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How the participation in STME clinic encourage female students to continue the study of Science, Technology and Mathematics in higher institutions.

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Abstract

The study assessed how the participation in Science Technology and Mathematics Education (STME) clinic encourage female students to continue the study of science, technology and mathematics in higher institution. The research design used was the descriptive survey. Convenient sampling method was used in selecting the participants for the study. A total of 157 female students from Senior Secondary Schools in (12) twelve districts in the Central Region participated in the study.

The study revealed that there was no statistically significant improvement in the performance of females in mathematics as well as in science. However, the study indicated a remarkable change in the females' attitude towards the study of the subjects.

In addition, the study shown that participation in the STME clinic goes a long way to motivate the participants to continue the study of science technology and mathematics in higher institutions and edges them to take a science oriented careers.

It is recommended, among others, that the clinic coordinators should give much attention to activities that will help improve test results in science and mathematics. It is also recommended that Junior Secondary School girls who participate in Form one should be made to attend each year till they get to the third year of the senior secondary school.

Keywords: Technology, clinic, participation, career guidance.

Introduction

The world has become a global village as a result of developments in science and technology and any nation that overlooks the study of science and technology would be left behind in the quest for development. Baah-Wiredu (2003) stated that the capacity of science and technology to change a person's attitude to accept new things and new ways of doing things to improve quality of life cannot be overemphasized. He continued by saying that there is the need to encourage both the young and old to realize in no uncertain terms, that the only way to level up with the developed world is through a definite desire to process scientific knowledge and skills and apply them to better our lot as a people. Isenberg and Altizer (1994) also stated that knowledge in mathematics and science is very important in determining a nation's success in the world today and in the future.

It is an undeniable fact that no nation could draw level with the scientific and technological revolution in the world today without paying attention to the development of her education. As a result of the scientific revolution, many countries including Ghana are making efforts to allocate funds to the educational sector for the development of science and technology.

The government of Ghana in recent times has taken giant steps to make education relevant to the needs of the society. This has been done through a series of Educational Reforms. The 1987 educational reform placed

emphasis on vocational, technical and science education. There cannot be industrialization without the pursuit of science and technology. It is therefore, imperative that governments invest in human resources to make the nations advance in the field of science and technology.

In Ghana's Vision 2020 document, education is to produce the manpower needs of the nation and to lay the foundation for an educational system that will meet the needs of a technological based-economy. The demand on Ghana to be abreast with the rest of the world in science and technology places a responsibility on the educational sector to provide the pre-requisite human resource development base to properly manage the country's economy. This national aspiration would easily be realized if girls, the future mothers, are well grounded in the knowledge and skills of science and technology.

In spite of these scientific and technological developments, many adolescent girls in senior secondary schools in Ghana do not choose to study higher mathematics or to pursue science related courses to any appreciable or recognizable heights. Instead, they study courses considered 'appropriate' for women by society. Recent research indicates that girls pursue careers deemed proper for women by society, and do not follow career paths that may be considered non-traditional (Fran, 1993). As a result of limited mathematical background and training, these girls are denied access to technological careers and management positions when they reach womanhood and enter the job market. Girls today are expected to be competing in the highly technical world of the information and computer age of the twenty-first century, therefore, a reversal of the situation that arises in adolescent girls must be addressed at an early age.

Studies have attributed the low participation of girls and women in science and technology to a number of factors which can be grouped under three broad headings: (a) socio-cultural values, (b) societal expectation and, (c) educational practices. Socio-cultural values include views and beliefs of traditional society. The Ghanaian society is saturated with traditional norms and values that dictate the roles and activities of the two sexes (Anamuah-Mensah, 2000). There is a general traditional view that women are fragile and should not be made to perform strenuous activities. There is also the belief that the women's place is in the kitchen and in the care of children and they are to be seen and admired but not to be heard (Anamuah-Mensah, 1995). The girl in the family is expected to be trained by the mother to perform household chores, learn a trade or marry while the boy is trained by the father to provide social security for him in his old age. The view is that when a girl marries she becomes the property of the husband (Anamuah-Mensah, 1995). There is a strong belief, therefore, that educating females is a waste of time since they would be lost to the family when they marry.

