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Science Education in Nigeria: An Examination of People's Perceptions about Female Participation in Science, Mathematics and Technology

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The paper brings to focus people's perception about female involvement in science, mathematics and technology (SMT). Data for the study were obtained from a survey conducted in March, 2005 in two Local Government Areas of Osun state, Southwest Nigeria. The paper reveals that: (i) about 57% of household heads, 45.6% of mothers and 57.6% of the children are of the opinion that both boys and girls are given equal right to SMT education (ii) social forces play an important role in determining people's attitude to SMT (iii) though, parents and stakeholders perceptions about girls' participation in some professions is changing, however, socio-cultural and economic factors still determine which sex to encourage to read SMT.

KEY WORDS: attitude; participation; perception; science; technology; teacher.

INTRODUCTION

In general, girls and women have made steady progress in all areas of formal education in some African countries since independence in 1960. Enrollment rates have risen at all levels of education, drop out rates have fallen while the governments continue to make constant effort to improve the quality of education that is received. Female education, however, still lags behind that of males in many respects. For instance, female enrollment rates at all levels of formal education remain below those of male; girls have a higher drop out rate; girls are much fewer in the important subject areas of science, mathematics and technology and their career choice is still largely confined to the 'feminine' areas of teaching, nursing, secretariat studies, catering, etc. In spite of the various actions and inputs by governments as well as intervention by Non-Governmental Organizations (NGOs), religious organizations and international organizations, girls still lag behind boys at all levels of education. They continue to avoid courses, which lead to careers in science and technology.

Gender gaps in achievement in science, mathematics and technology (SMT) appear to be narrowing but they are still very real. Women are still not applying to graduate and professional schools in numbers even close to their proportion in the population (Kirkpatrick and Cuban, 1998). Many studies have documented the wide gender gap in achievement scores between girls and boys in the areas of SMT (AAUW, 1992; Alele-Williams, 1988; Arnot and Phipps, 2003; Avalos, 2003; Baker and Leary, 1995; Erinosho, 1994; Hammrich, 1996; Magno *et al.*, 2002). However, these authors assert that when girls are allowed to work in a manner intrinsic to their collective learning style, appropriate science, mathematics and technology learning takes place.

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Gender disparity in the study of science, mathematics and technology is not peculiar to Africa. It is a problem that had long been recognized in other parts of the globe. For instance, Nebres and Mercado (1998) observed that in Australia, New Zealand and the Philippines, males outnumbered females in engineering. A similar trend was observed in the United State of America where in some high schools for the study of science and technology, advanced physics, engineering and mathematics classes were dominated by males (Strauss, 2005). In France, despite their performing marginally better than boys in science at secondary level, only 44.2% of science pupils in 2000 were girls (Baudino, 2003). It was also reported that most of the places in mathematics, science and technology in the United Kingdom, were taken up by men (Opportunity 2000, 1996). Recent statistics from some other developed countries showed that there is gender disparity between men and women as regards courses in science and technology. In Japan, Kite (2005) reported that as of 2004, only 9.5% of Japanese graduate students in engineering were women.

Kasente (1995) pointed out that there had been an overemphasis on "structural aspects of education" which obscured the role of "societal factors and gender role behaviour" in the perpetuation of gender differentiation in education. Though, school factors such as school type, curriculum, selection process, subject options, school facilities and staffing are paramount when the issue of gender differential in science and technology is under consideration, the impact of socio-cultural and economic factors also become crucial to our understanding of the problems associated with gender differentials in SMT. Societal factors such as cultural values, gender ideology, home background, socialization context, labour market and employment opportunities and personal values and attitudes, beliefs and behaviour are some of the factors that foster gender differences in SMT. This paper, therefore, attempts to examine the underlying factors militating against female-child participation in science, mathematics and technology.

