Gender Differences and Mathematics Achievement of Rural Senior Secondary Students in Cross River State, Nigeria

Sam William Bassey[1], M. T. Joshua[2] and Alice E. Asim[2]

[1] Cross River University of Technology, Calabar, Nigeria, [2] University of Calabar, Calabar, Nigeria

To contribute to the realization of the Millennium Development Goal (MDG) by the United Nations on the promotion of gender equity, the researchers sought to empirically verify the existence or otherwise of gender inequality in the mathematics achievement of rural male and female students in Cross River State, Nigeria; and whether parental socio-economic status and school proprietorship, taken independently, are significant factors in the achievement of the students. By stratified and simple random sampling, 2000 students (50% males, 50% female) were selected and a 30-item four-option multiple choice mathematics achievement test (MAT) was constructed (KR20 of 0.87 and item difficulty, $0.40 \leq p \leq 0.82$) and administered. The independent t-test analysis of significance revealed gender inequality in the entire sample as well as among the low socio economic students and within public schools. Educational implications have been highlighted.

Introduction

Mathematics education is to a nation what protein is to a young human organism. As a vital tool for the understanding and application of science and technology, the discipline plays the vital role of a precursor and harbinger to the much needed technological and of course national development, which has become an imperative in the developing nations of the world. The choice of this topic is predicated on the current world trend and research emphasis on gender issues following the millennium declaration of September 2000 (United Nations, 2000) which has as its goal, the promotion of gender equity, the empowerment of women and the elimination of gender inequality in basic and secondary education by 2005 and at all levels by 2015. In realization of the significant role of Mathematics to nation building, the government of the Federal Republic of Nigeria made the subject compulsory at the basic and secondary levels. This was aimed at ensuring the inculcation of Mathematics literacy and the associated equipment with logical and abstract thinking needed for living, problem solving and educational furtherance. For full realization of this laudable objective of Mathematics education, subject mastery and demonstrated achievement should be evenly distributed across gender. Unfortunately, gender inequality in education has remained a perennial problem of global scope (Bordo, 2001; UNESCO, 2003; Reid, 2003).

Mathematics is a science subject and some gender-based science researchers have reported that what both the 'feminist empiricists' and the 'liberal feminist critics' seem to agree is that females in principle will produce exactly the same scientific knowledge as males provided that sufficient rigour is undertaken in scientific inquiry (Howes, 2002; Barton, 1998; Sinnes, 2006). They also believe that initiatives that build on the assumption that females and males are equal in their approach to science, and that inequality in science and science education is caused by political, educational and social factors external to science, would be expected to focus on removing these external obstacles. There is need therefore to give boys and girls exactly the same opportunities and challenges.

In Nigeria, gender-achievement studies include Abiam and Odok (2006) who found no significant relationship between gender and achievement in number and numeration, algebraic processes and statistics. They however found the existence of a weak significant relationship in Geometry and Trigonometry. Though globally the issue of gender

inequality in Science, Technology and Mathematics Education (STME) has produced inconclusive results, one meta-analysis covering the period 1974 – 1987 on Mathematics and gender led to two conclusions: the average gender gap is very small (statistically insignificant), and the fact that the differences tend to decline with time (Friedman, 1989). Another meta-analysis of 100 studies in gender and Mathematics performance corroborated the above findings (Hyde, Fennema & Lamon, 1990). Some scholars blame the colonizers of Africa for applying direct transfer of Western Science curricula, examinations and teaching methods, which fail to address the continental challenges of Africa. Yoloye (1998) submitted that the result of this direct transfer of western curricula, is a science and mathematics education in most African countries that is exemplified by decontextualized knowledge being transmitted by poorly trained teachers in under-resourced and sometimes overcrowded classrooms. As a consequence, the situation in Nigeria is that, academic performance in Mathematics education is still deplorably low, both in certificate and non-certificate examinations. Many researchers identify inherent unfairness in school-based assessment (Grifith, 2005; Njabili, et al. 2005; Asim, 2007) which may result from teachers' incompetency in assessment (Asim, et al. 2007), as well as psycho-cultural factors among others as being responsible for this anomaly (Enukoha, 1995; Obodo, 1997; West African Examination Council, 2002). This poor Mathematics performance of students is further worsened by gender imbalance leading to the problem which now constitutes a major research focus across the globe (UNESCO, 2003). In a study by Opolot-Okurut (2005) it was found that for all the attitudinal variables (anxiety, confidence and motivation), males had higher mean scores than females. That is, differences in student attitude toward mathematics based on gender were confirmed. Attitudes are known to have positive relationship with student achievement. This may be an indication that males perform better than females mathematically as a result of their higher attitude scores.

