PRINT: ISSN 0971-8923 ONLINE: ISSN 2456-6756
J. Soc. Sci., 15(2): 121-126 (2007)
DOI: 10.31901/24566756.2007/15.02.05

Female Participation in Science, Technology and Mathematics (STM) Education in Nigeria and National Development

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KEYWORDS Education; females participation; national development; science, technology and mathematics

ABSTRACT Over the past two decades, women limited participation in science, technology and mathematics (STM) courses in tertiary institutions has been a cause for concern in Nigeria. Women today, constitute over half of the world's population. This paper therefore, discusses the present situation of female participation in STM, some of the factors that tend to hinder females' participation in STM, vis-à-vis the effects of this limited participation on national development. The paper recommended some of the ways to overcome the barriers to female participation in STM.

INTRODUCTION

In the development of nations, science technology and mathematics plays a vital role. Ukeje (1997: 3) observes that without mathematics there is no science, without science there is no modern technology and without modern technology there is no modern society. In other words, mathematics is the precursor and the queen of science and technology and the indispensable single element in modern societal development. So, if any nation must develop, the study of science, technology and mathematics should be given adequate attention in the various levels of her education. Nigeria as a developing nation, appears to have been prepared to resolve the issue of developments in science, technology and mathematics through her policy on education. The policy provides for a 60: 40 admission ratio in the tertiary institutions in favour of science, technology and mathematics (Federal Republic of Nigeria, 1998). Efforts in this direction appear to be yielding dividends as indicated by the admission ratio of Art to Science of 26: 71, 34: 66 and 33: 69 for 1992/93, 1993/94 and 1995/96 academic years respectively (Aguele and Uhumuavbi, 2003). This is an improvement over what it used to be in the past where the ratio was in favour of Arts related subjects. However, the problem that seems to lingered for quite sometime now, is the question of female participation in science, technology and mathematics (STM) and related subjects. This has become a source of worry, as it is difficult in the present day society to address the issue of national development without recourse to gender factor.

Recently, there has been rising global consciousness both at the grassroots and policy levels regarding the impact of gender issues in education and national development. There is also the growing consciousness that women constitute more than half of the world's population. Thus, we cannot afford to ignore them in matters regarding national development and STM education, which is a vital tool in the development of nation. The problem of this study therefore was that of addressing the following questions.

(i) Are there differentials in gender participation in STM and related subjects?
(ii) What are the causes of gender differentials in STM?
(iii) What are the role of women in national development?
(iv) What are the effects of gender differentials in STM on National development?

GENDER DIFFERENTIALS IN STM PARTICIPATION

There has been rapid development in education since independence in Nigeria. More particularly, there has been rapid development in tertiary education with respect to science, technology and mathematics (STM) in the last two decades. This is due to the role of STM in the development of a nation. Aminu (cited in Imarhiagbe, 1996) observes that if anything is important to any nation in solving its problems, it is science and technology education. Earlier, Fafunwa (1990) had observed, that we cannot hope to develop as a nation and be self-reliant

with other people's science and technology. We must develop our own in order to be self-reliant. Hence the current emphasis in university admission is in favour of STM.

It is common knowledge today that university enrolment in STM appears to favour the males more than the females. This picture can be seen in table 1 which gives the university enrolment from twelve (12) states of Nigeria in science and technology for the academic years 1998/99, 1999/2000, 2000/2001 and 2001/2002 (Table 1).

The enrolment for the four academic sessions gives a clear picture of female participation in STM in Nigerian Universities for the period. This situation tends to agree with the findings of Aguele and Uhumuavbi (2003) that significant differences exist between male and female enrolment in STM in Nigerian universities. They however, did not find any definite trend or pattern in the enrolment:

Coombs (cited in Aguele and Uhumuavbi, 2003) observed that gender differentials in enrolment and achievement in higher education is invariably rooted in inequality at the primary and secondary levels where the real sorting out of University bound students take place. According to Coombs, female participation and interest in STM diminishes as they move up in the educational ladder towards the university level due to a variety of factors that are primarily rooted in their religious and cultural beliefs surrounding the role of women in the society.

