help the students make right decisions especially in regard to science courses. Some teachers are also annually sent to the United Kingdom through a program sponsored by the British government to train in science and computer related courses. When these teachers return to Uganda, they are normally provided with computers to bring back to their schools. Girls in core schools have therefore been exposed to computers through such generosities.

Apart from the scholarship program implemented at the core schools, FAWE also has established a mentoring program. A second FAWE Staff explained the purpose of the program "we encourage women who work in Kampala and other urban areas in high positions, especially science related positions to go back to the rural and the district primary schools they come from to encourage girls to do sciences". She continued to explain the importance of the mentoring program "once we begin to encourage women

from the primary level, they'll develop an interest in science and mathematics and when they get to the university, they'll be able to do courses like computer science".

FAWE has also organized science camps (this has been limited only to four districts due to limited resources) as away of promoting girls interests in computer science. In these camps, girls from rural schools are exposed to computers at the best equipped laboratory within the urban schools. The girls are also taken to tour Makerere University's Institute of Computer Science and the science department. The main objective according to the FAWE staff is to "encourage them and show them that when you work hard and you do sciences you'll be like these university students"

FAWE in conjunction with UNICEF (United Nations Children Fund) has also initiated a program called Girls Education Movement Club in selected primary schools to help empower girls identify problems related to their education and suggest solutions to help resolve it. The program aims to sensitize local communities about the importance of girls' education.

The FAWE staff explained how GEM club works "girls at a participating primary school are trained to have self esteem and be advocates of their causes. They are also trained in income generating activities such as gardening and in drama". She continued "the girls would then use the acquired skills to empower and help one another and to sensitize parents about the importance of girls' education".

The FAWE staff further noted:

> Typical examples of what the GEM clubs have done have included sensitizing parents about the importance of educating girls rather than getting them into early marriages. The club members have done these through plays and dramas. GEM

> clubs have also helped buy school materials such as pens and books for girls who dropped out of school because of lack of such materials. The club generates income to finance such activities from selling the crops they grow in their gardens.

A graduate student who works at the Institute of Computer Science and was part of the focus group discussion remarked that the director of the institute was also doing much to encourage women to study computer science she stated:

> The director we have here encourages women a lot, and I am sure in future if he can get more scholarships he can offer more to women. For the staff who are here and studying, he is always encouraging us and he does not discriminate between men and women, he treats us equally.

The study also revealed various factors that hinder women's participation in computer science education: discouragement by society; lack of support by spouses and peers; urban/rural differences; lack of career guidance in schools at the primary and secondary levels; lack of coordination among women advocacy groups; lack of mentors and role models; lack of an official policy addressing women's participation in sciences; computer science anxiety; lack of scholarships; lack of educational materials and lack of well trained computer science instructors.

Discouragement by society

Of the 49 female students who participated in the survey, 14 stated that society discouraged them from taking computer science by claiming that it is a subject for men only, 32 stated that society discouraged them by claiming that computer science is a "hard" and "difficult" subject.

The feeling that society discourages female students from taking computer science was also echoed by participants who were interviewed. According to the first FAWE staff "within our society people spread the word that sciences in general are for boys. When girls hear that kind of message, they develop that kind of thinking. They think sciences are for boys and do not come out to take it". A third faculty member agreed, she stated "I have seen families who encourage their girls to take any science subject such as computer science, but once these girls got out into the society they got discouraged and dropped sciences all together". Societal discouragement is summed up by a male student quoted above who stated that society makes boys feel that they are "cut out" for sciences and girls "cut out" for Arts.

Lack of support by spouses

All the 5 female graduate students who took part in the focus group discussion felt that they did not have support from their spouses, because their husbands felt that they may support a wife who would end up leaving after the completion of the course. A graduate student summed up the frustration of her colleagues "since most of our husbands have only completed master degrees, they do not like to see a wife also getting a masters or even an advanced degree in such a course as computer science. Because it would mean a better job and more money for the wife" she continued " the problem is that most of our husbands have no security, they think once you have a higher education and a high income, then you'll leave them". The lack of spousal support thus makes it very difficult to pursue the course especially because a woman can not cater for a family and meet the financial costs involved in paying tuition individually.

Lack of support by peers

The 5 female undergraduate and 5 female graduate students who took part in the focus group discussion also stated that their male classmates reacted negatively to their taking computer science. Among students who took part in the survey, 5.1% (n = 10) as opposed to 3.6% (n = 7) stated that their classmates reacted negatively to their taking computer science. The negative reaction of male students that was narrated by the 10 female students who took part in the focus group discussion was summarized by a female graduate student who stated "it is sometimes challenging to be taking the course because some guys in the class would openly tell you that computer science is not for women". Although a higher percentage 19.9% (n = 39) females and 71.4% (n = 140) males who took the survey reported that their classmates were supportive, such negative utterances from male classmates only serve to discourage the participation of female students in computer sciences.