It is believed that bridging gender gap is one major way of achieving egalitarianism and enhancing human development. School location is a variable in achievement and rural students, who constitute the majority group in Nigeria, tend to manifest more simple social relationships than their urban counterparts, probably due to greater interpersonal ties in rural settings, Hence one is led to wonder whether gender disparities exist in the Mathematics achievement of rural secondary school students in Cross River State. It is also the objective of this study to verify whether parental socio economic status and school proprietorship are significant factors in the rural students' Mathematics achievement. Popular cultures view rural education as a deficit model (Hopkins, 2004), whereas others hold the view that there is no difference between rural and urban education (Howley, 2002).

Hypotheses

The following null hypotheses are hereby stated:

Ho_1: There is no significant difference between the Mathematics achievement of rural male and female students in Cross River State, Nigeria.

Ho_2: Parental socio-economic status and school propri etorship taken independently, are not significant fac tors in the mathematics achievement of the rural male and female students.

Methodology

This study used the survey design which involves the collection of data at current status for description of phenomena, without deliberate effort to control the variables. The area of the study, Cross River State, is one of the thirty six (36) states of the Federal Republic of Nigeria, situated in the oil-rich south-south geo-political zone. It has eighteen local government areas and lies between latitude $5^{o}32'$ and $4^{o}27'$ North of the Equator and longitude $7^{o}50'$ and $9^{o}28'$ East of the Greenwich meridian. The state has Calabar as its capital, and is a leading tourist haven in Nigeria, with attractions like the Tinapa, Calabar Export Processing Zone (EPZ), the International Obudu Cattle Ranch, the Old Residency museum and Agbokim and Kwa waterfalls.

From the population of 19,200 rural secondary school two (SS II) students in the state, 2000 students, that is 10.41 percent (50% male and 50% female) were selected by the stratified random sampling technique. By the simple random process, 30 schools (ten from each of the three senatorial districts) were selected such that by the same procedure 800 were obtained from the Southern senatorial district, 600 from the central district and 600 from the north. Intact classes were used, subject to the sample size described above. Sample students have mean age 16.80 years. The sample distribution is shown in Table 1.

Senatorial district	No. of School	Number of Students sampled	Male	Female
South	10	800	400	400
Central	10	600	300	300
North	10	600	300	300
Total	**30**	**2000**	**1000**	**1000**

Table. 1. Sample distribution by district and sex

Instrumentation

A forty-five minute, thirty (30) item multiple choice mathematics achievement test (MAT) of four options, A to D, was constructed by the researchers based on the prescribed senior secondary two (SS II) curriculum to cover the basic areas of number and numeration, Algebraic processes, Geometry and Mensuration, Trigonometry and Statistics/probability. Students were expected to encircle the option bearing the answer.

The items were set based on the table of specifications in Table 2.

Content	Knowledge 30%	Comprehension 20%	Application 20%	Thinking 30%	Total
Number/ Numeration 20%	2	1	1	2	6
Algebraic process 20%	2	1	1	2	6
Geometry 30%	2	2	2	3	9
Trigonometry 10%	1	1	1	Nil	3
Statistics/ Probability 20%	2	1	1	2	6
Total	9	6	6	9	30

Table. 2. Table of specification for MAT

The MAT has reliability coefficient (KR20) of 0.87 and was certified to be content valid by three independent experts (two of Mathematics education and one of educational measurement and evaluation). The item difficulties, p_i are such that $0.40 \leq p_i \leq 0.82$. This instrument was administered by the researchers with the aid of Graduate Students to the sample of 2000 students across the state at the beginning of the third term of 2007/2008 session (in early April).

Results

The results of the study are summarized as shown below:

Hypothesis 1

From Table 3, it is seen that there is a significant difference between the Mathematics achievement of the rural male and female students. This is because the calculated t-value of 5.43 is greater than the critical t-value of 1.645 at .05 level of significance and 1998 degrees of freedom. The null hypothesis, Ho_1 is therefore rejected and the alternative upheld.

Variable	N	$\overline{x}$	s	df.	t_{cal}
Rural male	1000	13.74	3.54	1998	5.43*
Rural female	1000	12.92	3.21		

*p < .05

Table. 3. Independent t-test analysis of significance between the Mathematics achievement of rural male and female students in Cross River State, Nigeria

Hypothesis 2

It is seen from Table 4 that, the achievement of rural male and female students differ only for those in the low socio-economic bracket and for public schools. At other levels of the variables, there is no statistically significant difference.