MATERIAL AND METHOD

The study was carried out in Osun state, Southwestern Nigeria. Limiting the study to Osun state being a Yoruba state minimizes the effect of ethnic variations in attitudes to female education in general. Osun state stands out clearly as one of the educationally advantaged states in the country with her literacy level as high as 61.98%. This is above the national average of 49.44%. More than 95% of children in the state attend primary school compared with 76% for the whole country. As at 1995 the state had a total of 1189 primary schools with population of 522,500, 328 secondary schools with a student population of 214,057 and the schools' attendance records showed a total percentage of 40.81% representing 45.19% males and 36.6% females (Osun State Ministry of Education, 1995).

As part of the preliminary exercise, secondary data on literacy and enrolment was used to select two local government areas in the state. From these data, Ifedayo Local Government Area (LGA), the LGA with the highest gender gap and Oriade Local Government Area, the LGA with highest literacy and enrollment rates were selected for the study. Ifedayo Local Government Area is one of the poorest LGAs in Osun state. It lies in an undeveloped part of agricultural hinterland between Osun and Kwara state. The total population of the Local Government Area, according to the 1991 census, is 43,287; the projected population figure as at 2003 is 58,870. It is populated predominantly by the Yoruba ethnic group. This local government area was chosen because of the apparent gender disparity in literacy and enrollment and the poverty of the area. A situation analysis carried out in the LGA in 2001 estimated the female literacy rate at 41.7% compared with 58.4% for boys. The LGA was created in order to bring development close to the people. There is the likelihood that the gender disparity in education will be higher than available figures for the LGA, since official statistics often-times overstate such parameters of development (Osun State Ministry of Education, 2001).

Available statistics for Oriade local government portrays a LGA with higher female literacy and enrollment rates (48.7% for girls compared with 51.6% for boys). The total population of Oriade LGA as of 1991 was 80,833 (39,283 males and 41,550 females) with 17,967 households. The population of the LGA is projected to be about 109,932 as at 2003. It was on the basis of this background that the LGA was selected as one of the LGAs used for the study.

Each LGA was divided into clusters based on the spread of educational infrastructure represented in LGA maps and documentation. Two communities were selected from each of the LGA. Specifically, the entire LGA was stratified into big or major communities with minor or small communities attached to these communities as sub-communities. These major communities were named 'head of clusters'. School records of all communities in each of the LGA were

used to determine the 2 communities with highest gender gap in literacy and enrollment in Ifedayo and the 2 communities with the highest female literacy and enrollment rates in Oriade LGA. A household survey and qualitative studies were carried out in the selected LGAs. The target sample size was 200 households made up of 100 households from each LGA. Different structured questionnaires were prepared for the heads of the households, mothers with school-age children and school-age children. Another structured questionnaire was used to secure information from 50 primary and secondary school teachers. The community study involved collection of qualitative data from community and opinion leaders and school teachers through in-depth interview and focus group discussions with parents and school children. Information from in-depth interviews and focus group discussions were transcribed and organized under broad headings that depict different aspects of the discussions. The transcribed information was analyzed descriptively (qualitatively) and also used in the discussion of the issue. The Interview schedules were coded and analyzed with the SPSS version 11 with emphasis on frequency distributions, cross-tabulations of parameters, and their influence on science, mathematics and technology education. Cross-tabulations with each of the causal variables explained the relationship between the independent and dependent variables.

A breakdown of the background characteristics of the respondents shows that a total of 189 household heads and 195 women with school-age children were successfully interviewed in the selected households. Of the 195 women, 50.7% were drawn from Oriade and 49.3% from Ifedayo LGA. Also, 184 children of school age were included in the study sample, of which 56.3% were interviewed in Oriade and 43.7% in Ifedayo. Boys slightly outnumbered girls; the proportion of boys being 51.8% compared to 48.2% girls. The samples were predominantly Yorubas with 96.7% of household heads and 95.3% of mothers. Only 4.6% of the household heads were females. The age distribution of household heads showed the majority to be in the age range 45–64 years. A majority of the mothers were in age group 35–49 (66%). Christianity and Islam were the two principal religions practised by all categories of respondents. Among household heads, 70.6% were Christians, 27.0% Moslems and 2.4% practiced Traditional religion. A higher proportion of mothers (74.1%) also adhered to Christianity, 25.3% were Moslems and 0.6% practiced Traditional religion. There were more women in monogamous unions in Oriade than in Ifedayo probably due to the higher level of exposure to education and the dominance of Christianity. The average family size of 4.7 observed for the two LGA was below the national average of 6.3 but close to the average of 4.8 for Southwestern region (NPC, 2004). Household heads with formal education generally received some primary education. A majority of the mothers (64.1%) also had no formal education, while those with some form of formal education mainly had basic education (that is primary education). The children, however, have a better chance of being educated. About 75% of children in the household records were currently enrolled in school, 77.3% boys and 73.6% girls. In Oriade, 84.5% of the female children and 81.2% males were in school. This confirmed the official statistics, which reported higher enrollment for females than males in this LGA. In Ifedayo, 73.4% of sons compared with 62.7% of the daughters were in school.