Urban/Rural differences

According to the World Development Indicators (2003), only 15% of the Ugandan populations live in the urban areas. Most participants who were interviewed as well as those who took part in the focus group discussions stated that the urban/rural cleavages had implications for women's participation in computer science. The view of these participants was espoused by a FAWE staff who stated "most primary and secondary schools in this country are located in the rural areas. And since most parents do not want their daughters to study away from home, most girls study in these rural schools" she continued "the problem with studying in rural schools is that students do not get much exposure the way it is in urban schools" she commented:

> Students in urban schools are exposed to science subjects; they have computers and computer labs. They are also exposed to mentors, women who have done sciences before, like women engineers, technicians, and doctors. However, in most rural schools, sciences is not even taught and there are also very few women in science professions there who could act as mentors.

A fourth faculty member interviewed added to the implications the urban/rural differences has for women's participation in computer sciences she stated:

> The majority of the students study in the rural areas and there you have UNEB (Uganda National Examination Board) centers that are only authorized to test Arts subjects. Most of the rural schools lack requirements for the teaching of sciences such as science teachers, laboratories and other science equipments. This therefore leads to a majority of students from the rural schools taking Arts and not being exposed to sciences. This situation affects a lot of girls since most of them study in the rural schools which are always nearer to home. The end result of all this is that you get very few women coming from the secondary schools with a background in sciences who can join courses such as computer science at the university.

It is therefore clear that in order to improve women's participation in computer sciences, some intervention need to be initiated to address the rural/urban cleavages so that women can start taking sciences right at the primary and secondary levels.

Lack of Career Guidance and Counseling

The term "guidance" as used here includes the entire apparatus of information, encouragement and action to support students and parents throughout the school years.

Career guidance is only one aspect of the total guidance program which helps students to learn to make appropriate choices as they prepare for the working world. Counseling on the other hand enables students to discuss their personal or academic problems with an adult usually a teacher or tutor. Both career guidance and counseling are essential components of schooling.

According to Kwesiga (2002), career guidance and counseling unit of the ministry of education was established in 1964, to facilitate the "Ugandanisation" of personnel in the employment sector. This was to be achieved through providing students with information on employment, further training, raising awareness about their capabilities and providing relevant information to teachers and parents. However, to date the unit consists of only three senior staff members and is too financially constrained to reach many schools and it only has the capacity to distribute application forms to higher training institutions. The onus is therefore on individual schools to provide what they can to their students. Furthermore, guidance and counseling is absent as a service and discipline. The study revealed that there is inadequate career guidance and counseling.

When the all female graduate focus group discussion participants were asked what they thought was preventing more females from joining computer science, one of the participants responded "I know from my own experience that from primary schools girls are not informed about the benefits of science courses, so most girls do not take science seriously". She continued "it is only later when one applies to join the university that one discovers that a science background is necessary for enrollment in most courses, but by then it will be too late".

Another participant added:

> They provide such services but not in most schools, and even where guidance and counseling is provided, it is mostly based on the preferences of the counselor not on the students' capability. You can be told that you cannot apply for a course because most people have applied for it so you cannot get it. Or that a course is for people from bigger urban schools which perform well. So you get something like that which discourages one from computer science.

The result of the study shows that the need for career guidance and counseling in all primary and secondary schools in the country is now very clear. It is also essential that professionals provide guidance and counseling on the basis of students' capabilities should play the leading role, not those that confuse their own preferences with student's capabilities.

Lack of Mentors and Role Models

The study revealed that the absence of role models and mentors played a big role in hindering women's participation in computer science. According to the first FAWE staff interviewed:

> Most women, who have done sciences such as women doctors, women engineers and women technicians, rarely go back to the villages and rural areas where they are originally from. They tend to mentor girls in the urban areas where they work and yet their presence as mentors and role models in the rural schools where most of the populace live would have a big motivational potential for girl students to get into sciences.

The second faculty interviewed staff reiterated on the importance of having women role models and mentors as away of encouraging women to take computer science. Narrating experiences from her classroom she stated:

> Most women I have had in my classes' required extra attention and extra help, because they did not have a science background, so it takes time for them to pick up. Through my interaction with these students, I realized that they were encouraged because I am a woman teaching the course and they look at me as a role model.

The first faculty member interviewed also narrated a situation from her classroom in which a female student confided in her that she would not have taken the class if it was being taught by a man. The result of the study thus shows that having women role models and mentors for girl students especially in the rural schools would go a long way to get more women interested in science courses such as computer science. It also further suggests that having single sex girls schools where women would teach women; mentor and be role models for them could contribute a lot to attracting girls to do science subjects and especially computer science.