Variable	Level	Gender	N	$\overline{x}$	s	df.	t_{cal}
Parental socio-economic status	High	Male	166	13.92	3.40	244	1.145
		Female	156	13.48	3.53		
	Low	Male	834	13.08	3.51	1752	3.391*
		Female	579	12.50	3.48		
School proprietorship public	Public	Male	801	13.02	3.55	1378	2.722*
		Female	579	12.50	3.48		
	Private	Male	199	13.98	3.40	618	0.380
		Female	421	13.87	3.32		

*p < .05

Table. 4. Independent t-test analysis of significance between the Mathematics' achievement of rural male and female students of Cross River State, Nigeria, by SES and School Proprietorship

Discussion of Results

Interest in gender-achievement relationship among rural students stems from the fact that these students are in the majority in Nigeria as a heavily populated developing nation in Africa. The first finding revealed the existence of significant gender achievement gap in favour of the rural males (t_{cal} 5.43, t_{crit} 1.645 at .05 level of significance).

This corroborates popular research findings in gender literature (Ezeameyi 2002; Asimeng – Boahene 2006). Nurture in Nigeria tends to favour male dominance over the feminine gender. Environmental provision for male students makes them fit and able to cope with tasks requiring high intellectual challenge, computation and rigor. This phenomenon is further compounded in Africa where sex-stereotyping is so pervasive that from birth, society fixes gender roles and conditions males to play and act within the con-

fines of intellectually and physically more challenging tasks like construction, moulding, football, palm-wine tapping, climbing, agriculture, fishing and the like. Women on the other hand, are 'sentenced' to the kitchen and related domestic chores, including child-rearing. By extension, female students in the school tend to opt for subjects like, Home Economics and at most Biology. Chemistry, Physics, Mathematics and Further Mathematics are male-dominated zones (Graham, 2001). In school, one hears female students saying that further Mathematics is for the boys and this low motivation may further widen the gender gap in mathematics achievement (Mutemeri & Mygweni, 2005). In fact, a typical informal survey in the Nigerian classroom will readily show a greater proportion of female students opting for non-Mathematical subjects if given the opportunity. This may explain why Mathematics is made compulsory in both primary and secondary schools. Yet, till date many students still offer the subject not by conviction of its significance but on the basis of the compulsion.

The second hypothesis revealed that parental socio-economic status (SES) and school proprietorship as correlates of Student's Mathematics achievement are only partially gender sensitive. That is, whereas there is no significant achievement difference between male and female Mathematics students from the high socio-economic parents, significance is established for the achievements of male and female students from the low socio-economic parents. Also, whereas, male and female students exhibit homogenous Mathematics ability in the private schools, there is a significant difference in the ability of the male and female students from the public schools. All cases of significance favour the male students.

These phenomena could be justified by the fact that students of high socio-economic parents enjoy such motivational intervention as extra home coaching, enriched home environment with tutorial disks and programmes available in video, good library and better state of mental health. Their less fortunate counterparts are highly stressed and exploited at home through engagements in domestic tasks leaving little time for studies. Private schools on the other hand are characterized largely by effective teaching, good instructional supervision and the other advantages of small-scale operation and more manageable teacher-pupil ratio. The consequence is that learner inadequacies including gender defect is over shadowed by strengths from other sources, thus bridging gender gap. This cannot be said of public schools. It is very likely therefore that the environmental disadvantage, coupled with persistent sex-stereotyping typical of African cultures tend to keep the girls below the boys in mathematics achievement.

Conclusion

It is concluded that there exists significant gender differences in rural students' Mathematics achievement in Cross River State, Nigeria.

Educational Implications

A lot needs to be done to bridge the observed gender gap in the Mathematics achievement of rural students in Cross River State, Nigeria. More co-educational institutions for instance, should be established to foster greater healthy rivalry in Mathematics instruction. Male and female students need to compete, collaborate and gain from one another in Mathematics teaching and learning.

Guidance machinery in the school should be energized to encourage more women participation in effective mathematics learning. The female students should be informed that mathematics could be studied and passed just like other subjects, and that the subject is an essential tool, a prerequisite for further education in a host of vocations. Failure in Mathematics is therefore a serious set-back in capacity building and human development.

The current poverty alleviation programme in Nigeria should be sustained and made practically more effective to bridge the gap between the rich and the poor. This will improve child education and foster national development.

Greater collaboration in school funding should be pursued by the government at all levels so that the public schools which are so poorly funded could improve their capacity for productivity. The government should apply itself to the United nations prescribed minimum budgetary allocation for education. The situation whereby governors release less funds than they budgeted for will keep the public school permanently impoverished, and paupers are educational under-achievers.

Mathematics teaching and evaluation strategies should be gender bias-free. This way, males and females will tend to see themselves as equals, capable of competing and collaborating in classroom activities.