The issue of low female participation in STM seems to be a global issue. Other studies appear to be supportive of this position. For example, Croxford (2002) in a study on "participation in science, Engineering and Technology" in Scotland following the introduction of a new programme titled "Science Strategy for Scotland" observed the following:

(i) After taking account of attainment and science qualifications, females were less likely than males to study mathematics, informatics and engineering.
(ii) One quarter of students with two or more sciences at higher grade were studying medicines and dentistry or subjects allied to medicine. The proportion for science-qualified females was 34%
(iii) In the final years of compulsory education (S3-S4), all pupils studied at least one science and over half studied at least one technology subject. Gender and attainment were the main factors that influenced differences in choice of science and technology subjects.

The case appear to be the same in the United States of America, where

Billings (2003) observed that despite efforts over the last 20 years to redress female under-representation, the percentage of women studying computing and related subjects continued to fall in between 1985 and 1990. Accordingly, this status quo was also maintained in the United Kingdom with females making up only 18% of computer science and 11% of software and engineering in 1996. Not only are enrolments low and declining, but proportionately more women than men drop out, fail courses or choose to major in another subject other than science (Selby, 1997). Furthermore woman in United States Universities in 2000-2001 accounted for only 17% undergraduate science majors. (Billings, 2003). The deleterious trend was repeated in New Zealand with women accounting for a mere 20% of undergraduates in information technology and the sciences (Brook et al., 2000).

The issue of low female participation and attainment in STM is not peculiar to Nigeria alone, but a global problem. It is coming more and more into lime light particularly with women accounting for more than half of the world's population. What therefore are the likely causes of these gender differential in participation in STM?

Causes of Gender Differentials in STM Participation

A number of factors have been identified to

Table 1: University enrolment in STM for 1998/99, 1999/2000, 2000/2001 2001/2002 academic sessions for 12 states.

Year	*Technology*		*Science*		*Total*	
	Male	*Female*	*Male*	*Female*	*Male*	*Female*
1998/1999	4830	1011	4000	1900	8830	2911
1999/2000	7800	1500	6800	3500	14600	5000
2000/2001	8468	1400	9460	3924	17928	5324
2001/2002	7840	2400	10450	3650	18290	6050

Source: Federal Office of Statistics 2003 Abstracts.

influence gender differentials in STM participation. These range from societal, religious, and psychological to attitudinal and interest levels of students. George (cited in Pathways Home, 2002) identified the following eight factors as being responsible for low participation of females in mathematics and science.

1. Attitudes and expectations of parents and teachers.
2. Instructional strategies, such as hands-on experiences, group projects, field trips, and interactions with role models, as opposed to traditional textbook methods.
3. Curriculum materials that perpetuate the stereotype of the white, male scientists and ignore the contributions of minorities and female scientists.
4. Involvement in out-school science activities.
5. Portrayal of scientists in the media as white males or as negative stereotypes.
6. Tracking or ability-grouped assignments.
7. Self-image and expectation that often change from high interest and low anxiety about science and mathematics in the early grades to avoidance in the intermediate class.

In a study on Gender Bias in mathematics, science and technology, Strauss (2002), found that the absence of equitable elementary and middle school science instruction that includes hands-on activities is a serious form of discrimination in the educational system. Similarly, Croxford (2002) observed that one of the reason why young people, particularly females, opt out of science and technology is due largely to their perception. In a similar vein, Aguele (2004) observed that the negative image of women towards STM has accounted largely for the low enrolment of females in these subjects particularly in the universities. He observed further that enrolment ratio of males to females in STM for the academic years 1993/94, 1995/96. 1996/97 and 1997/98 in some Nigerian universities stood at 6: 1, 3: 1, 3: 2 and 3: 1 respectively. A further problem associated with this negative image is low interest. According to Chang (2002), women in America still appear to have lower level of interest in the sciences and technology as research indicates that attitudinal factors, such as negative image and interest contribute to the discrepancy. National Science Foundation (1996) also reported that lack of interaction with current participants in STM fields tends to constitute barrier to increased interest. Cases of mathematics anxiety and instructors' lowered expectations have also been shown to hinder women from participating in STM (Seymour and Hewitt, 1997).