Lack of Coordination among women's Advocacy Groups

The study found that there were several groups advocating for women's education, however the activities of most of these groups were not coordinated. In some instances there was duplication and some groups did not know what each one of them was doing. When asked what she thought should be done to promote women's' participation in computer science, a fifth faculty member interviewed answered:

> There are many people and groups trying to do many things, for instance you have the department of gender and women studies, the office for gender mainstreaming, Forum for African Women Educationalist and various other NGOs (Non Governmental Organizations). However there is no coordination in the activities of these groups. I think there is a need for coordination of all the activities of these groups. It is also important that all these groups that advocate on gender issues, publish on their activities, so that people and other groups know what they are doing in order to allow for cooperation and avoid duplication. Even here at the university, the Office for Gender Mainstreaming should own up to its task and coordinate the activities of all women's groups on campus.

The all women graduate focus group discussion participants argued that these groups needed to do more and give out information about their activities and reach out to students, especially women students doing science courses. A participant stated the groups' position:

> These organizations are not doing anything because although we read about them we do not know about them. I think if they are to do anything they are supposed to encourage us, have meetings with us, and if they know somewhere we can get scholarships they can inform us about it, and tell us to inform more women to apply for such scholarships. I think they should be more active than what they have shown so far.

The third faculty interviewed observed that although she has heard of various organizations advocating for women's education, it was clear to her that these organizations were not calling for women's participation in science courses such as

computer science but were rather advocating for women's participation in general education. She commented:

> One thing I have noticed is that there are various organizations campaigning for promoting girl/child education, but this is not specifically geared towards encouraging girls to study sciences. It is merely aimed at the general education of girls. If they can come up with a scheme which says educate the girl/child but encourage the girl/child to study sciences, maybe that approach could get more women to study science subjects such as computer science.

The result of the study thus shows the need for coordination between the various organizations advocating for women's education. It is also essential that these groups specify that women should be encouraged to study sciences, i.e., advocacy should not only be restricted to general education.

Lack of official Policy addressing Women's Participation in sciences

The lack of an official policy with specific regard to computer science was emphasized by a second faculty member interviewed. When asked what the government was doing to increase women's participation in computer sciences, she stated:

> I do not think the government is doing much; of course there have been campaigns about girl/child education. You hear various government official saying girl/child this girl/child that, but I doubt if any practical measures have been taken to improve girl/child education in the sciences or computer science for that matter because I do not see anything to show for it.

The lack of a policy was also made clear by a member of the parliamentary committee on technology. When asked to enunciate parliaments position in regard to

women's participation in sciences in general and computer science in particular, he stated categorically that "there is no such policy in place".

The study thus shows that the government seems to operate on the premise that there is no gender in equality in the sciences.

Lack of Scholarships

In the past, which is up to about the late 1980s, men and women who qualified to join government aided universities were automatically sponsored by the government. However, due to the liberalization of the economy the government has remove subsidies to the education sector leading to very few students being sponsored. Although the situation affects both male and female students, it is adverse for female because of the factors discussed above.

The study revealed that 70% of women who participated in the survey reported that their participation in computer science was being hindered by high tuition costs. Almost all the women who participated in the focus group discussion mentioned the lack of scholarships and high costs of tuition as a hindrance to a lot of women. The view expressed by a female graduate student who is employed at the institute is representative of the views of her peers, she stated:

> The course is expensive especially when you are sponsoring yourself. Since I work here at the institute, I have seen many women who have come here and expressed an interest in the course, but they cannot afford to pay and cannot find scholarships. If these women had away to get funding, I am sure we can get more female students here.

Computer Science Anxiety

The study revealed that the word "computer science" brought a lot of anxiety to most women and is a major source of discouragement for them participating in computer science. According to the first FAWE staff interviewed "when women hear the word sciences, they think these are very hard courses. The courses supposed to be for men". A female graduate student confirmed the anxiety, she commented:

> The biggest obstacle or challenges that discourage women to join computer science is the name "computer science" itself. When you hear that, you begin to wonder how you'll manage it. Most of my friends ask me "how do you manage"?, and I tell them it is a course like any other and you just need to put your full input there and do your best. But however, much you explain they know it is really hard because there is the word science in it.

It therefore seems the way forward is to provide some guidance so that women can be made aware of their capabilities and given the confidence and self esteem to do a course such as computer science without much anxiety.

Lack of Educational Materials

All the 10 undergraduate male and female students plus the 5 female graduate students who took part in the focus group discussions were of the view that the lack of educational materials such as computers and text books was a hindrance in their computer science study. A male undergraduate student stated the views of his peers "the main problem for me, and I think for most of my counterparts is that there are very few computers at the institute, actually the ratio is 1 computer to 10 students". He continued "although we have laboratories, the institute only allocates 2 hours per day per students.