References

Abiam, P. O. & Odok, J. K. (2006). Factors in Students' achievement in different branches of secondary school Mathematics. *Journal of Education and Technology.* 1(1), 161 – 168.

Asim, A. E. (2007). Examination ethics and school based assessments in science, technology and mathematics: A

critical concern for universal basic education. *Proceedings of the 9th National Conference of National Association of Evaluators and Researchers*. Nigeria, Ago-Iuoye.

Asim, A. E., Kalu, I. M., Idaka, I. E., & Bassey, S. W. (2007). Competency in STM assessment: The case of primary school teachers in Cross River State, Nigeria. *Proceedings of International Conference to Review Research in Science, Technology and Mathematics Education* (epiSTEME-2), Feb. 12-15, Mumbai, India.

Asimeng – Boahene, L. (2006). Gender inequality in science and mathematics education in Africa: The causes, consequences and solution. Unpublished Seminar paper.

Barton, A. C. (1998). *Feminist Science Education*. New York: Teachers College Press.

Bordo, S. (2001). Selection from the flight to objectivity. In Lederman, M., & Barrtsh, I. (Eds.), *The Gender and science reader*. London: Routledge.

Enukoha, O. I. (1995). *The Psycho-cultural basis for teaching mathematics*. Calabar: Executive publishers.

Ezeameyi, M. N. (2002). The effects of games on Mathematics achievement, interest and retention of junior secondary school students. Unpublished PhD Thesis. University of Nigeria, Nsukka.

Friedman, L. (1989). Mathematics and the gender gap: A meta analysis of recent studies on sex differences in Mathematical tasks. *Review of educational Research,* (59), 185 – 213.

Graham, M. (2001). Increasing participation of female students in physical science class. Unpublished Master's Thesis. Chicago: Saint Xavier University.

Griffith, S. A. (2005). Assuring fairness in school-based assessment: Mapping the boundaries of teachers' involvement. Paper presented at the 31st Annual Conference of International Association for Educational Assessments, 4-9 September. Abuja.

Hopkins, T. M. (2004). Gender issues in Mathematics' achievement in Tennessee: Does rural school locale matter? A Ph.D. dissertation, University of Tennessee, Knoxville.

Howes, E. V. (2002). *Connecting girls and science. Constructivism, feminism, and education reform*. New York: Teachers College Press.

Howley, C. (2002). Research about Mathematics achievement in rural circumstance. Working paper, No. 4. Athens: Ohio University, Appalachian Collaborative Centre for the study of learning, assessment and instruction in Mathematics.

Hyde, J. S., Fennema, E., & Lamon, S. J. (1990). Gender differences in mathematics performance. A meta-analysis. *Psychological Bulletin*, 107, 139 – 155.

Mutemeri, J., & Mugweni, R. (2005). The extent to which mathematics instructional practices in early childhood education in Zimbabwe relates to or makes use of children's experiences. *African Journal of Research in Mathematics, Science and Technology Education*, 9(1), 49-54

Njabili, A. F., Abedi, S., Magesse, M. W., & Kalole, S. A. M. (2005). Equity and school-based assessment: The case of Tanzania. Paper presented at the 31st Annual Conference of International Association for Educational Assessment, 4-9 Sept, Abuja, Nigeria.

Obodo, G. C. (1997). *Principles and practices of mathematics education in Nigeria*. Enugu: General Studies division, Enugu State University of Technology (ESUT).

Opolot-Okurot, C. (2005). Student attitudes toward mathematics in Uganda Secondary Schools. *African Journal of Research in Mathematics, Science and Technology Education*, 9 (2), 167-174.

Reid, N. (2003). Gender and Physics. *International Journal of Science Education,* 25 (4), 509 – 536.

Sinnes, A. T. (2005). Approaches to gender equity in science education. Two initiatives in sub-Saharan African seen through a lens derived from feminist critique of science. Oslo: Unipub. http://www.ils.u10.no/forskninig/palidrgrad/doktorarhandlinger/docs/AstridSinnes Avhandlingfeminist critque of science.oslo: Unipub.pdf.

UNESCO (2003). Gender and education for all: the leap for equality. Global monitoring report 2003/2004. http://www.unesco/oc.unesco.org/education/eta-report/2003-pdf/chapter3.pdf.

United Nations (2000). U. N. millennium declaration 55/2 resolution adapted by the general assembly, September 18, 2000. http://www.un.org/milleniumgoals/.

West African Examination Council (2002). *Chief Examiner's Report*. Lagos: WAEC, Statistics Division.

Yoloye, E. A. (1998). Students' gender and science achievement: Historical perspectives and their present and future practice. In Naido, P., & Savage, M. (Eds.), *African Science and Technology in the new millennium.* Cape Town: Junta & Co.