Assessment of the Perception of Female Undergraduates' Participation in Science, Technology and Mathematics

BY

John H. Rechard, *Ph.D*
Faculty of Education
University of Cape Coast,
Cape Coast, Ghana

ABSTRACT

Science is a body of knowledge that belongs to humanity as a whole. The history of science is full of ups and downs, which have famously been likened to political revolutions. Mathematics is a socially shared and logically structured conceptual system. The process axis for personal understanding must contain the following categories; intuitive, declaratory, argumentative, and structural. Science, Technology and Mathematics (STM) have been identified as the bed rock or foundation of wealth and consequently an imperative for national development. It has also been argued that in this era of globalization only persons with appreciable knowledge, skills and abilities in STM are required in the job market. Female gender discrimination is also as any situation where a woman is denied an opportunity or misjudged solely on the basis of her sex in the school system of many developing countries. The paper concluded that despite the relevance and utilitarian purpose of STM, it has been observed that participation of females in the field is low. One of the recommendations was that the necessary facilities and infrastructures for the study of STM subjects/courses should be provided at the different levels of education.

KEYWORDS: Science, Technology & Mathematics (STM), Undergraduates, Female undergraduates, Participation and Gender Discrimination

Introduction

Mathematics is about the oldest subject in existence. It originated from man's quest for a language or means of counting, measuring and recording his possessions. It is a subject whose knowledge is useful in every aspect of life. This is why it occupies a significant position in the school curriculum. It is a compulsory subject at the primary and secondary school levels, and a credit pass in ordinary level mathematics is required for admission to study the majority of the courses at the tertiary level. Today, mathematics has been generally accepted as the bedrock of science and technology, a language which scientists use to express scientific findings. Audu (2005) stressed that "mathematics is the foundation for any meaningful scientific endeavour and any nation that must develop in science and technology must have a strong mathematical foundation for its youths". According to him, mathematics is frequently encountered in association and interaction with astronomy, physics, and other branches of natural sciences, and it also has deep-rooted affinities to the humanities. He concluded that mathematics is an indispensable medium by which and within which science expresses, formulates, continues and communicates itself. Alutu and Eraikhuemen (2004) investigated the involvement of females in mathematics in some universities. The study shows that the ratio of male to female lecturers was approximately 16:1, and the ratio of males to females enrolled at the undergraduate levels was 2:1, while at the post graduate levels, the ratio of male to female on roll was 6:1.

Nwelih, Igene & Igene (2013) investigated gender studies in computing at the University of Benin. The results show that females are disadvantaged or less involved in the technical and logical aspects of computer use. They concluded “that something definitive has to be done to improve the statistics in computing in favour of females; else we risk having a population teeming with females inadequately prepared to face the future; a future in which computers, information and technology hold sway”. The work of Imogie & Eraikhuemen (2008) on sex differentiation in admission and academic performance at the University of Benin yielded similar findings. Their data analysis revealed wild gaps in favour of males in the enrolment and graduation figures of males and females. They opined that the observed gaps are basically a result of the society’s perception of the roles of males and females, especially as it is generally believed that arts and education disciplines are for females, while engineering, medicine and social science disciplines are for males. Gender disparity in enrolment into education physics as a course of study in the university has also been reported (Eraikhuemen & Eraikhuemen, 2010). This study shows that more males than females enroll into education physics.

Concept of Science

Science can be defined as the human activity practiced by “scientists”, who are often assembled in scientific communities, and whose results and pronouncements often conflict. Science is a body of knowledge that belongs to humanity as a whole. The history of science is full of ups and downs, which have famously been likened to political revolutions. There are stated and unstated principles and rules by which scientists operate, primarily encoded in the “scientific method”, which is in principle based on empirical observation, logic, verification and falsification, but in practice affected by many other contingencies. Out of this scientific activity there emerges a body of knowledge we will call “Science”, which has special properties that are quite different from those of “science” (the human activity) or of any other human activity (Hohenberg, 2010). This body of knowledge, of which the clearest example is arithmetic is a unique creation of the human community. It must be stressed, however, that the features of Science that lend it authority are also the source of limitations of Science, limitations that need to be identified and understood.