But you might find that it is the only 2 hours you have in the whole week, so you can hardly practice".

Another male student stated the case for the lack of books "computer science books are not available at the department, not even at the main library. These books are also too expensive for the students to buy. We therefore end up photocopying and it becomes a problem too if you do not have money."

Lack of well trained Computer Science Instructors

The 5 male students who were part of the focus group discussions complained that the lack of well trained computer science instructors was a hindrance to their participation in the discipline. One male student espoused the general view of his colleagues he stated:

> Computer science is a relatively new course here and most of the lecturers are also students in the masters' program. So they do not necessarily have enough time to attend to us and yet the subject requires a lot of assistance and help. The lack of such assistance thus affects the overall performance of students.

Summary

This chapter has addressed the nature of the gender disparity in computer science education in Uganda. It has also provided the evidence from the study that constitute factors hindering women's participation in computer science in Uganda. The next chapter will summarize the study and suggest recommendations.

Chapter Five

Discussion and Recommendations

This chapter will discuss the results of the study, summarize and make recommendations.

Discussions

The study sought to investigate, the nature of the gender gap in computer science education in Uganda and to understand the factors that influence gender differences in computer science education in Uganda. Study participants consisted of three clusters. The first cluster participated in a survey and was made up of 600 undergraduate students from the Institute of Computer science at Makerere University. The development of the survey questionnaire was based on the analysis of the literature review.

The second cluster participated in qualitative interviews and was made up of two representatives each from Makerere University Office of Gender Mainstreaming, the Forum for African Women Educationalist and the Technology Committee of the Parliament of Uganda. In addition, 5 female faculty members from the Institute of Computer science also constituted the second cluster. The third cluster participated in focus group discussions and was composed of 5 male and 5 female undergraduate Bachelor of Science majors in computer science and 5 female graduates.

The following research questions were addressed:

1. What is the nature of the gender disparity in computer science education in Uganda?
2. What factors promote/hinder women's computer science education in Uganda?

The analysis of question 1 revealed that 200 undergraduate students out of 600 responded to the survey. There were 75.5% (n = 151) males and 24.5% (n = 49) females. The researcher also received from the Director of academic services, a list of students enrolled in the computer science undergraduate program for the 2003/2004. The list showed that there were 89 female and 511 male students. This list thus shows that there is a gender disparity in the discipline. The disparity was also confirmed by various participants who take part in both the qualitative interviews and focus group discussions

For instance the representative of the university's office for gender mainstreaming while commenting on gender and computer science stated "I know there is a problem but our office has not looked deeply into it since we have been very busy working on other urgent matters". A faculty member in explaining the disparity stated "when I came here I use to hear people talk so much about gender, but not in relation to computer science and it never bothered me. But since I started teaching I have changed my attitude because I really see it".

She continued that her experience as a lecturer at the university made her realize the importance of talking about gender and computer science education. She commented "in one of the courses I teach, that is net working, the institute wanted to have at least 30% of women taking the course, but we have been struggling to get women to fill the slot".

A graduate student explained the disparity by arguing that "most girls are not informed about the importance of sciences at the lower levels so they do not take it seriously, and when they get to higher levels of education, they find that they cannot take those courses and careers which require science courses"

The findings above compare with a FEMSA (1997a) which found that the performance of girls in mathematics and science subjects (gateway to computer science) in both the primary and secondary levels in Ghana, Uganda, Tanzania and Cameroon was generally poorer than boys thus the lower number of girls than men joining science and computer science disciplines.

The finding is further supported by a number of studies. For example, a UNESCO (1998) report above showed that the number of women who enrolled for math and computer science courses compared to men were very low on a global basis. Another UNESCO (1999) report above also showed that the percentage of women who took natural sciences which include mathematics and computer was low on a world wide basis. An American Association of University Women (1998) report also found that women received one in four of the computer science bachelor's degrees and only 11% of the doctorate.

All the studies above support the existence of a gender gap in computer science education, as found in the Ugandan study. Nonetheless, since the research in Uganda was only carried out at one university, it would be better to extend the study to other universities and other technical institutions of higher learning in order to understand the greater depth of the situation

The analysis of question 2 revealed that various factors hindered women's participation in computer science education. The factors are: discouragement by society and lack of support by spouses and peers. Other factors include urban/rural differences; lack of career guidance in schools at the primary and secondary levels; lack of coordination among women advocacy groups; lack of mentors and role models; lack of

an official policy addressing women's participation in the sciences; computer science anxiety; lack of well trained computer science instructors; lack of educational materials and lack of scholarships.

