research parks publishing

International Journal on Integrated Education (IJIE)

e-ISSN: 2620 - 3502
p-ISSN: 2615 - 3785

Volume: 7 Issue: 1 | Jan 2024
https://journals.researchparks.org/index.php/IJIE

Gender Parity in the Teaching of Science, Technology, Engineering, and Mathematics (Stem) in Cameroon

Nekang, Fabian Nfon (PhD)
Associate Professor, Faculty of Education, University of Buea, Cameroon

Nfor, Julius Cheny (PhD)
Lecturer, Higher Technical Teacher Training College Bambili, The University of Bamenda, Cameroon

Abstract

The paper discusses the gender disparity in education, particularly in Science, Technology, Engineering, and Mathematics (STEM). It examines the fact that teachers tend to stereotype mathematics as a male domain resulting in differential treatment of males and females in classrooms. This also results in the development of gender differences in STEM. It presents extracurricular, out of school factors and socio-cultural factors which contribute substantially to poor female enrolment in school thus causing serious gender imbalance in education in Cameroon and other African countries. The paper looks at the goals that lay the foundation for global policy on quality education and gender equity in the new millennium.

Keywords: Gender stereotype, gender disparity, teaching of STEM, Cameroon.

Introduction

The Cameroon government and many governments in Africa are aware of the benefits of female education. The education of females has a profound effect on national development as lack of their education has been linked to low birth weight, poor health and high mortality rates in children, high fertility rates, poor family nutrition, low life expectancy, poor sanitation and high illiteracy rates. Thus, the socio-economic importance of female education cannot be over emphasized (Nekang & Agwagah, 2011,).

Efforts to boost female education have been made by the many African governments, international organizations, Non-Governmental Organizations (NGOs) and religious organizations. In spite of the various actions and inputs, there is still a gender disparity in education. Girls continue to avoid courses which lead to careers in science, technology, engineering, and Mathematics (STEM). According to Torto (2004), females still have low access to education, low participation and poor performance in many subjects, especially mathematics and the mathematical sciences. Many factors which are home, community and school based, continue to restrict developments in female education (Cheny, 2020). Ogunjuyigbe, Liasiu and Sulaiman (2008) believe that deeper forces in society that extend well beyond the boundaries of educational systems, institutions and processes cause gender inequality in STEM. Mallam (1993) found out that there is a significant difference between the attitudes towards mathematics of females taught by male teachers and of females taught by female teachers in Nigeria. The highest proportion of female students demonstrating positive attitudes towards mathematics was found in all-girls' secondary schools where mathematics was taught by female teachers, while the lowest proportion was in coeducational secondary schools where mathematics was taught by male teachers. Fennema (1990) states that there is no conclusive evidence about teachers' believes that mathematics is more appropriate for males than for females. Wherever evidence exists, it indicates that teachers tend to stereotype mathematics as a male domain. Such stereotyping results partially in differential treatment of males and females in classrooms and undoubtedly influences the development of gender differences in mathematics. Teachers' beliefs are somewhat negative about females and the learning of mathematics.

According to Ogunjuyigbe, Liasu and Sulaiman (2008), since there are no policies against gender balance in science and technology activities and access to educational institutions, teachers enjoy reverse discrimination in favour of females. The constraints against parity in participation or performance in science and technology are mainly socio-cultural, economic and of teaching/learning process factors.

Causes of Gender Disparity in STEM

Ogunjuyigbe, Liasu and Salaiman (2008) opine that in African countries, economic, socio-cultural and religious factors are the causes of gender disparity in education. Poor infrastructure, the poor quality of education, and geographical factors are also considered significant. Household heads tend to emphasize structural and cultural constraints to female participation in STEM. In Cameroon, the most frequently cited reasons given by household heads are financial constraints, cost of education materials, poor attitudes of government and parents to female participation in STEM, the negative attitude of girls and cost related factors. As concerns children, the causes of gender disparity in STEM are related to women's traditional roles and their personal attitudes, which may also result from their religious orientation. A good number of male and female children belief that gender determines who pursues STEM education.

