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Exploring the Gender Gap in Computer Science Education in Uganda

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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. The findings of the study indicate that there is a gender gap in computer science education. The reasons for the gap were revealed in the interviews, surveys 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.

KEYWORDS
Gender gap; computer science education; Uganda

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Gender Gap in Computer Science Education: Experiences of Women in Uganda

STATEMENT OF THE PROBLEM

Women throughout the world continue to be denied equal access to the opportunities enjoyed by men in computer science education. According to various studies (see Huber & Schofield, 1998; Levin & Gordon, 1989; Margolis & Fisher, 2002; Sanders & Stone, 1986; Shashaani, 1994; Sax, 1994; Turkle, 1995; Valian, 1998) the low participation of women in computer science education might be attributed to factors such as computer science 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, 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 that of men (FEMSA 1997a). 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.

METHODOLOGY

This study sought to investigate the gender gap in computer science education in Uganda. The questions that the study sought to address were:

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?

This study utilized a combined quantitative and qualitative methodology, also referred to as 'triangulation' (Babbie, 2004; Creswell, 1994). The qualitative research approach consisted of in depth face-to-face interviews and focus group discussions. The quantitative approach consisted of a survey method, which employed open-ended and closed questions.

The main study site was Makerere University Institute of Computer Science. Located in Kampala, Makerere University 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. Makerere University Council established the Institute of Computer Science in 1986. It offers courses leading to the awards of Certificate in Computer Science applications; Bachelor of Science in Computer Science; Master of Science in Computer Science; and Postgraduate Diploma in Computer Science. In

the 2003/2004 academic year the institute had about 25 faculty members, 300 graduate students and over 600 undergraduate students (Makerere University Institute of Computer Science, 2004).

The method used for the selection of participants was 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 (Patton, 1990, p. 169). In this study, the participants qualified as an appropriate sample given their knowledge and immediate and personal experience of computer science education in Uganda. The participants for the study consisted of four clusters (the first three clusters participated in 2004 and the fourth cluster participated in 2008).

Once the participants were recruited, they were briefed about the topic to be discussed. Consent to tape record was obtained from the participants on the day of the discussions. A discussion guide, which included specific questions, was used. Although the researcher was present during the discussions, the two all-female focus groups were moderated by a female research assistant. The purpose of this was to make the participants feel at ease. The all-male focus group was facilitated by the researcher.

Survey

The first cluster consisted of all the 600 male and female undergraduate Bachelor of Science in Computer Science students, who were surveyed during a six-week period (qualitative interviews and focus group discussions took place during the same period).The development of the survey questionnaire was based on the analysis of a literature review. It was particularly designed to elicit information about each student's background (the economic social status of the students), history (the educational history of both the students and parents), experiences and interests. Special attention was focused on the roles 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.

Initial Interviews

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; and , five women faculty members from Makerere University's Institute of Computer Science.

The purpose of the interviews was to gain a greater depth of understanding about the issue being studied. Semi-structured interviews using open-ended questions were conducted. Questions asked were mostly related to education policy and were specific to gender and computer science education in Uganda.

Initial Focus Groups
The third cluster, which participated in the focus group discussion, was made up of five male and five female undergraduate Bachelor of Science majors in computer science as well as five women graduate students in computer science. A focus group offers a more in-depth understanding of the participant's perspective or opinion and allows the researcher to capture the comments and evaluate them. Having more than one focus group ensured the best representation of the sample and allowed for comparisons between the groups (Edmunds, 1999).

Follow-up Interviews and Focus Groups
The fourth cluster, which participated in the follow up interview and focus group discussions in 2008, consisted of some interviewees that had been interviewed in 2004 (two representatives from Makerere University's Office for Gender Mainstreaming, five women faculty members from Makerere University's Institute of Computer Science); and five female and five male undergraduates as well as five female graduate students who had joined the computer science program in 2008. The follow up interviews and focus group discussions were done to assess whether there had been some changes within the computer science program since the initial study in 2004.

RESULTS

The results from the study are:

Survey
Response rate and gender of participants
Two hundred students responded, yielding a 33% response rate. The response rate is lower than expected because not all students completed the questionnaires in class. Of these responses 151 were from male students and 49 from female students.

Class Rank
Of the 200 respondents, 198 provided their class rank (Table 1)

Table :1 Numbers of participants by gender and class rank.

	Total		**Male**		**Female**	
Year	No.	%	No.	% of total	No.	% of total
1	65	32.8	38	19.2	27	13.6
2	47	23.7	40	20.2	7	3.5
3	83	42	71	35.9	12	6.1
4	3	1.5	0	0	3	1.5

Parents' Educational Attainment
Students were asked to provide their parents' level of educational attainment. All the respondents provided their mothers' level of education: n= 151 males and n= 49 females (Table 2). The data also revealed that as the mothers' educational attainment is primary level there are few males and females taking computer science: n= 16 males, n= 5 females. However, when the mothers' level of

education rises to university degree, the number of males and females rises to n= 56 males and n= 26 females. This result suggests that mothers' with a high educational attainment tend to support their children's participation in computer science without regard to gender.