Discouragement by society: the study revealed that 14 out of the 49 female students who participated in the survey responded that society discouraged them from taking computer science by claiming that it is a subject for men. 39 females reported that society discouraged them by claiming that computer science is a "hard" and "difficult" subject. The issue of societal discouragement was echoed by others who participated in the interview. A FAWE staff stated that "within our society people spread the word that sciences in general are for boys. When girls hear that kind of message, they develop that kind of thinking. They think sciences are for boys and do not come out to take it".

A faculty member agreed she commented "I have seen families who encourage their girls to take science subjects such as computer science, but once these girls got out into the society they got discouraged and dropped sciences all together". Societal discouragement was summed up by a male student who stated that society make boys feel that they are "cut out" for sciences and girls "cut out" for Arts.

The result of the study is confirmed by earlier studies by Canter (1979), Davies and Kandel (1981), Eccles (1987), Houser and Gravey (1985), Margolis and Fisher (2002) which reported that sex differences in attitudes towards computer science have originated in the way that males and females are brought up. These studies pointed out that there is a perception within society at different educational levels that computing is a male domain. This stereotypical view is conveyed to children and it affects children's course selection and achievement when they get to school.

Lack of support by spouses: female graduate students who took part in the focus group discussion felt that they did not have support from their spouses, because their husbands felt that they may support a wife who would end up leaving after the completion of the course. The lack of spousal support thus made it very difficult for women to pursue the course especially because they could not cater for a family and meet the financial costs involved in paying tuition individually.

The results of the study are confirmed by a FEMSA (1997b) study which found that most men were of the view that educating women is a waste of money because they would end up leaving the household. Thus the benefits of an educated woman would therefore accrue to whoever she would then be living with.

Lack of support by peers: 10 out of 49 female students who took part in the study reported that their classmates had reacted negatively to their taking computer science. A female student commented "it is sometimes challenging to be taking the course because some guys in the class would openly tell you that computer science is not for women".

The findings confirm a study by Margolis and Fisher (2002) which found that most women interviewed at Carnegie Mellon University where the study took place, reported hearing comments from male peers implying that the only reason they were admitted to study computer science was because of their gender. An earlier study Spertus (1991) also supports the findings, reporting on MIT women in computer science he concluded that male peer comments and behaviors are "the symptoms of a more fundamental problem: lower expectations for females". The finding of the study shows that women need support from the society, family and peers in pursuance of their studies in computer science.

Urban/Rural differences: the study revealed that only 15% of the Uganda population lives in the urban areas. Most of the participants who were interviewed stated that the urban/rural dichotomy had implications for women's' participation in computer science. The view of these participants was espoused by a FAWE staff who observed "most primary and secondary schools in this country are located in the rural areas. And since most parents do not want their daughters to study away from home, most girls study in these rural schools" she continued "the problem with studying in rural schools is that students do not get much exposure".

A faculty member interviewed added to the implications the urban/rural differences has for women's participation in computer sciences, she stated "the majority of students study in the rural areas and yet the Uganda National Examination Board centers in those places are only authorize to test Arts" She continued "most of the rural schools lack requirements for the teaching of sciences such as science teachers, laboratories and other science equipments. This situation affects a lot of girls since most of them study in the rural schools which are always nearer to home. The end result is that you get very few women coming from secondary schools with a background in sciences who can join courses such as computer science".

The findings of the study confirms a study by Kwesiga (2002) which revealed that the single most important independent cause of educational inequalities is the fact that in Sub-Saharan Africa, the majority of the population live in the rural areas.

Lack of Career Guidance and Counseling: the study revealed that there was a lack of career guidance and counseling at the primary, secondary even at the university level and yet such a service would help students prepare to choose the right courses and career.

A female student commented on the issue "most girls are not informed about the importance of science at the lower level so they do not take it seriously, and when they get to higher levels of education, they find that they cannot take those courses and careers which require science courses".

A study by Kwesiga (2002) confirms the findings above. She found that career guidance and counseling has not generally received the attention it deserves in the Ugandan educational setting. She found that counseling as a discipline did not even exist, and in schools where the program was in place, it was providing minimal services. However, various studies and examples have shown that students, especially girls need advice on improving self esteem and building confidence. They also need to know how to chart their own future in an environment that allows their intellectual capacities to develop.

Lack of mentors: the study revealed that the absence of role models and mentors played a big role in hindering women's participation in computer science. A FAWE staff noted "most women who have done sciences such as women doctors, women engineers, and women technicians rarely go back to the villages and rural areas where they are originally from. They tend to mentor women in the urban areas where they work, and yet their presence as mentors and role models in the rural schools where most of the populace live would have a big motivational potential for girls students to get into sciences"

The findings above are supported by the Kwesiga (2002) study which found that the education system in Uganda lacks enough female role models to motivate girls and women to aspire to enter higher education. However, this is not the case for boys and men. The study looked specifically at the teaching profession and found that there were

not many female teachers that could be role models and mentors to girls. The study further reported that the lack of such role models and mentors was the cause of girls increased rate of persistence. With specific regard to the sciences, the study found that the absence of women teachers in co-educational institutions which tend to be male-dominated left female students out of the system. The under representation of female teachers in such institutions was cited as one of the reasons why girls did not enjoy or take up mathematics and science related subjects. Nevertheless, having single sex schools where women would teach and mentor fellow females would go a long way to support women's retention in the sciences.