According to Torto (2004), research has shown that factors within the classroom are not the only cause of gender imbalance in education and that home based factors which include family size, household income, parents' education, cultural and traditional beliefs all contribute substantially to poor female enrolment in school. Girls are pulled out of school and boys left in school when the family income dictates that all children cannot be educated. Girls miss school when there are chores to be done at home or there is a sick family member to nurse. Girls are taken out of school when they mature to prepare them for marriage or help supplement the family income by selling, farming or performing other money earning activities.

Torto equally stated that extracurricular and out of school factors play a big role in female education such as long distances from school, sexual harassment by classmates, teachers and males in the community and inefficient use of her time contribute to making attendance in school poor. The girl child drops out of school when conditions at home, in school, on the way to school and in the community prevent her from having a meaningful and conducive learning environment.

Time is inefficiently used by many girls at school and at home. Time is needed for homework and studies rather than for household chores, playing, chatting and visiting friends. In school, while boys may spend the hours outside the class time discussing academic problems, girls may be found in clusters gossiping. Also, teachers ask girls to baby-sit and run errands for them during and outside school hours. Girls sometimes volunteer for these jobs to gain favours from the teacher or to enable them get out of participation in some lessons or school activities. Girls also use their school time inefficiently by not participating fully in class discussions. Unfortunately, this attitude of girls is partially based on African traditional practices where girls and women are not supposed to enter into discussions with men but are only to listen. Since some teachers do not make the effort to pull students into discussions when they do not participate, the girl then lose out on so much and are also not able to share with the rest of the class ideas they may have (Torto, 2004).

Some African women belief that women participation in STEM education is a waste of time and resources. This perception comes from the erroneous belief that STEM courses take longer time to complete and girls have very limited time before marriage. Also, female underdevelopment and backwardness, hatred and intra-familial squabbles, poverty, poorly motivated children, control of public post by men and unemployment of women are some of the root causes of gender disparity. Gender disparity in STEM could have negative impact on familial relationship since such disparity could engender misunderstanding among family members especially between women who have only female children and those with only male children (Ogunjuyigbe, Liasu & Sulaiman; 2002).

Among the less literate and predominantly Islamic communities in Africa, female education ends in marriage. This is in line with early findings that "it is more beneficial to formally educate a boy than a girl and that girls only need to be educated and trained in house chores to prepare them for marriage" (FEMSA, 1996; Report No. 9). Female education is also believed to be destabilizing as many educated women agitate for change in traditional roles and decision making process (FEMSA, 1996; Report No. 10).

Lahle and Meece (1994) observe that the basic causes of gender discrimination against women involvement in education are deeply rooted in socio-culturally determined attitudes. The socio-cultural factors include patriarchy which encourages and perpetuates discrimination against females, sex stereotype, division of labour in which domestic chores at home are assigned to females. In some homes of illiterate parents who still form the majority of African population, education of boys is given priority and more prominence in view of the need to perpetuate family name in a competitive society. Kahle and Meece further states that the cultural division of labour stereotypes certain careers as unfeminine and incompatible with marital demands. This is largely because majority of science and technology-related careers have in-built inflexibility in work schedules, requiring those involved to be taken out of their homes to the laboratory or the field, they are believed to be incompatible with feminine responsibility to meet the dual-role demand of home and work. Consequently, majority of girls with potential for technical and scientific skills are discouraged from pursuing STEM subjects. It is not that girls cannot and do not have the ability to succeed in science, technology, engineering, and mathematics courses, but rather that obstacles arise in recruiting and retaining girls.

Similarly, Erinosho (1994) opine that girls are facing many obstacles caused by societal ills such as poverty. Since girls are still largely under-valued by society, when family members become incapacitated by illness or old age, girls are often the first to be relegated to the caregiver status and thus further compromising their chances of self-development and success. They are also the most defenseless and vulnerable, hence, they are more open to rape, sexual harassment and gender-based violence in the schools and society (Adelman, 1991). Although girls' enrolment in primary and secondary education has improved in many African countries, the global education rates for girls at the primary level remain lower than those for boys for the various socio-cultural factors already advanced.

Policy Specifics and Gender Equity

Zonta International (2007) believes that education is critical to improving women's status in all aspects of society. Zonta International has demonstrated its commitment to ensuring that women and girls have access to education by supporting and providing local and international education opportunities and by awarding grants for projects that seek to change personal and/or political knowledge, attitudes and behaviours contributing to barriers that prevent women and girls from accessing education.