Table 2:Mothers, educational attainment

Gender	Primary School	Ordinary Level	Advanced Level	University Degree	Total
Male	16	33	44	56	149
Female	5	8	10	26	49

With regard to their fathers' level of education, 194 (n= 145 males and n= 49 females) respondents provided this information (Table 3). The data also showed that when the father's educational attainment is at the primary level, the number of males and females taking computer science is the same: n= 5 males and n= 5 females. However, when the father's educational attainment is at ordinary level, advanced and university level, there are more males than females taking computer science: n= 20 males, n= 3 females; n= 27 males, n= 5 females and n= 93 males, n= 36 females.

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

Table 3: Fathers' level of educational achievement.

Gender	Primary School	Ordinary Level	Advanced Level	University Degree	Total
Male	5	20	27	93	145
Female	5	3	5	36	49

Parents Income Level

Students were asked to provide their parents level of income. There is no criterion for level of income; it is based on self-reporting by students. With regard to their mothers' income level, 171(n= 133 males and n= 38 females) respondents supplied this information (Table 4). The data also showed that when the mother's income level is low and middle, there are more males than females taking computer science: n= 50 males, n= 8 females; n= 77 males, n= 27 females. The number of males compared to females drops when the mother's income level is high: n= 6 males, n= 3 females.

Table 4: Mothers' level of income.

Gender	Low	Middle	High	Total
Male	50	77	6	133
Female	8	27	3	38

With regard to their fathers' level of income, 173 (n= 133 males and n= 40 females) respondents supplied this information (Table 5). The data showed that

when the father's level of income is low and middle, there are more males than females taking computer science: n= 34 males, n= 8 females; n= 68 males, n= 17 females. The number of males compared to females drops when the father's level of income is high: n= 31 males, n= 15 females.

Table 5: Fathers' level of income.

Gender	Low	Middle	High	Total
Male	34	68	31	133
Female	8	17	15	40

These results show that mothers and fathers support more males than females to take computer science when their income level is low and middle. There is an increase in the number of females supported (though still lower than males) when the parents' income is high.

Gender and Computer Science Subject

Students were asked whether they thought computer science is a masculine or feminine oriented subject. One hundred and ninety nine students responded to the question (Table 6). The data showed that although some male (n= 21) participants considered computer science to be a masculine subject, none of the female participants considered it to be so.

Table 6: Perceptions of computer science as a masculine/feminine orientated subject.

Gender	Masculine	Feminine	Neutral	Total
Male	21	3	127	151
Female	0	2	46	48

Gender and Educators in Computer Science

Students were asked whether they thought male and female educators brought in different experiences to the teaching of computer science. A total number of 195 (n= 146 males and n= 49 females) respondents answered this question (Table 7). The data further showed that n= 63 males and n= 17 females agreed that male and female educators brought different influences into the teaching of computer science. However, n= 83 males and n= 32 females disagreed. The result suggests that a high percentage of both male and female students disagreed that male and female educators brought different influences into the teaching of computer science.

Table 7:Perceptions of the influence of the gender of educators.

Gender	Yes	No	Total
Male	63	83	146
Female	17	32	49

Gender and Confidence in Computer Science

A total of 198 (n= 149 males and n= 49 females) respondents answered the question relating to whether or not their confidence level has increased since joining the program (Table 8). The data further showed that n= 134 males and n=

47 females agreed that their confidence level increased after they joined the program compared to n= 15 males and n= 2 females who felt that their confidence level did not increase. The result suggests that the majority of both male and female students agreed that their confidence level increased since they had been in the program.

Table 8: Increase/decrease in levels of confidence.

Gender	Increased	Decreased	Total
Male	134	15	149
Female	47	2	49

Qualitative Results

A total number of 11 participants were interviewed and 30 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. 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. Relevant quotations of the interviewees were also included to illustrate the context and tone in which the interviewees responded to the questions.

DISCUSSION

Data collected in this study were analyzed using both quantitative and qualitative techniques, and then 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 questions.

What is the Nature of the Gender Disparity in Computer Science Education in Uganda?