The assertion is supported by various studies (see Boit, 1986; Forge, 1989; Obisodun, 1991 & Eshiwani, 1985) which found that single sex schools provide particular advantages and benefits for their constituents especially girls. Girls who attended single sex schools had higher educational aspirations and improved performance levels than those in co-educational schools.

Lack of coordination among women's advocacy groups: the study found that there were several groups advocating for women's education, however, the activities of most of these groups were not coordinated. In some instances, there were duplications and some groups did not know what each one was doing. The result of this study shows that it is essential for these groups to coordinate their activities if they are to promote women education.

Lack of official policy addressing women's participation in sciences: the study found that there was no official government policy as far as women's participation in science was concerned. These finding confirms Kwesiga (2002) study which found that

there was no institutional body specifically charged with planning for women's education. She narrated a situation in which a deputy commissioner for education told her that "we cannot encourage separate planning for girls". The study found that the educational system in Uganda operates as if there is no gender inequality in educational opportunities.

Lack of scholarships: the study revealed that 70% of women who participated in the survey reported that their participation was being hindered by high tuition costs. Almost all the women who participated in the focus group discussion mentioned the lack of scholarships and high tuition costs as a hindrance to their studies.

The findings above confirmed a FEMSA (1997c) study, which found that poverty is a major factor that hinders women's education in mathematics and sciences, since the costs of science related courses are more expensive than Arts. The findings are also supported by a study by Kwesiga (2002). The study found that women are not being drawn into higher education because of the low number of scholarships that is provided to them.

Lack of Educational Materials: the study revealed that the lack of educational resources such as computers and textbooks was a hindrance to students' study of computer science. A male undergraduate student summarized the views of all the students who took part in the survey, qualitative interviews and focus group discussions. He stated "the main problem for me, and I think for most of my counterparts is that there are very few computers at the institute, actually the ration is 1 computer to 10 students". The findings above is supported by a World Development Indicators (2003) report which showed that Sub-Saharan Africa had 10 personal computers per 1000 people compared to

a world total of 86 per 1000. This therefore meant that very few people in Africa had access to computers.

Lack of Well Trained Computer Science Instructors: the study revealed that the lack of well trained computer science instructors was a hindrance in the study of the discipline. A male undergraduate student espoused the general view of his peers "computer science is a relatively new course here and most of the lecturers are also students in the masters' program. So you find that they do not have enough time to attend to us"

Computer science anxiety: the study revealed that the word "computer science" brought a lot of anxiety to most women, and is a major source of discouragement for them participating in the discipline. The findings confirmed studies by Collis (1987), Hawkin (1987), Sax (1994), Saymour & Hewitt (1997), which found that it is the anxiety which the male 'mould' impose on science and mathematics that women transfer directly to the study of computer science. Although the lack of trained teachers is a problem now in the short run, it seems it can be resolved as more teachers get trained. For as the student readily admits computer science is still relatively new in Uganda and as it evolves with time there will be more qualified teachers in the discipline.

Summary

This study revealed that there is a gender gap in computer science education in Uganda; it also revealed that several factors contribute to the hindrance of women's participation in the field

Implications of the study

The findings of this research can be influential in shaping educational policy and intervention strategies to expand and encourage more women to take computer science courses in Uganda. For example it can be used as a foundation for the formulation of an official government policy addressing gender equality in education and especially in the sciences. It can also be used in the campaign to introduce more single sex schools at the primary and secondary levels. It can further be used as a catalyst to expand the teaching of science subjects in the rural areas, as well as for the introduction of counseling as a discipline within the educational curriculum in the Ugandan educational system.

In addition, the findings can also be used to sensitize various stake holders about the need to promote and support women's' education and especially in the sciences

Recommendations

Based on this study, the researcher recommends the following measures

1. The government needs to have a specific official policy addressing women's participation in the sciences. The study showed that there is no official policy; however, one can not have gender equality in education, without recognizing the existing problem and addressing it.
2. Expansion of science subjects into the rural primary and secondary schools. As indicated in the study rural schools lack the necessary requirements for the teaching of science such as teachers, laboratories and other science equipment. Since science is the gateway to most courses and careers, it is essential that such requirements be provided to rural schools where the vast majority of the population lives.

3. There is a need to establish counseling and career guidance as a discipline in tertiary schools. In addition, counselors should be trained and posted to primary and secondary schools in the rural areas through out the country to provide guidance and counseling to students.