RIGHTS OF GIRLS TO SMT

Table I shows that very high proportions of respondents believed there should be equal rights for males and females in SMT education. In reality, lower proportions believed this right was being exercised. The gap between belief and reality was highest in Ifedayo. Interestingly, the majority of household heads (72.9%), mothers (56.3%) and children (77.2%) felt that male and female children should have equal rights to SMT at all levels. In practice, only 56.5% of household heads, 45.6% of mothers and 57.6% of children reported equal rights to SMT in the respective household (Table II). The table shows that many of the respondents accepted

Table I. Percentage Distribution of Respondents by Whether or Not Both Boys and Girls Should Have Equal Rights to SMT According to LGA

		Local government area		
Right to SMT		Oriade	Ifedayo	Total
Household head	Yes	77.2 (75)	68.7 (63)	72.9 (138)
	No	22.8 (22)	31.3 (29)	27.1 (51)
		100.0 (97)	100.0 (92)	100.0 (189)
Mothers	Yes	61.4 (61)	51.3 (49)	56.3 (109)
	No	38.6 (38)	48.7 (47)	43.7 (86)
		100.0 (99)	100.0 (96)	100.0 (195)
Children	Yes	88.5 (92)	65.9 (53)	77.2 (142)
	No	11.5 (12)	34.1 (27)	22.8 (42)
		100.0 (104)	100.0 (80)	100.0 (184)

Table II. Distribution of Respondents by Whether or not Both Boys and Girls are Given Equal Rights to SMT According to LGA

Given equal right to SMT		Local government area		
		Oriade	Ifedayo	Total
Household head	Yes	57.2 (55)	55.8 (51)	56.5 (107)
	No	42.8 (42)	44.2 (41)	43.5 (82)
		100.0 (97)	100.0 (92)	100.0 (184)
Mothers	Yes	42.5 (42)	38.7 (37)	45.6 (89)
	No	57.5 (57)	61.3 (59)	54.4 (106)
		100.0 (99)	100.0 (96)	100.0 (195)
Children	Yes	65.9 (69)	49.3 (39)	57.6 (106)
	No	34.1 (35)	50.7 (41)	42.4 (78)
		100.0 (104)	100.0 (80)	100.0 (184)

that there was gender disparity in SMT just as witnessed in literacy and school enrolment generally.

PERCEIVED GAINS AND LOSSES ON GIRLS DOING SMT

Table III shows how some household heads and parents quantified the gains and losses of allowing female children to enroll for science and technology-related courses. For the majority of parents in both Oriade and Ifedayo (66.2% and 55.4%, respectively) perceived the gains to be very high. That the majority were from Oriade, was consistent with the high female literacy rates. Less than 5% of the parents in Oriade and a little above 8% in Ifedayo, felt they lost something by their children specializing in science, mathematics and technology. They emphasized the loss of child's labour. This is not surprising since female labour, especially running errands, hawking/trading, cooking meals and doing some household chores are still regarded as very necessary. The perception is that more time is required to study SMT subjects than courses in humanities and social sciences. However, the overall loss recorded by allowing girls to choose SMT subjects tends to be overshadowed by the gains.