Another value is the kind of activities that boys and girls are encouraged to engage in, for instance, the play materials that are intentionally (or unintentionally) provided for girls and boys when they are young and the task they are made to perform in their homes heightens the roles they are to play when they become adults. While boys get car and gun toys, girls receive dolls.

Jaarsma (1987) argued that as a result of the activities they engage in and the role mapped out for them, girls tend to be relationship-oriented or person-oriented or object oriented. What this means is that a girl would opt for subjects in the humanities. Where science and technology subjects are chosen, these tend to be in nursing and home economics.

Parental attitude and low level of education have also been cited as factors contributing to the low enrolment of girls in science and technology. Addae-Mensah, Djangmah and Agbenyega (1973) argued that parents' educational background as well as their socio-economic status influences the enrolment of girls in schools. They observed that only 35 percent of children of illiterate parents were enrolled in secondary schools throughout the country at the time. Parents' frequently serve as role models for their children. As a result, girls may want to be like their mothers.

Other socio-cultural factors contribute to the marginalization of females in science and technology. For example, teenage pregnancies contribute to a high dropout rate for girls at the secondary level. Coupled with this are early

marriages in some sub-cultures. Certain religious practices such as offering female children to fetish priests and priestesses do contribute to the marginalization of girls in science and technology (Anamuah-Mensah, 1995).

In poor homes where only one or two children can be sent to school, parents usually select boys to attend school because they see the opportunity costs as less and return for their investment as greater since boys have a greater chance to be employed into more lucrative jobs (Du Plessis, 1991).

Another factor that has been cited by Du Plessis (1999) in his study has to do with social expectations. One notion with regard to this is the negative notion of the public. There is a negative notion that the higher education of female university graduates makes them arrogant, sophisticated and discontent and even sometimes immoral and, therefore, "unmarriageable". Higher education is also believed to make it difficult for girls to find husbands, to be good wives and to be good cooks (Du Plessis, 1999). Furthermore, there is a public perception that science and technology subjects are for males only. Females are made to think that they are encroaching on the secret domain of males. A girl who excels in mathematics or science is branded as a witch by her peers and even teachers. It is believed that the low career aspirations of and for girls in science and technology as men held by employers and the rest of society exacerbate the exclusion of women in science-related occupations.

The expectations and behaviour of science and technology teachers have been found to contribute to the low participation of girls in science and technology. Teachers even those in girls' institutions, have been observed to express surprise when girls perform well in their science, mathematics and technology classes (Okeke, 1986). According to Okeke this surprise is not shown in home economics, general arts and visual arts classes. He went on to say that there is also evidence that some science and technology teachers unintentionally become oblivious of the females in their classes. Studies have shown that teachers perceive science as more important for boys than for girls (Okeke, 1986). The gender-stereotyping of science, mathematics and technology as masculine leads to de facto encouragement of boys in these subjects to the detriment of the girls. In the classroom, both male and female science teachers tend to call on boys more than girls to either answer questions or perform an activity. The teachers respond quickly to boys' call for assistance and give derogatory comments to female students but give positive reinforcement to boys (Du Plessis, 1999).

The school science and technology curricula are seen to be biased against girls and women. In a research by Erinosho (1997) in Nigeria on female participation in science, Erinosho (1997) analyzed secondary school curriculum materials and observed that, although the educational system ostensibly gives equal access to both sexes, curriculum materials covertly mold the consciousness of pupils to identify with a particular sex. According to Erinosho (1997), analysis of textbooks have shown to a very large extent how school texts reflect sex bias: they fail to give full due to the range of activities of both sexes; they incorporate values and assumptions which downgrade and devalue women's experience and achievement; they omit the actions and achievement of women; they demean women by using patronizing language; show women or men only in stereotyped roles with less than the full range of human interests, traits, and capabilities; and seldom expose girls to literature that deal comprehensively with aspects of their own lives. It was concluded that textbooks and other supporting materials do not portray girls and women as playing important roles in science and technology (Erinosho, 1997). Such images of girls and women do not encourage the promotion of girls' participation in science and technology.