4.An awareness should be developed in the society about the importance of women participating in science courses such as computer science. This means sensitizing parents, teachers and community about the importance of encouraging and supporting women's participation in the sciences.

5. The government needs to be more gender sensitive in awarding scholarships in order to draw more women into higher education and combat gender inequality in education.

6. Structures need to be established for groups advocating for women's participation in the sciences to come together for communication and support.

7. There is a need to establish more single sex schools, since such an environment would contribute immensely to the participation of women in the sciences

8. The government and other higher institutions of higher learning need to provide more educational materials such as computers and text books.

Suggestions for Further Studies

1. It is recommended that this study be extended to include secondary schools. This will help provide a broader in-depth of women participation in the sciences. This is important because students choose subjects at the secondary level before they get to the university.

2. It is recommended that a similar study be extended to institutions of higher learning at a national, since this study only looked at one university.

3. It is recommended that the study be extended to institutions and organizations that support women's' education, to see what they are doing and whether they are effective in impacting policy

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Appendix A

Survey Instrument

Questionnaire on Gender Gap in Computer Science Education

Directions: Please place a check mark (√) in the appropriate space.

1. **Demographics of participants**

1.1 What is your gender?

__Male __Female

1.2 What is your class rank?

__First year undergraduate __Third year undergraduate

__Second year undergraduate __Fourth year undergraduate

2. **Background of participants**

2.1 What is your mother's highest educational attainment?

__Primary school certificate __Advanced Level School Certificate

__Ordinary Level School Certificate __University Degree

2.2 What is your father's highest educational attainment?

__Primary School Certificate __Advanced Level School Certificate

__Ordinary Level School Certificate __University Degree

2.3 Is your mother employed? If so, what is her job?

_____

_____

_____

2.4 Is your father employed? If so, what is his job?

_____

_____

_____

2.5 What is your mothers' income level?

__Low _Middle __High

2.6 What is your fathers' income level?

__Low __Middle __High

2.7 Do you have a computer at home?

__Yes __No

2.8 If you have a computer at home, how often do you use it?

__Most of the time __Sometimes __Not at all

3. **Experiences of Participants**

3.1 How did your parents feel about your taking science subjects in secondary school?

_____

_____

_____

3.2 How did teachers in secondary school encourage you to take science subjects?

_____

_____

_____

3.3 How did fellow classmates react to you taking science courses?

_____

_____

_____

3.4 Do you think computer science is a masculine or feminine oriented subject?

__Masculine oriented __Feminine oriented

__Neutral subject

3.5 What experience made you decide to major in computer science? Choose all that apply

__influence of parents __personal interests

__influence of teachers __both parents and teachers

__ Other

3.6 Did your parents support your decision to take computer science?

_____

_____

_____

4. Interests of Participants

4.1 What first interested you in computer science as a major?

_____

_____

_____

4.2 Why do you think that women are brought up to believe that computer science is meant for men?

_____

_____

_____

4.3 In what ways does society discourage students from taking computer science?

_____

_____

_____

4.4 Do you think educators bring different experiences between women and men in the teaching of computer science?

__Yes __No

4.5 Has your confidence in your ability to do well in computer science increased or decreased since you have been in the program?

__Increased __Decreased

5. Please take a few more minutes to answer the following questions.

5.1 What factors promoted your participation in computer science education?

_____

_____

_____

5.2 What obstacle hinders your participation in computer science education?

_____

_____

_____

Appendix B

Interview Protocol

Qualitative interview Questions: Open ended.

1. What is your educational/professional background?
2. What comes to mind when you think of gender and computer science education?
3. What barriers/obstacles hinder women's participation in computer science?
4. What has so far been done to increase women's participation in computer science?
5. What do you think should be done to promote women's participation in computer science?

Appendix C

Focus Group Discussion Questions

Focus Group Discussion Questions

1. What do you think of computer science?
2. What interested you in computer science?
3. What obstacles/barriers did you face in your study of computer science?
4. What factors encouraged or helped your study in computer science?

Appendix D
Cover Letters

P.O.BOX 271
Oberlin, Ohio 44074.
E-mail:james.ochwa-echel@oberlin.edu

Dear Student,

My name is James Ochwa-Echel, a Ugandan currently pursuing a PhD in Education at Ohio University. I am conducting this research to examine gender gap in computer science education in Uganda. Specifically, to find out the nature of gender disparity in computer science education and the factors that promote/hinder women's participation.

As a student at Makerere's Institute of Computer Science, you have knowledge that can help me in this research. It is within this context that I am requesting your participation in the survey which begins on June 5th 2004. Your participation in this research is voluntary and your confidentiality is assured. Please read and sign the attached consent form if you decide to participate in the study.