Concept of Technology

As we can see, technology concepts are not consistently defined in the literature. The first point is that technology concepts are defined or described in two level: The first level refers to the overall concepts of nature of technology as big ideas: Concepts of technology (De Vries, 2007), universal attributes (Savage & Sterry, 2010), principle (Engineering y Design™ Program, TEA). The second level refers (mainly) to factors or features that should be considered through design activities in class (ITEA, 2000; Compton, 2004; Hill, 2014; Banks, 2009). The second point is that there is inconsistency and confusion even within each level. For example, on the level of technology as big ideas the concepts of technology as processes, knowledge, artifacts and volitions (Mitcham, 2002), are more on a philosophical level than the universal attributes (Savage & Sterry, 2010) or the principles that are expressed by The Engineering by Design™ Program (ITEA). Inconsistency and confusion is also at the second level which refers to theoretical concepts that are used in technological activities. While there are concepts like systems and control that cut across all the different views (ITEA, 2000; Compton, 2004; Hill, 2014; Banks, 2009), there are some concepts which are unique to each view: Values (Banks, 2009), fitness for purpose, efficiency (Compton, 2004), requirements (ITEA, 2000). Technology consists of two primary components: 1) a physical component which comprises of items such as products, tooling, equipments, blueprints, techniques, and processes; and 2) the informational component which consists of know-how in management, marketing, production, quality control, reliability, skilled labor and functional areas.

Concept of Mathematics

The conception of mathematics underlying our theoretical model is characterized primarily by considering mathematics as a human activity. Concepts and mathematical procedures emerge from a persons' acts for solving some problem fields. This activity is mediated by the semiotic instruments provided by the culture and by our capacity for deductive logical reasoning. Secondly, mathematics is a socially shared and logically structured conceptual system. Consequently, the process axis for personal understanding must contain the following categories; intuitive (operative), declaratory (communicative), argumentative (validating), and structural (institutionalized). The achievement of these levels of understanding for a concept or conceptual field will require the organization of specific didactic moments or situations, as Brousseau (2009) proposes in his didactic situations theory. Mathematics can also define in various ways Mathematics is a human activity involving the solution of problematic situations. In finding the responses or solutions to these external and internal problems, mathematical objects progressively emerge and evolve. According to Piagetian constructivist theories, people's acts must be considered the genetic source of mathematical conceptualization.

Mathematical problems and their solutions are shared in specific institutions or collectives involved in studying such problems. Thus, mathematical objects are socially shared cultural entities. Mathematics is a symbolic language in which problem-situations and the solutions found are expressed. The systems of mathematical symbols have a communicative function and an instrumental role. Mathematics is a logically organized conceptual system. Once a mathematical object has been accepted as a part of this system, it can also be considered as a textual reality and a component of the global structure. It may be handled as a whole to create new mathematical objects, widening the range of mathematical tools and, at the same time, introducing new restrictions in mathematical work and language. The subject performs different types of practices, or actions intended to solve a mathematical problem, to communicate the solution to other people or to validate or generalize that solution to other settings and problems. The genesis of a subject's knowledge arises as a consequence of that subject's interaction with the field of problems, which is mediated by institutional contexts (Juan, 2013).

Concept of Science, Technology and Mathematics (STM)

Science, Technology and Mathematics (STM) can be seen as a cord of three strings which are interwoven and interdependent. Advances in one field result in/from development in the other. STM have been identified as the bedrock or foundation of wealth and consequently an imperative for national development. It has also been argued that in this era of globalization only persons with appreciable knowledge, skills and abilities in STM are required in the job market. Any country that has not embraced or made significant efforts to advance STM education is said to be on the wrong or negative side of the international digital divide. Despite the relevance and utilitarian purpose of STM, it has been observed that participation of females in the field is low. Badekale (2003) reported that women in Africa are greatly underrepresented in science and technology related courses/occupations. In the same vein, the international conference organized by UNESCO in Bamako, Mali in July 2009 assessed the participation of girls and women in science and technology in Africa to be the lowest of all the regions of the world (Nnaka, 2009).

Concept of Female Gender Discrimination

The Black's Law Dictionary defined discrimination as "a practice that confers privileges on certain class or that denies privileges to a certain class because of race, age sex, nationality, religion, or handicap or differential treatment, especially a failure to treat all persons equally when no reasonable distinction can be found between those favoured and those not favoured" (Fasina and Faniyi, 2017). Female gender discrimination refers to any situation where a woman is denied an opportunity or misjudged solely on the basis of her sex in the school system of many developing countries. Gender discrimination is any unequal treatment based on gender and may also be referred to as sexism. Langston University (2014) defines gender discrimination as an unequal or disadvantageous treatment of an individual or group of individuals based on gender. Sexual harassment is a form of illegal gender discrimination. Gender discrimination can be treating an individual differently based upon his/her gender in academia or extracurricular activities, academic programs, discipline, class assignments given in a classroom, class enrollment, physical education, grading, and/or athletics (Langston University, 2014). According to Jeong (2019), victims of gender-based discrimination struggle to make a case and get justice as it is hard to prove gender discrimination and sometimes do not complain because they are afraid of the repercussions. The existing directives against gender discrimination are not effective because the law is weakly enforced and corporations do not comply (Paulsen, 2019).