Teachers' lack of awareness of the different pedagogical needs of boys and girls is also a constraint to female participation in science and technology. Above all, the number of female science and mathematics teachers in the secondary schools who could be role models is very low when compared to their male counterparts. Available data in Ghana for 1989 indicated that women formed 20 percent of the total number of graduate science teachers.

To increase the representation of girls and women in science and technology, the barriers referred to above need to be addressed. In view of this, the Ministry of Education (MOE) has demonstrated its focus on the education of the Ghanaian girl-child by the establishment of a Girls's Education Unit (GEU) in 1997 within the Ghana Education Service under the Basic Education Division. Provision has been made in the Free, Compulsory and

Universal Basic Education (FCUBE) programme to enhance the participation of more girls in science, technology, and mathematics education (STME). The unit was established to support the organization of STME activities which was in existence ten years before its establishment.

The STME clinic is a project for girls that aim at increasing the participation of girls in the field of science, mathematics and technology. Since its inception in 1987, the STME clinic has become an annual event where girls from both junior and senior secondary school (JSS & SSS) are exposed to science, technology and mathematics so that they may develop an interest in these subjects. Apart from exposing girls to science, technology and mathematics subjects, the clinic also strives to improve the methods teachers use when teaching these subjects to all students.

The objectives of the STME clinic as stated in the 1998 Clinic report are to:

1. Make participants aware of the gender stereotypes that inhibit females from entering science, technology and mathematics-based occupations and how they can overcome these stereotypes;

2. Encourage girls to study the full range of science and mathematics-related subjects in secondary schools;

3. Make participants aware of the STME in various occupations and in the production of goods and services

4. Prove to participants, through role models, that women can succeed in science, technology and mathematics-based occupations and at the same time maintain normal family life;

5. Provide opportunities for participants to explore science and mathematics-based careers through firsthand experiences and

6. Create opportunity for participants to improve their skills in observation and science problem-solving, through the development of science projects.

The STME clinic continued to carry out its objectives under the Girls' Education Unit until 1997, when it was decentralized to include basic schools in all regions of the country. This was followed by the Regional Clinics and in 2002 it became a district level programme. In 2003, the programme was extended to include boys. The decentralization came about out of a growing concern and a perception, which not only stems from Ghana but also from other developing countries as well as, about the apparent exclusion of boys from a motivational programme like STME clinics.

The Intervention Activities of the STME Clinic

The content of the science, technology and mathematics education clinic for girls was planned in such a way as to give unique orientation to girls and to expose them to situation that are not normally covered in the formal school system. The clinic also gave the girls exposure to the processes involved in the production of goods and services in various industries, the natural environment, and the use of computer, women in various fields of science and to a wide range of science-related occupations. The main activities of the STME clinic include the following;

a) Exhibition of science projects by girls in a science fair section

b) Developing projects based on topics treated at the clinics

c) "Hand-on" activities which include the use of teaching aids like overhead projectors, videos, charts and specimens to help girls understand and appreciate scientific issues better.

d) Quiz competitions, film show

e) Educational visits to places of scientific interests such as; industries, research departments, computer firms, integrated farms, zoo, medical schools, air force base, hydroelectric power generation plants among other.

f) Talks by women to provide the girls with the knowledge of women in science-related occupations, industries, production of goods and services and the use of computer.

One purpose of the STME clinic within the Free, Compulsory, Universal, Basic Education (FCUBE) programme was to expose ten thousand (10,000) girls from basic and senior secondary schools to science, technology and mathematics education (STME) clinics by the year 2000 with the hope that at least 30% to 35% of girls would choose science as an elective subject at the senior secondary level. Whether the organization of the STME clinics is having any impact on the choice of science and its related subjects by girls in higher institutions is the main focus of this research.

Statement of the problem

The under-representation of women in science, technology and mathematics has attracted worldwide attention in recent years. Statistics in Ghana show that at the primary school stage, the ratio of girls to boys is nearly 1:1, but this ratio gradually reduces with progression on the educational ladder. The ratio becomes even lower as subject groupings occur in the higher levels of education, where very few girls study science and mathematics (Ghana Education Service, 1997).