The use of data generated as a result of this survey will be restricted to this research, as authorized by Ohio University at Athens, Ohio, U.S.A. However, results may ultimately be presented in formats other than the dissertation, such as journal articles or conference presentations. You have the right to express concerns to me at the address above; to my dissertation advisor Dr. Sandra Turner at Ohio University, Department of Educational Studies, turners@ohio.edu or the Ohio University Institutional Review Board.
The survey will take 20 minutes to complete. Please return the completed survey to the research assistant or designated office.
Thank you for your interests and participation in this study.
Sincerely,

James Ochwa-Echel

P.O.BOX 271
Oberlin, Ohio 44074.
E-mail:james.ochwa-echel@oberlin.edu

Dear Sir/Madam,

My name is James Ochwa-Echel, a Ugandan currently pursuing a PhD in Education at Ohio University. I am conducting this research to examine gender gap in computer science education in Uganda. Specifically, to find out the nature of gender disparity in computer science education and the factors that promote/hinder women's participation.

As an official who is involved in education at the level of teaching, advocacy or policy formulation; you have knowledge and experiences that can help me in this research. It is in this regard that I am writing to request your participation in the interview which begins on June 15th 2004. Your participation in this research is voluntary and your confidentiality is assured. Please read and sign the attached consent form if you decide to participate in the study.

The use of data generated as a result of this interview will be restricted to this research, as authorized by Ohio University at Athens, Ohio, U.S.A. However, results may ultimately be presented in formats other than the dissertation, such as journal articles or conference presentations. You have the right to express concerns to me at the address above; to my dissertation advisor Dr. Sandra Turner at Ohio University, Department of Educational Studies, turners@ohio.edu or the Ohio University Institutional Review Board.
The interview will take approximately 30 to 40 minutes to complete.
Thank you for your interests and participation in this study.
Sincerely,

James Ochwa-Echel

4-27-04
P.O.BOX 271
Oberlin, Ohio 44074.
E-mail:james.ochwa-echel@oberlin.edu

Director,
Makerere Institute of Computer Science
Makerere University
Kampala, Uganda

Dear Sir,

My name is James Ochwa-Echel, a Ugandan currently pursuing a PhD in Education at Ohio University in the United States. I intend to conduct research to examine gender gap in computer science education in Uganda. I am therefore writing to seek permission to gain access to Makerere's Institute of Computer Science to carry out the research.

My choice of Makerere as a site of study is a result of extensive research which shows that no study has been done on gender gap in computer science education in Africa in general or in any particular African country. In order to bring clarity to the situation, I decided to carry out the study in Uganda and particularly Makerere. The choice of Makerere is based on the fact that it is the pioneer University to introduce computer science in Uganda.

The timeline for the research is from June 5, 2004 to July 30, 2004. During that time period, I intend to survey all undergraduate students at the Institute pursing the B.Sc. in Computer Science and to interview some female faculty members. Other than cooperation from students and faculty no resources will be required and my presence at the Institute will not be disruptive.

Data generated as a result of the study will be restricted to the research, as authorized by Ohio University at Athens, Ohio, U.S.A. However, results may ultimately be presented in formats other than the dissertation, such as journal articles or conference presentations. I

also strongly believe that the information obtained from the research will help Uganda in formulating gender responsive policy in the area of computer science. Thank you for your consideration,

Sincerely,

James Ochwa-Echel

Author

Ochwa-Echel, James Rogers Ph.D. June 2005

Major

Curriculum and Instruction: Instructional Technology

Title

Gender Gap in Computer Science Education: Experiences of Women in Uganda (197 Pages).

Abstract

The purpose of this study is two-fold: to investigate the nature of the gender gap in computer science education in Uganda and to understand the factors that influence gender differences in computer science education in Uganda.

Data collection for the study was done in three stages. In the first stage all the 600 male and female undergraduate Bachelors of Sciences in computer science students at Makerere University were surveyed during a six week period from June 15th to July 30th 2004. 200 students responded to the survey yielding a 33.3 percent response rate. The second stage in data collection consisted of a series of qualitative interviews. Two participants each were selected based on purposeful sampling from Makerere University's office of Gender Mainstreaming, the Forum for African Women Educationalist, the Technology Committee of the Parliament of Uganda and Makerere University's Institute of Computer Science. The third stage in data collection consisted of focus group discussions. There were three focus groups: 5 male undergraduate students of computer science, 5 female undergraduate students of computer science and 5 female graduate students of computer science. Volunteers were asked from within the computer

science student population. Data analysis involved quantitative and qualitative techniques.

The findings of the study indicate that there is a gender gap in computer science education. There were 511 male students and 89 female students in the undergraduate program. The reasons for the gap were revealed in the interviews, survey and focus group discussions. The study concluded that several policy measures need to be taken to address the gender gap in computer science education in Uganda.

Approved_____