Conclusion

This paper concludes that mathematics is an indispensable medium by which and within which science expresses, formulates, continues and communicates itself. Meanwhile, despite the relevance and utilitarian purpose of STM, it has been observed that participation of females in the field is low. Women in Africa are greatly underrepresented in science and technology related courses/occupations.

Recommendations

1. The necessary facilities and infrastructures for the study of STM subjects/courses should be provided at the different levels of education.
2. Females should be encouraged into STM through awareness campaign, role modelling and mathematics and science competitions.
3. Mathematics and science teachers should make their subject interesting to learn, and they should encourage healthy competition between males and females in STM subjects/courses.
4. Parents should socialize their daughters in such a way that they will opt for STM courses/careers.

REFERENCES

Alutu, A. N. G. & Eraikhuemen (2004). The Shortfall of female mathematics lectures in Nigeria Universities: Strategies for promotion and retention of prospective female mathematics lecturers. *Journal of International Women's Studies*. 5(5). 72-84.

Audu, M. S. (2005). Application of Mathematics. In Ale, S. O. & Adetula, L. O. (eds.) *Reflective and intellective position papers on Mathematics Education Issues*, Abuja: Marvelous Mike Ventures Ltd.

Badekale, A. J. (2003). Women and Engineering in Nigeria: Towards Policy Initiatives and Increased Female Participation in Badekale A. J. (Ed). African Technology Policy studies(ATPS) working paper series No. 37.s

Banks, F. (2009). *Teaching Technology*, The Open University Press, U.K

Brousseau, G. (2009). Fondements et méthodes de la didactique des mathématiques. *Recherches en Didactique des Mathématiques*, 7 (2): 33-115.

Compton V., (2004). *Technological Knowledge*: A developing framework for technology education in New Zealand http://www.tki.org.nz/r/nzcurriculum/docs/technological-kn.do

De Vries, M. J. & Tamir, E (2007). Shaping Concepts of Technology: What Concepts and How to Shape them? *International Journal of Technology and Design Education*, 7 (1-2).

Eraikhuemen, L. & Eraikhuemen, I. B. (2010). An Analysis of Gender Disparity in Students' Enrolment into Education Science Disciplines in the University of Benin. *Journal of Mathematical Sciences*. 21(4). 363-375.

Fasina, F. and Faniyi, F. F. (2017). *Gender Discrimination and Development in Nigeria*: Issues and Perspective. Covenant University, Ota. Ogun state.

Hill, A. M., (2014). Reconstructions in Technology Education. *Journal of Technology and Design Education*. 7(1-2).

Hohenberg, P. C. (2010). *What is Science*? New York University.

Imogie, A.O. & Eraikhuemen, L. (2008). An Inquiry into sex differentiation in Admission and Academic Performance at the University of Benin, Nigeria. *Benin Journal of Gender Studies*. 1(1): 1-14.

ITEA. (2000). Standards for technological literacy: Content for the study of technology. Reston.

Jeong, S. (2019). *South Korea's glass ceiling: the women struggling to get hired by companies that only want men*. CNN World

Juan D. Godino (2013) *Mathematical Concepts, Their Meanings, And Understanding*1 https://www.ugr.es/~jgodino/articulos_ingles/meaning_understanding

Langston University (2014). *Gender Discrimination Defined*. Retrieved from: https://www.langston.edu/

Mitcham, C, (2002), *Thinking Trough Technology*. The University of Chicago Press.

Nnaka, C. V. (2009). The Media as a viable Instrument for enhancing Women's entry and success in science and technology related courses/occupations in Nigeria. In Ighoroje, A.D.A; Kisamo, D; Edema, M. O. (eds.) *TWOWS African Regional Conference Proceedings*. 421-427.

Nwelih, E.; Igene, O.O. & Igene, O. K. (2013). An Exploratory Gender Study in Computing: A case Study of University of Benin, Benin City, Nigeria. *Benin Journal of Gender Studies*.3(1&2): 170-179.

Paulsen, F. (2019). *Gender-related discrimination in the Japanese and South Korean workforce*. National Chengchi University. Retrieved from: www.japanesestudies.org.uk.

Savage & Sterry (2010). *A Conceptual Framework for Technology Education*. ITEA