Zonta International states that although female enrolment at all levels of education is increasing; women and girls continue to face barriers to education in STEM and are under-represented in these areas of study and employment. Encouraging women and girls to study these subjects is essential to achieving gender equality, advancing economic development and scientific discovery, and addressing the increasing shortage of skilled scientists, engineers and mathematicians worldwide. Recognizing that:

- The full potential of scientific research and development cannot be realized without women's equal participation and incorporation of women's priorities, perspectives, and approaches to problem solving;
- Women's contributions to science and technology are critical to improving the quality of life and economic development of any country and will be a key element to reducing poverty, creating job opportunities and increasing agricultural and industrial productivity;
- Equal representation of women in STEM professions will increase the capacity of the scientific community to solve global problems.

Zonta International strongly endorses policies, legislation and programs that support and improve women's and girls' access and full participation in STEM education and professional advancement.

UNESCO reported in 2007 that girls' enrolment has increased at the secondary level in all developing regions since 1990, while enrolment levels favoring boys at the secondary level are seen almost exclusively in low-income countries. Despite recent progress in girls' enrolment, girls are not choosing to study science and technology subjects at the same rate as boys. A lack of role models among teachers, gender-biased curricula and textbooks, negative attitudes of teachers, and gender stereotyping of girls' career interests all influence girls' decisions not to enroll in scientific and technical subjects. Consequently, girls are less likely to obtain the education required to take up a STEM career and less likely to receive appropriate career information.

UNESCO also reported in 2007 that at the tertiary level, women have made significant progress in enrolment rates in many countries. However, gender disparities across specific fields of STEM are persistent. In many countries, women's pursuit of biosciences has significantly increased, while women's representation in mathematics, physics and engineering remains low globally. Women may be deterred from pursuing a career path in STEM by a male-centered workplace culture, recruitment and promotion practices, and misinformed perception of what the job entails, selection and allocation of research funding, policies towards family and work balance issues, and a lack of women role models and mentors in leadership positions. Women in science and technology fields are often paid less than equally-qualified men, less likely to be promoted, and hold positions in the lower ranking levels of the science system.

The six Dakar goals that lay the foundation for global policy on quality education in the new millennium are the following:

- Expanding and improving comprehensive early childhood care and education, especially for the most vulnerable and disadvantaged children.
- Ensuring that by 2015 all children, particularly girls, children in difficult circumstances and those belonging to ethnic minorities, have access to and complete, free and compulsory primary education of good quality.
- Ensuring that the learning needs of all young people and adults are met through equitable access to appropriate learning and life-skills programmes.
- Achieving a 50 per cent improvement in levels of adult literacy by 2015, especially for women, and equitable access to basic and continuing education for all adults.
- Eliminating gender disparities in primary and secondary education by 2005, and achieving gender equality in education by 2015, with a focus on ensuring girls' full and equal access to an achievement in basic education of good quality.
- Improving all aspects of the quality of education and ensuring excellence of all so that recognized and measurable learning outcomes are achieved by all, especially in literacy, numeric and essential life skills (UNESCO, 2002).

Improving the Teaching of Mathematics in Cameroon

The state of higher education in Cameroon reveals that the system is ill-suited to the task of producing graduates with the right set of functional and entrepreneurial skills implied by the vision 2035 blueprint. It is supposed to produce theoretically and practically deep entrepreneurial graduates in mathematical sciences, graduates who are appropriately ICT-literate to be able to drive knowledge economies in Africa. Unfortunately, there are a number of issues related to dysfunctional mathematical science education in Cameroon and other developing African countries (Nekang & Agwagah, 2011).