The data revealed that there is a gender disparity in computer science education at Makerere University. This condition is indicative of the situation in Uganda since Makerere as the country's premier university is the only institution which has a computer science institute with the infrastructure and capacity (was built and funded by a grant from the government of Norway) to offer a wide range of courses which range from certificate courses to post graduate degrees. Students are also admitted from all parts of Uganda since the university is a public institution. There are many more men than women studying the courses. A list provided by the Director of Academic Affairs also showed that there were 89 female students out of a total of 600 in the undergraduate computer science program in the 2003/2004 academic year. A follow up interview and focus group discussions in 2008, showed that the disparity still exists. This was confirmed by a list provided by the Dean of the Institute of Computer Science that showed that there were 1323 students in the undergraduate program in the 2008/2009 academic year: n= 1021 male students and n= 302 female students.

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 female faculty member 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 suppose 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 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 girls shy away. She wondered aloud whether it was due to factors such as the young age at which these girls would be (age makes a difference because the older a person is the more resilient one maybe able to face challenges), or pressure from the community.

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.

The findings of this study would appear to confirm the argument of social reproduction theorists that schools are agencies of socialization that do more than teach students how to read, write, compute and master the content of subjects such as history, social studies and sciences, but are also sites of reproduction of unequal relations (Mehan, 1980). 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).

The findings also compare with a FEMSA (1997a) study which found that the performance of girls in mathematics and science subjects (gateway to computer science) at the primary and secondary levels were generally poorer than boys, leading to a low number of girls joining the science and computer science disciplines at the university level.

What Factors Promote Women's Computer Science Education in Uganda?
The study identified various steps 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 Uganda Ministry of Education.

Scholarships
FAWE provides scholarships to girls in secondary schools. The schools are identified by FAWE as 'core schools' or girls' schools that are performing well in the sciences. Currently there are 49 'core schools' in 49 of the 56 districts in Uganda. The recipients of these scholarships are mostly from low-income families. They are selected based on 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 a member of FAWE staff:

> The scholarships we (FAWE as an organization) 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.

Educational Materials Programs
In addition to providing scholarships to girls, FAWE has also equipped the core schools with science books and laboratory equipment to build their capacities in science education. Some teachers have also been trained in career guidance to help the students make decisions, especially in regard to science courses. Some teachers are also sent to the United Kingdom on an annual basis through a program sponsored by the UK 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.

Positive Role Models
FAWE also established a mentoring program to provide positive role models. A FAWE staff member 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 areas and the district primary schools they come from to encourage girls to do sciences."

FAWE has also organized science camps. Girls from rural schools are exposed to computers at the best equipped laboratories within the urban schools and are taken

to tour Makerere University's Institute of Computer Science and other science departments. The main objective according to one member of 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."

A graduate student who works at the Institute of Computer Science, and who 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 results of this study support the argument made by Steel (1992), who wrote "a critical component of reducing the vulnerability of women students in traditional male fields is for students to feel valued by the teacher for their potential". Steel considers building a relationship of respect between a teacher and women students to be the "first order of business at all levels of school" (p.77).

What Factors Hinder Women's Computer Science Education in Uganda?
The study also revealed various factors that hinder women's participation in computer science education as well as factors that affect both men and women, such as: lack of educational materials, and lack of well trained computer science instructors. Nonetheless, only gender specific factors will be addressed as follows:

Discouragement by Society
The role of societal discouragement was found in the surveys. 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 and 32 stated that society discouraged them by claiming that computer science is a 'hard' and 'difficult' subject. On the other hand, 15 male students out of 151 who participated in the survey stated that society discouraged them from taking computer science because it is 'hard' and 'difficult' subject.

The result of this study seems to suggest that societal discouragement of women from taking computer science seems to be based on a gender bias.

The feeling that society discourages female students from taking computer science was also expressed in the interviews. According to a FAWE staff member, "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." Another faculty member agreed: "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."

The results of this study confirm those of earlier studies by Canter (1979), Davies and Kandel (1981), Eccles (1987), Houser and Gravey (1985), and Margolis and

Fisher (2002), which reported that gender differences in attitudes towards computer science have originated in the way that males and females are brought up. 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

All the 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 the relationship 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 results of this study confirm the findings of a FEMSA (1997b) study that found that some fathers were of the view that educating women is a waste of money because they would end up leaving the household. The benefits of an educated woman would thus accrue to whoever she would then be living with.

Lack of Support by Peers

Lack of support by peers was also revealed as a hindrance. All the female students who took part in the focus group discussions stated that some of their male classmates reacted negatively to their taking computer science. A female graduate student noted, "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) that found that most female students 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. This is supported by Zeldin and Pajares (2000) who found that:

> The most important factor in the enhancement of self-efficacy beliefs of women in mathematics related careers was the confidence that significant others expressed in the women's capabilities. Women seem to rely extensively on the accompanying confidence development from the relationships in their lives while they were honing their mathematics related skills. Relational episodes gave birth to relational confidence developed by others, and this relational efficacy informed their judgments on their own abilities profoundly (p.239).