Table III. Percentage Distribution of Parents by Perceived Gains and Losses on Girls Doing SMT

	Local government area			
	Oriade		Ifedayo	
Responses	Gains	Losses	Gains	Losses
Very high	66.2	5.3	55.4	8.9
High	22.3	2.5	17.8	3.5
Average	7.5	4.7	18.7	9.6
Low	1.2	15.4	3.7	14.8
Very low	2.8	72.1	4.4	63.2
Total	100.0	100.0	100.0	100.0

STUDENTS' ACCESS TO SMT

Though the effect of personal attitude and children's career aspirations on the schooling of boys and girls have not been given adequate attention among researchers, students' self-perceptions have been found to affect their participation in science and technology courses. Peer pressure has also been observed to greatly influence attitudes towards schooling (Opolot, 1994) and as well influence the choice of subjects. Higher proportions of both male and female children were of the opinion that they were not denied access to SMT education, but more males than females hold this opinion (62.9% males as against 51.1% females). Erroneously, 30.1% females compared with 24.7% males believed that there is a biological foundation to performance in SMT. About 34% of the girls as against 27.4% boys were of the opinion that teachers give more attention and encouragement to boys than the girls in SMT education. However, significant proportions of both male and female students believe that both boys and girls should be given equal right (53.6% and 65.8% males and females respectively) (see Table IV).

As depicted in Figure 1 above, 49% of the students felt discouraged by their teachers' attitude to SMT while another 13% were indifferent. Also teachers' attitude, according to some students who participated in the focus groups discussions, dis-

Table IV. Students' Perceptions and Attitudes to Female Participation in SMT

Students' perception and attitudes		Sex composition	
		Male (N = 105)	Female (N = 79)
Were you given less opportunity to pursue SMT?	Yes	37.1	48.9
	No	62.9	51.1
Is there biological foundation to performance in SMT?	Yes	24.7	30.1
	No	75.3	69.9
Teachers give more attention and encouragement to male-child?	Yes	27.4	33.8
	No	72.6	66.2
Both sexes should be given equal right?	Yes	53.6	65.8
	No	46.4	34.2
Total		100.0	100.0

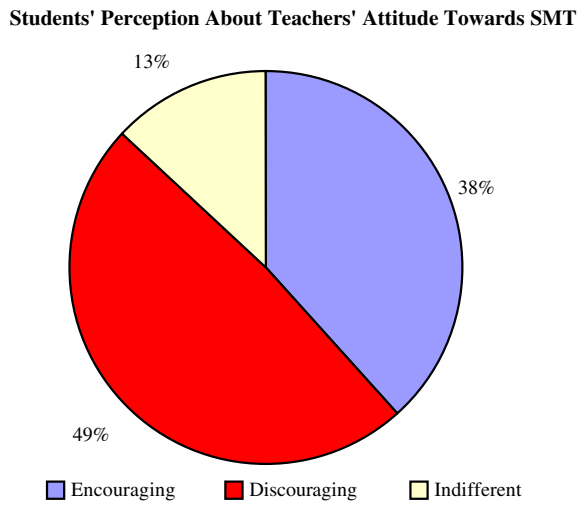

Fig. 1. Student's perception about teachers' attitude towards SMT.

couraged many of the students, especially girls from choosing science and technology courses in their schools. As claimed by a girl in one of the focus group discussions:

> "The attitude of some of our teachers show that they either don't understand the subjects or that they don't know how to teach them"

Another boy posited that:

> "They (the teachers) give us assignments on what we don't know, asking us to write on concepts we have not heard of ..." Some will even come to the class with cane, while some important terms will not be explained; they will ask us to memorize them".

On the group of teachers students' prefer to teach SMT courses, male-teachers are preferred to female teachers (38.1% as against 31.4%). However, significant proportion of the students (30.5%) were indifferent to whoever is teaching the courses provided they could be properly taught (the significance is not being used in a statistical context).