Most mathematical sciences lecturers simply have deep subject matter knowledge with little or no professional teaching experiences or qualifications. Hence, core concepts are not deeply explained, with sufficient empathy for the learners' backgrounds and clear links to practice. Also, the mathematical sciences curriculum in Cameroon like other African countries present broad educational objectives but the teachers fail to link the subject matter of the different modules to specific learning outcomes. This gap in professional practices means that students graduate without adequate grounding in critical use of the acquired knowledge in real life contexts, and without substantial development of related professional skills. Had the curriculum linked the learning sufficiently to effective problem solving skills and awareness of how the concepts learned could be used to understudy cogent societal problems, the graduates would have been equipped to add more value than is now the case. Lastly, the pedagogical research of good quality in the mathematical sciences exist in general education departments in higher educational institutions and research institutes but the results are not used as expected to improve teaching and learning in the core departments themselves. The goal is to enable the graduates to become better skilled and employable learners, thereby enhancing the socio-economic wellbeing of the country (Ezepue, 2006).

James and Brown (2005) state a number of issues pertinent to the improvement of learning outcomes which include: the attainment of key competencies; understanding of ideas, concepts and processes; capacities for cognitive understanding, creative construction of own meanings and knowledge innovation by learners; effective use of learning in appropriate contexts; higher-order learning involving advanced thinking, reasoning and metacognition (learning how to think reflexively and deeply about own and others work); dispositions including attitudes, perceptions and motivations; and group training.

To expand on the above view, McGuiness (2005) presents the following learning outcomes:

- Learning-as-receiving information, which mainly occurs in teacher-led lecture situation aimed at covering the key concepts of a model and typically assessed by tests of recall of such concepts for example, in examinations;
- Learning-as-construction, which goes beyond information capture to the generation of new meanings and requires mostly non-examination based assessment for/of learning.
- Learning-as-active information processing involving knowledge organization for reasoning, problem-solving and improvement of own learning and most appropriately assessed through extended coursework, term papers and case analysis for example;
- Learning-as-developing expertise in a domain, requiring deep theoretical understanding of a particular discipline like Mathematics and its use in diverse problem contexts mastery in a nutshell.
- Learning-as-developing contextual structures, involving progressive capacities in the learner to overcome misconceptions in a discipline like misconception in statistics and mathematics.
- Learning-as-mindful self-regulation in which the learner learns how to learn, re-appraise and align the knowledge gained to self-improvement and wider organizational plus societal goals, and

- Learning-as-social construction, such as collaborative learning through group work in which the learner imbibes the skills of sharing meanings outside-of-self and contextualizing the knowledge gained through participatory awareness of a wider range of views.

This multifaceted goal of meaningful, contextualized and personalized learning is not achievable with traditional teacher-led (Sage-on-the-stage) as opposed to student-led (guide-on-the-side) approaches to teaching and assessing STEM. It is therefore the tasks of the mathematical sciences fraternity in Cameroon and developing countries of sub-Sahara Africa to urgently improve their overall understanding of modern instructional dynamics by developing and effectively assessing learning outcomes that enhance both male and female students learning in mathematics and the mathematical sciences.

Basis for Improvement in STEM Education in Cameroon

To address gender disparity in higher education, Bunyi (2004) highlighted two major issues:

1. Higher education institutions, especially African universities, have a critical role to play in the social and economic transformation of African societies. Increased women's participation in higher education is particularly important in the era of globalization that we live in. Globalization seems to favour those with higher levels of useful knowledge and skill (but threatens the livelihoods of the lowest skilled and low knowledge levels, and devalued by technological changes, those in traditional areas of skill). It is only through higher education that women can be sure to acquire the knowledge and skills needed to earn competitive incomes and thus lead meaningful lives in a globalized world.
2. Concern about gender issues in higher education is rife because of women's contribution to social, economic and political development. If basic education for women has produced unequalled socio-economic benefits at the family and community levels, then higher education enables women to participate usefully in the social, political and economic lives of their communities and countries as leaders in business, in the professions and in politics. All these go to prove right, the popular adage that 'when you educate a man you educate an individual, but when you educate a woman you educate a generation'.

To enable both boys and girls participation in STEM education in Cameroon and Africa, the following have been suggested:

- Sensitization and awareness building activities to enable society do away with cultural beliefs which marginalize women.
- Identification and support of orphaned and needy girls so that they can stay in school and bridge the gap between the boys and the girls.
- Girls should be encouraged in school and should be allowed more opportunities to observe female role models in STEM careers and women scientists at work.
- They should be provision of sponsorships for girls in STEM careers.
- More and better facilities for the teaching and learning of science should be provided.
- Parents should try and decrease the work load of girls at home to enable them have more time for their studies.
- There should be equitable distribution of educational facilities (instructional aids, classrooms) in educationally needy communities.
- There should be adequate remuneration for teachers and those in science fields to encourage others to follow in their profession.
- There should be a policy on homework where there is a compulsory period for doing homework and assignments in the evening or immediately after school so that girls should have a chance to

get their school work done before household chores. There should be education campaigns and advocacy programmes to encourage girls to stay in school. The Nigerian government should make it mandatory for parents to send their daughters to school or face the consequences.