Research findings have indicated that gender differentials in higher education are invariably rooted in inequalities at the primary, and secondary levels where the real sorting out of university bound students takes place (Coombs, as cited in Aguele and Uhumuavbi, 2003). These, inequalities includes traditional and religious beliefs, remoteness, poverty, child labour, social roles required for the different sexes, argument about biological built up of women and birth order. Some other factors that have been identified (Okeke, 1990; Obodo, 1993; Ifeluni. 1997) include lack of support from education policy makers, different socialization patterns for boys and girls at early stages of life, early marriages, and teachers' attitude to girls. It is a known fact in Africa that women used to be denied and deprived of many benefits (social and economical) which their male counterparts enjoyed. Such deprivation has also affected the status of girls and women in the society. The extent to which such deprivation has modified their mental capacity may never be fully explicated (Aguele, 2004).

Women and National Development

Development essentially has to do with improvement in human well-being, elimination of hunger and poverty, and gainful and productive employment for all the citizen of a nation. According to Abbe and Momodu (1999: 159) development means "bringing a nation to an advanced or highly organized state, that is utilizing all the human and material potentials of a nation to bring about growth or advancement". So national development therefore , would refer to the ability to harness all the available resources, human and material or economic, to bring out the potentials of a nation. It may also imply the ability to flow along with others in terms of effective management and utilization of current developments in science and technology.

In the recent past, women have become a serious factor of recognition in nation building. Their important contributions to countries national economics and international trade stand out clearly and cannot be over emphasized. Women now constitute about one-third of all industrial sector of the labour force in export processing activities and services sectors such as tourism and banking (Commonwealth, 1999).

Hence, we cannot continue to undermine their total and complete involvement in issues of national development in Nigeria. Again there are a number of international agreements/mandates that bear upon the issue of women involvement in national development which Nigeria is a signatory to. One of such agreements is the Beijing Platform for Action on women. The final clause of the Declaration according to Commonwealth (2000: 15) is that "we hereby adopt and commit ourselves as government to implement the platform for Action, ensuring that a gender perspective is reflected in a our polices and programmes".

On the Commonwealth front, there have been various moves and activities on gender equality and development. For instance, the 1995 Commonwealth Plan of Action on Gender and Development is grounded in the Commonwealth fundamental values of democracy, rule of law and good governance, human rights, gender equality and the promotion of sustainable development. The plan presents a vision in which:

The commonwealth works towards a world in which women and men have equal rights and opportunities at all stages of their lives to express their creativity in all fields of human endeavour and in which women are respected and valued as equal and able partners in establishing values of social justice. Within such a framework of values, women and men will work in collaboration and partnership to ensure people oriented development for all nations (Commonwealth, 2000: 10).

Such a plan recognizes the fact that women are very vital and indispensable in national development and we can therefore, not continue to undermine them.

Despite considerable progress in some areas of women's lives since the United Nations named 1975 to 1985 as the Decade for women, gender inequality/inequity persists in almost all areas of life and all nations of the world. According to King(2000), women often made the important and unsung contributions to national economies especially in support of export-led economic growth, yet more than 70 percent of the 2.8 billion people living on less that US$2.00 per day are women. During the sixth meeting of Commonwealth Ministers responsible for Women Affairs held in New Delhi, India in April 2000, it was pointed out by Spence (2000) that Poverty for example continues to have a female face. Women constitute 70% of the world's 1.3 billion absolute poor. They have the most limited access to livelihood, resources or to new technologies-the key to employment in the 21st century (p 14). She added further that their huge contribution to economic growth of their countries is often not accounted for in national budget and thus, largely ignored in economic development programmes.