PARENTS' JOB PREFERENCE FOR GIRLS

Data on the type of professions parents would like their daughters enter showed a marked difference from traditional view of occupational preference for girls. As presented in Table V, mothers wanted girls to engage in such occupations as medicine (18.2%), law (16.5%), accountancy (14.9%), pharmacy (11.4%), and teaching (10.8%). Farming and trading, the traditional occupations among women in the zone were no longer considered suitable. In the two LGAs, most mothers (21.7%) desired medical profession for their girls. Law was the second most cited profession by mothers, while only a small proportion still wanted girls to remain in traditional occupations such as trading and farming. However, a very small proportion of both household heads and mothers want their daughters to pursue engineering as a career (6.2% and 4.6% of household heads and mothers respectively).

As shown in Table V, parents now perceived a good education, especially specialization in professions like medicine, pharmacy, and law, will not only allow a girl to marry well, it will also grant her economic independence needed for good life. Despite this, a significant proportion of the parents (4.3% household heads and 5.5% of mothers) still believed that girls' specialization in these professions is of no importance (the significance is not being used in a statistical context).

TEACHERS' PERCEPTION AND ATTITUDES

It is well documented that schools tend to reinforce and even aggravate the gender stereotypes found in wider society (Arnot *et al*., 1999; Arnot and Phipps, 2003; FAWE, 2003). For instance, teachers' attitudes and their perceptions do not differ from

Table V. Percentage Distribution of Parents by Professions Preferred for Their Daughters and Importance of Girls' Specialization in Science, Mathematics and Technology-Related Courses

Profession	Household heads (N = 189)	Women (N = 195)
Accounting	15.6	14.3
Agriculture	3.2	2.7
Engineering	6.2	4.6
Farming	2.6	3.5
Pharmacy	11.3	11.4
Teaching	9.4	12.3
Trading	8.2	5.9
Law	14.3	18.7
Medicine/Nursing	14.7	21.7
Others	14.5	4.9
Importance of SMT		
Cope economically	13.4	11.4
Compete with boys	14.6	13.5
Marry educated man	6.5	3.4
Become responsible	19.8	22.6
Lead exemplary life	15.3	18.2
Uphold family name	7.5	7.9
Empowerment	18.6	17.5
No importance	4.3	5.5
Total	100.0	100.0

those found in larger society. Teachers, males and females, were found to have lower expectations of girls' academic performance. Boys are perceived to be intelligent, hardworking, motivated and cooperative, while girls are perceived to be passive, easy to control, calm and submissive (Basu, 2001; Colclough *et al*., 2003; Davidson and Kanyuka, 1990; Kainja and Mkandawire, 1990).

As shown in Figure 2, some teachers highlighted the conditions in the schools environment that inhibit the provision of adequate care for the girl-child. Financial problem had the highest percentage (71.8%). Others were unfavourable parental attitudes to girl-child education (64.9%) and lack of facilities in school (52.1%). Though significant, relatively very few teachers listed lack of interest on the part of the girls (25.3%) (the significance is not being used in a statistical context). Many of the teachers believed that the amount of fees currently paid in schools could have been tolerable but for the economic depression. To them, parents could hardly afford to feed their children. As expressed by some of the teachers that were engaged in the in-depth interview: *"if government makes education completely free, there will still be the problem of feeding at home"* (Also see Table VI).

Responses from teachers' interview showed their perception about certain measures that could be taken to enhance girl-child participation in SMT. As shown in Table VI, the teachers held the opinion that parents and the female child should be counseled on the value derivable from girl-child participation in SMT. They also suggested regular PTA meetings where the importance of female participation in science, mathematics and technology would always be emphasized. Special awards for girls who excel in SMT subjects were also mentioned. Conditions in the school environment, which promote the girl-child involvement in SMT, were also mentioned in the in-depth interviews. Such conditions include: giving females leadership positions, promotion of equal rights between males and females, and better relationship with teachers among others. Apart from school-related factors, the teachers also mentioned such factors as lack of finance, lack of parental care and support, and the lack of learning materials as

Table VI. Distribution of Teachers by their Perceptions on Gender Disparity in Schools

	Number	Percentage
Gender disparity exists in SMT education?		
Agreed	31	61.6
Disagreed	15	29.1
Indifferent	4	9.3
*Factors responsible for disparity		
Lack of time	11	22.7
Parent's attitude	32	63.8
Financial problem	34	67.6
Unconducive school environment	31	62.1
Lack of SMT materials	31	61.4
Others	27	53.9
Measures to encourage female involvement in SMT		
Counsel parents/children	15	29.7
Regular PTA meetings	17	33.0
Special awards for girls	11	22.1
Others	7	15.2

*Multiple responses are allowed; SMT = Science, Mathematics and Technology.