- Payment of school fees in installments should be permitted to enable poor parents cope with stressful situations of educating their children. The linkages between the school, parents and teachers associations (PTA) should be reviewed with the aim of enhancing the role each of them plays in STEM education.
- Parents and girls should be encouraged to participate in self-help projects to generate money which could be used towards the girl's education.
- Teachers should consider their students as equals, relate equally with them and give them equal tasks so as to bridge the gender gap, encourage participation and success in STEM courses.

Since women's and girls' access to and participation in science, mathematics and technology education varies among countries, advocacy strategies will need to be adapted to local circumstances. Zonta International (2007) calls on parents, educators, administrators, law, and policy makers to:

- Provide free primary education for all;
- Encourage young girls to engage in projects that develop critical thinking and analytical skills and ensure that they are given the necessary mathematics and science courses to enter into the science, mathematics and technology fields for future careers;
- Adopt teaching methods that address gender-related differences in learning that affect student interest, achievement, and career choices;
- Use learning materials that promote gender equity and eliminate gender-biased curricula and textbooks, gender stereotyping, and negative attitudes surrounding girls' pursuit of education and careers in science, mathematics and technology;
- Sensitize male students and teachers to gender stereotyping of girls' in science, mathematics and technology;
- Create mentorship programs for girls interested in science, mathematics and technology;
- Increase the number of female educators and role models in STEM;
- Encourage female students to fully participate in all aspects of the learning/teaching processes and science, mathematics and technology activities;
- Provide girls and women with career information and scholarship eligibility in the science, mathematics and technology fields and encourage their study in these fields and related subjects;
- Create laws that support work-life balance issues such as maternity and paternity leave;
- Assign funding to implement all these initiatives.

Zonta International calls on industries to:

- Provide equal pay for equal work;
- Remove barriers that discourage women's participation and advancement in science, mathematics and technology positions in industry;
- Offer incentives to science, mathematics and technology professionals for mentoring female students in science, mathematics and technology at primary, secondary and tertiary school levels. This could include outreach programs and short term work experience placements with schools and tertiary institutions to provide female role models and encourage female students to seek careers in science, mathematics and technology professions;

- Provide scholarships and awards for women and girls to encourage their participation in science, mathematics and technology education;
- Develop or expand recruitment strategies aimed at attracting and retaining women in both science, mathematics and technology positions, as well as in management and senior management positions in these industries;
- Adopt policies that allow for work-life balance (maternity and paternity leave, flexible or part-time work, job share, working from home, affordable day-care for children, and so on);
- Support professional development opportunities for women.

Conclusion

Boys usually think more of professions that will yield money to enable them marry and maintain a home. Hence, professions like medicine, engineering, business, banking and finance are highly favoured by them. On the other hand, society expects females to play a supporting role when it comes to maintenance of families. Unfortunately, many men now find it difficult to perform this role for various reasons ranging from poor remuneration if employed, to poor revenue generation if self- employed. In many homes, women are faced with the task of becoming the breadwinner due to economic crisis. According to Ogunjuyigbe, Liasu and Sulaiman (2008), there is urgent need for change of attitude towards gender fairness and encouragement of gender balance in all endeavours so that women can be well prepared for such roles in future. Serious economic problems do arise when widows are faced with the problem of bringing up the young ones. Women need to be properly empowered to handle such responsibilities in life if and when the need arises.