Since this aspect of peer dynamics appears to be all too common in computer science, it is important to take into account the key roles social relationships play in women's persistence.

Urban/Rural Differences
According to the World Development Indicators (World Bank, 2003), only 15 % of the Ugandan population live in the urban areas. Most participants who were interviewed and 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 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. 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.

The findings above confirm a study by Kwesiga (2002) that revealed that the single most important independent cause of educational inequalities in Sub-Saharan Africa is that the majority of the population lives in the rural areas. It is therefore clear that in order to improve women's participation in computer science, some intervention needs to be initiated to address the rural/urban cleavages so that women can start taking sciences 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, which helps students to learn to make appropriate choices as they prepare for the working world, is only one aspect of the total guidance program. 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.

When the all female graduate focus group participants were asked what they thought was preventing more women 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 such as computer science, but by then it will be too late."

This study confirms Kwesiga's (2002) findings. She found that career guidance and counseling has not generally received the attention it deserves in the Ugandan educational setting. Counseling as a discipline does not even exist in schools and institutions of higher learning, and yet various studies and examples have shown that students, and especially girls, need advice on improving self esteem and building confidence. The judgment that guidance counselors make and the encouragement they give (or not) to take certain courses affects how students see themselves and the type of courses they choose.

Lack of Mentors and Role Models

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

> 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.

A faculty member reiterated the importance of having women role models and mentors as a way 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.

Again this study supports Kwesiga's (2002) findings which cited, the relative absence of women teachers in science subjects within co-educational institutions as one of the reasons why girls did not enjoy or take up mathematics and science related subjects. Having single sex schools where women would teach and mentor female students might go a long way to support women's absorption and retention in the sciences.

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

The studies thus show that having women role models and mentors for girl students, especially in the rural schools would go a long way to help more women become interested in science courses. It also further suggests that having single sex girls schools where women would teach women, mentor and be role models for

them could contribute 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 faculty member 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 participants in the all female graduate focus group argued that these advocacy 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 group's 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 findings of this study suggest 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
A faculty member emphasized the lack of an official policy with specific regard to computer science. When asked what the government was doing to increase women's participation in computer science, 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 parliament's 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." This would suggest that the Government seems to operate on the premise that there is no gender inequality in the sciences.

The finding confirms Kwesiga's (2002) findings that there was no institutional body within the Ministry of Education in Uganda that is charged with planning women's education.

Lack of Scholarships

Up until the late 1980s, the government automatically sponsored men and women who qualified to join government-aided universities. However, due to the liberalization of the economy the government has removed subsidies to the education sector leading to very few students being sponsored. Although the situation affects both male and female students, it has particularly adverse implications for women 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 was expressed by a female graduate student who is employed at the institute, is representative 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 a way to get funding, I am sure we can get more female students here.

The findings above confirmed a FEMSA (1997c) study, which found that, as the costs of science related courses are more expensive than Arts, poverty is a major factor that hinders women's education in mathematics and sciences.

Computer Science Anxiety

The study revealed that the term 'computer science' brought a lot of anxiety to some women and may be a major source of discouragement for them participating in computer science. According to a FAWE staff member, "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 this perception of anxiety when 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.

The findings confirmed studies by Collis (1987), Hawkins (1987), Sax (1994), and Seymour and Hewitt (1997), which found that it is the anxiety that the 'masculine model' imposes on science and mathematics which women transfer directly to the study of computer science. AAUW (2000) supported the finding when they found that computer science classes were often "bastions of poor pedagogy" (p.41), with teaching examples that often embed male dominated interests and activities, and often with little in the materials to engage girls. It called for the envisioning of computer science education, with more attention being paid to the application and impact of the technology through interdisciplinary problem solving assignments.

Brunner (1997) also supported the idea of differing 'masculine' and 'feminine' engagement with technology. He observed "The feminine take on technology looks right through the machine to its social functions, while the masculine view is more likely focused on the machine itself" (p.55).

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. It can be used as a foundation for the formulation of 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 should develop a specific official policy addressing women's participation in the sciences.
2. Science subjects should be expanded into the rural primary and secondary schools.
3. Counseling and career guidance as a discipline should be established in tertiary schools, and counselors should be trained and posted to primary and secondary schools in rural areas.
4. Awareness should be developed in society about the importance of women participating in science courses such as computer science.

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. More single-sex schools should be established to provide role models for female students.
8. More educational materials such as computers and textbooks should be provided.

Suggestions for Further Studies

1. This study can be extended to include secondary schools to provide a more in-depth understanding of participation by girls in the sciences. This is important because students choose subjects at the secondary level.
2. Research can be extended to other institutions of higher education at the national level.
3. Research can be extended to organizations that support women's education, to see what they are doing and whether they are effective in impacting on policy.

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