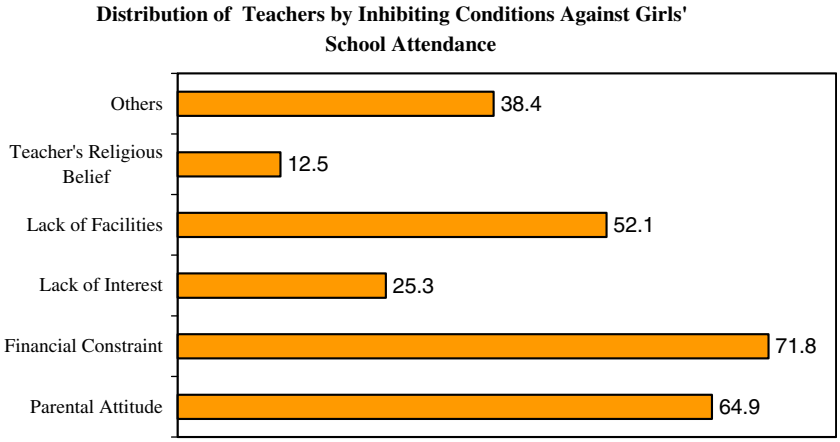

Fig. 2. *Multiple responses are allowed.

some of the factors that discourage female students from getting involved in SMT.

Therefore, to arouse female children interest in science, mathematics and technology, the teachers suggested the following: enlightenment campaign, giving responsible posts to women who specialized in science, mathematics and technology, provide free education for girls who decided to enter science, mathematics and technology in higher institution and provide employment for them after graduation, counseling girls right from primary school and promote measures that limit family size among the populace.

CONCLUSION

The social context proxied by gender, family, friends and the community, plays an important role in determining people's attitude to science, mathematics and technology. Among these social forces are social norms, family characteristics and processes, religion, peer influence and economic pressures. Although the situation differs from one society to the other and from one family to another, prevailing social systems are generally skewed in favour of the boy-child. Societal norms perceived boy-child as the future breadwinner and decision-maker, the one who was destined to carry the family name and lead the nation. Consequently, many families often neglected the development of the girl-child outside the family setting.

Our findings showed that the traditional perception of women's roles as being essentially domestic and hence requiring little or no education is a barrier to girl's involvement in SMT education. This attitude is in part reinforced by the belief that girls are likely to become pregnant while still in school. Many of the women still held on to their erroneous belief that girls will transfer the benefits of education to their husband's families upon marriage. Given the patriarchal nature of the Nigerian society, boys are regarded as heirs, responsible for the continuity of the lineage, and so they are given priority and more attention. Some parents have also expressed the opinion that girls were likely to become pregnant or get married before the completion of their schooling and were therefore not worth such an expensive investment.

The paper reinforced the points raised in previous studies (Burchfield and Kadzamira, 1996) that boys and girls' participation in science, mathematics and technology education is constrained by gender roles and expectations. Education is thought to be more beneficial in preparing girls for their roles as mothers and wives rather than for employment. Women's under-representation in the field of science, mathematics and technology is therefore a reflection of poorer educational outcomes for girls and strong cultural barriers to women's employment in related sector.

The downward trend in school enrolment in general and female involvement in science, mathematics and technology in particular is being addressed via a series of programmes engineered by notable organizations worldwide. Such initiatives include creation of FAWE Centre of Excellence in some African countries, out-of-school activities like science camp and formation of science clubs among others. One of the strategies for promoting these initiatives is the creation of awareness of the rights of the child to science, mathematics and technology education. This has therefore become topical in research and policy, although the concept is an abstract one.

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