To address the imbalances in females' access to STEM, there is need to implement some measures of fair discrimination or equitable redress in favour of girls who are normally subjected to greater disadvantages by the society. Teachers and the educational system have the ability to shape the self-image and future of girls as they approach STEM fields. There is also the need to use various teaching methods and strategies that can arouses students' interest, reduces arithmetic errors, increases student-teacher relation, and bridge the gender gap. According to Nekang (2016), these anti aversions are:

- ✓ Use of computer aided instructions (CAI) to present drills, practice exercise, tutorial sequences, and dialogue about the subject matter and so on.
- ✓ Mathematics readability skills should be taught since they enhance achievement.
- ✓ Application of ethno-mathematics approach in teaching school mathematics. Use of andragogical inquiry approach in teaching mathematics.
- ✓ Models for mathematics teaching and learning are enrichment devices which may be concrete or semi-concrete or abstract for use by teachers to make mathematics concepts clearer to learners.
- ✓ Use of games and simulations for teaching mathematics.
- ✓ Use of concept mapping instructional approach in mathematics.
- ✓ Application of mathematics problem solving models and many more.

References

1. Adelman, C. (1991). Women at thirty-something: Paradoxes of attainment. Washington DC: Office of Education Research and Improvement, U.S. Department of Education. pp. 14-25.
2. Cheny, J. N. (2020). Socio-economic status and female enrollment in Engineering and Technology programmes in Anglo-Saxon state universities of Cameroon. *International Journal of Trend in Scientific Research and Development. 4(3), 2456-6470.*

3. Eepue, P.O. (2006). Towards a model of Academic Excellence and Entrepreneurship in Teaching and Research, Proceedings of the 2nd International Conference on Integrating for Excellence, June 28-30, Sheffield Hallam University, UK.
4. Erinasho, S.Y; (1994). In: Girls and Science Education in Nigeria, Ango International Publishing, Abeokuta, Nigeria pp. 7-11.
5. Ezepue, P.O (2009). Addressing Economic Development Goals in African Higher Educational Institutions through Effective Teaching of Mathematical Science-A Statisitcal Modelling Example.
6. FEMSA (1996). Report No. 10: Status of Girls' Participation and Performance in SMT Subjects in Secondary Schools, FAWE, Kenya.
7. FEMSA (1996). Report No. 9: Status of Girls Participation and Performance in SMT Subjects in Primary Schools, FAWE, Kenya.
8. Fennea, E. (1990). Teachers Beliefs and Gender Differences in Mathematics. Mathematics and Gender. New York: Teachers' College Press pp. 169-187.
9. Kahle J.B. and Meec'e (1994). Research on Gender Issues in the Classroom. In A.B. Champagne (ed.) Handbook of Research on Science Teaching and Teaching New York: Macmillan.
10. Mallam, W.A (1993). Impact of School-type and Sex of the Teacher on Female Students' Attitude Towards Mathematics in Nigeria Secondary Schools. Educational Studies in Mathematics. 24, pp 223-229.
11. McGuiness, C. (2005). Behind the acquisition Metaphor: Conceptions of Learning and Learning Outcomes in TLRP School-based projects, The Curriculum Journal 16(1), pp. 31-47.
12. Nekang, F. N. (2016). *Principles and Practice of Mathematics Education in Cameroon. Yaoundé*: NEC- Yaoundé. ISBN: 995643690-9.
13. Nekang, F. N. and U.N.V Agwagah (2011). A Review of the Teaching of Science, Mathematics and Technology (SMT) for Attainment of the Seven Point Agenda in Nigeria: Implications for Gender Parity. *African Journal of Social Sciences, 2* (2) 12 - 24. Agwecams Printers, Bamenda.
14. Ogunjuyigbe, P.O, Liasu, A.S and Sulaiman, A.(2008). Gender Differences in Science Mathematics and Technology: Why do fewer females participate in SMT course in Nigeria? http://www.acardemicjournals.org//NGOJ pp.1-7.
15. Oyebade, S. A. (2007). Gender Participation in University Education in Nigeria and some Commonwealth Countries. *Reforming Higher Education in Africa*, pp. 284-307.
16. Torto, Rita (2004). Extracurricular and out of school factors affecting girls' participation and performance in SMT subjects: (Home/Community factors, distance from school, safety, time use), *DEA*.
17. UNESCO (2007). Sciences, Technology and Gender: An International Report.
18. Zonta International (2007). Zonta International Position Paper. Improving the Access of Women and Girls to Science, Mathematics and Technology Education.