Like other developing countries in the world, Ghana embraced science and technology immediately after independence. Science and technology have been seen as the panacea for overcoming problems of poverty, disease, illiteracy, overpopulation, insanitary conditions, high fertility rate, high maternal mortality and low gross national production (GNP), which are major indicators of underdevelopment.

It has been argued that only a direct display of commitment by the government through legislation and educational programme and the cooperation of the entire community can bring about the eradication of the gender disparity in science and technology (Anamuah-Mensah, 2000). Ghana need scientists and technologists but it cannot afford to leave behind half of the population, the feminine citizenry in the development of this human capacity. Girls and women need to be empowered through science and technology in order to make them productive.

According to Krienburg (1986), “women must gain equal access to the resources of mathematical competence” (p.6).The National Science Board Commission on Pre-College Education in Mathematics, Science and Technology (1993) further argued that grounding in mathematics should be available to all students who are the most important assets of America. The commission also considered mathematical skills as a fundamental pre-requisite to successful living in the coming century.

Hearne (1986) proposed that although it is difficult to change a person’s belief system, there are workshops that can institute such changes. Hearne (1986) also cited a variety of workshops and programmes that would change the perceptions of teachers.

To address the gender imbalance in the participation of science, mathematics and technical subjects in the senior secondary schools and other higher levels of education, the Ghana Education Service (GES) in 1987 instituted a science programme for girls known as Science, Technology and Mathematics Education (STME) Clinic. Available studies (Quashie, 2005; Anamuah-Mensah, 1996) on the programme since its inception 18 years ago, seems not to have explored the effect of the STME on the selection of science and its related subjects by girls in higher institutions.

The report on the STME Zonal Clinic (1997) indicated that the programme has significant impact on female participation in science and technology education in Ghana in recent years. In spite of this achievement, one is tempted to ask whether the STME clinics have had any significant improvement on the performance of girls in the science and its related subjects in the Senior Secondary Schools. Other questions that can be asked are: Are

the choices of science and its related subjects in higher institutions influenced by participation in the STME clinic? Is the organization of the clinics having any positive impact on the attitude of girls in science and mathematics? Does the career guidance given to the girls at the clinic make them choose to pursue science, technology and mathematics related careers? Answers to these questions can only be ascertained through a thorough investigation of the impact of science, technology and mathematics education clinic on the performance of girls in science and its related courses in Senior Secondary Schools in Ghana.

Purpose of the study

The purpose of the study was to investigate the impact of the organization and attendance of the STME clinics for girls in Ghana on the performance of girls in the science and mathematics in Senior Secondary Schools. Secondly, the study was to find out whether the choices of science, mathematics and technology related careers by girls are influenced by their participation in STME clinics. In addition, the study investigated whether STME clinics have had positive impact on the attitude of female students and thus have motivated them to continue the study of science and mathematics in high institutions.

Hypothesis

1. HO: No statistically significant improvement exists in the performance of girls who participated in the STME clinic in Mathematics in the Central Region

H1: There is a statistically significant improvement in the performance of girls who participated in the STME clinic in Mathematics in the Central Region

2. H0: No statistically significant improvement exists in the performance of girls who participated in the STME clinic in Science in the Central Region

H1: There is a statistically significant improvement in the performance of girls who participated in the STME clinic in science in the Central Region.

Research Question

1. How does the participation in STME clinic encourage female students to continue the study of science, technology and mathematics in higher institutions?

Methodology

The research design for the study was the descriptive survey research with quantitative methods of data collection. The population for the study comprised all students from both the senior secondary and junior secondary schools who participated in the 2004 STME clinic in the Central Region of Ghana. There were twelve districts in the Central Region in the year under consideration.

The study was conducted in all the twelve districts. The purposive sampling technique was used in selecting the 195 female respondents for the study. All the 195 female students who participated in the STME clinic from a number of selected secondary schools in the region were selected for the study but 157 participated in the study.