Effects of Gender Differentials in STM on National Development

Science, Technology and Mathematics (STM) are today known to be very central to the development of any nation. Ukeje (1997) observes that the development of a nation is properly accessed by the level of the education of its citizens in STM. Uhlig (1999) also alluded to this view when he stated that:

In the theory and policy of development it has been accepted from the beginning of the debate that one of the essential pre conditions for the development and transformation of a national economy is the factor of education in the broadest sense and science and technology in the particular sense (p. 51).

The implication of this is that to attain national development, it is not enough to educate the citizens in the broadest sense, but to give them sufficient education in STM. This is so because STM is considered as the vehicle for rapid development and economic transformation of a nation. Today, women constitute more than half of the world's population (Commonwealth, 1999). Hence, we cannot afford to ignore them if we must attain meaningful development in our nation. Their general education and in particular their education in STM is very vital to any nation.

The need to involve women equitably in national development needs no further emphasis. Hence, issues of governance and democracy, socio-economic development and peace couldn't be divorced from those of gender equalities (Mckinnon, as cited in King, 2000). In addition, it is becoming obvious that when women learn a nation stands to benefit. According to Abbe and Momodu (1999) women education positively correlates with several national and international goals and aspirations. Some of these according to them include economic productivity, social development, social equity and sustainable development. The low participation of women in education generally and STM in particular will

therefor hinder the rapid actualization of these goals and aspirations.

Access to STM can level the playing field for all social groups, equalizing connections between women and men, rich and poor and different ethnic groups. There is the possibility therefore, that continued inequalities, with regard to participation in STM will in the future create barriers between males and females in both the home and the workplace.

Women who are excluded from STM education will limit their earning power and employment prospects and may continue to languish in stereotyped occupations. It is indeed clear that women without STM education will be seriously disadvantaged in the world of work, to the detriment of the society in general. Of paramount importance is the inclusion of women's voices, experiences and perspectives in a technological world to strengthen organizational life, research and the future of humanity. As observed by Aptheker (cited in Billings, 2003: 6):

Women have a distinct way of seeing and interpreting the world. This is not to say that all women have the same consciousness or share the same beliefs. It is to say that women of each particular culture or group have a consciousness, a way of seeing, which is common to themselves as women in that it is distinct from the way the men of their culture or group sees things.

CONCLUSION

It was pointed out in this paper that women constitute more than half of the world's population. STM was also seen to play an important role in the development of any nation. Nigeria as a developing nation needs more scientists Engineers and mathematicians to help her get along with the developed nations and to develop her own technologies and sustain them. The women must be fully involved and can never be ignored in any meaningful development. They have a distinct way of seeing and interpreting the world. Their impact through STM should therefore be sought for and encouraged through their participation.

RECOMMENDATIONS

In order to improve upon the participation of women in STM and to empower them economically and integrate them into the mainstream of national development, the authors recommend the followings:

1. Efforts should be made to address the perceived lack of relevance of course work in tertiary institutions. There should be a restructuring of undergraduate STM curriculum to include more investigative learning, technology, laboratory experience, and collaborative work.. Programmes that have provided students an opportunity to engage in hands-on, real life projects would be successful in increasing female enrolment and retention.
2. Mentoring programmes that help socialize students in STM fields, which is another form of support for women should be established. As the presence and guidance of peer or faculty mentors have been shown to positively affect retention they should be encouraged. For women in the sciences, mentors can help to provide a support network that would increase students' self-confidence and feeling of worth in the field. As a follow-up, deliberate employment policy in favour of women, particularly as lecturers in STM subjects/ courses to enable them act as role models to the upcoming ones, should be implemented.
3. Female graduates in STM courses should be provided automatic employment opportunities. This would not only serve as creating more opportunities for them to contribute to national development but would serve as further incentives for young girls. Workshops, seminars and conferences show casing women in STM and other areas around the world, where women have featured prominently, should be organized on a continuous basis.

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