Findings/Discussions

Research Question One

Table 1: The extent to which participants were encouraged to pursue STM in higher institutions

Response	Frequency	Percentage
No extent	1	0.6
Large extent	54	34.4
Very large extent	102	65.0
Total	157	100

From Table 1 (0.6%) had no encouragement, 54 (34.4%) and 102 (65.0%) had to a large and very large extent encouragement respectively to pursue courses in STM in higher education. This means that in general the girls had been encouraged to pursue science and mathematics in higher institutions.

Hypothesis

Ho: No statistically significant improvement exists in the performance of girls who participated in the STME clinic in mathematics in the Central Region. The hypothesis was tested by using data from students' end-of-term examination scores in mathematics. The test scores of 130 girls out of the 157 who participated in the programme in 2004 were used. The scores for the analysis were obtained by computing the average score of each student from the scores obtained in three terms in each of the two years. The result is presented in Table 2.

Table 2: Paired sample t-test on performance in mathematics using end of term examination scores

Year	Mean	SD	t	Df	SEM	p
First year (pre-participation)	57.71	14.886				
Second year (post-participation)	57.47	13.035	.202	129	1.168	.840

A paired sample t-test was conducted to evaluate whether the girls' performance in mathematics improved after their participation in the STME clinic. The result indicated that the difference in the students' performance is not statistically significant (SEM = 1.168, t (129) = .202, p = .840). The researcher therefore failed to reject the null hypothesis at 0.05 alpha level of significance. The result shows that no significant improvement had resulted from the performance of the girls in mathematics from the clinic.

Research question 1 sought to find out the extent to which participation in the STME clinic encourages the female participants to pursue science and its related courses in the universities and polytechnics. The results indicated that generally, the clinic has encouraged the girls to pursue science courses. Analyses of responses indicated 65% of the girls asserting that they were motivated to a very large extent to pursue science, technology and mathematics-related courses in high institutions. The results showed clearly that participation in the clinic encouraged the girls to pursue science, technology and mathematic-related courses in higher institutions.

From the results the extent to which the girls were encouraged to pursue science, technology and mathematics courses in higher institutions was indicated as 99.4%. This high percentage of aspiration of the girls is supported by the number of girls that are offering science related courses that was reported in the KNUST 1998/99 congregation report.

It can therefore be explained that the encouragement to continue science and mathematics in higher institutions might have been due to the fact that the girls had the belief about the usefulness of science and mathematics in later life (Leach, 1994). It can also be said that the role played by the teachers as coordinators, the activities of role models and the fact that their parents allowed them to attend the workshop was an encouragement. Indeed the encouragement by teachers, role models and parents to pursue science and mathematics subjects has a positive influence on participation as stated by Leach (1994). From the available evidence, it can be argued that the STME intervention programme is in the right direction.

Conclusions

The Science, Technology and Mathematics Education (STME) clinic is a programme that is advancing the course of female participation in the science technology and mathematics related- subjects, a supposed male dominant area of study.

The STME program is also reversing the myth surrounding female pursuing science –related subjects in secondary schools and other higher institutions of learning. They have come to believe that, females can pursue science-related subjects and still live a normal life. The study revealed that participation in the STME clinic goes a long way to motivate participants to continue the study of science, technology and mathematics in higher institutions and edges them to go into the science oriented careers.

Although the programme is seen as redirecting the course of female participation and representation in the scientific, technology and mathematical sector, more need to be done in terms of their performance in the science, and mathematics to bridge the gap in the secondary schools. The girls' performance seems not to reflect any change in attitude when comparing the examination scores of the participants in the STME clinic.

Recommendations

With respect to the findings of the study, the following recommendations are made:

1. The clinic coordinators should give much attention to activities that will help improve test results, in science and mathematics. This may be done by motivating science and mathematics teachers to adopt the methodology used at the STME clinics in their teachings for a better understanding of the concepts and principles by the girls. This may enhance their performance in the examinations.

2. The JSS girls who participate in time STME clinic in Form One should be made to attend each year till they get to the third year of the senior secondary school. This is because the significant change in attitude of the girls will probably result ingood study habits which will inturn lead to better performance. This is likely to affect their perception about mathematics and science. Consequently, repeated participation from the lower levels will cause significant increases in performance ever the period.

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