

GENDER MAINSTREAMING: INNOVATIVE INSTRUCTIONAL STRATEGIES FOR PROMOTING GENDER EQUALITY IN STEM EDUCATION

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Abstract

This paper examined the under-representation of females in STEM education, issues bothering on gender inequality as well as innovative instructional strategies that can help to promote gender mainstreaming. Efforts were made in this work to provide the meaning of gender, gender equality, gender mainstreaming and STEM education. An overview of the innovative instructional strategies for mainstreaming gender in STEM education which include peer tutoring, concept mapping, blended learning, games and simulations were discussed. Some recommendations were made among which is; that STEM teachers should be encouraged to use innovative instructional strategies which are gender friendly in delivering science instructions to encourage student active participation in classroom activities and enhance their academic achievement.

Keywords: Gender, Gender equality, Gender mainstreaming, STEM education and Innovative instructional strategies.

Introduction

Gender is a social and cultural construct, which distinguishes differences in the attributes of men and women, girls and boys. Most times gender is misconstrued to mean “sex”. Sex and gender is different and it is important to understand why. Sex refers to the physical differences between people who are male or female while gender on the other hand is the socially constructed roles, behaviors and attributes that a society considers appropriate for men and women. Flynn (2012) defined gender as the range of physical, biological, mental and behavioural characteristics pertaining to and differentiating between masculinity and femininity. The concept of gender is also the expectations held about the characteristics, attitudes and likely behaviour of both men and women (masculinity and femininity) in the society (Ezeh, 2013). Babajide (2010), opined that science subject which include physics, biology and chemistry are given masculine outlook by educational practitioners. In addition to this, studies by Ogunleye and Babajide (2011) lend credence to significant gender effect in

science achievement. In Nigeria, discrimination with respect to gender inequality is at the apex in the contemporary era therefore the need for gender mainstreaming.

Gender mainstreaming is a globally accepted strategy for promoting gender equality. Mainstreaming is not an end in itself but a strategy, an approach, a means to achieve the goal of gender equality. The UN WOMEN (2001) states that Mainstreaming involves ensuring that gender perspectives and attention to the goal of gender equality are central to all activities - policy development, research, advocacy/ dialogue, legislation, resource allocation, and planning, implementation and monitoring of programmes and projects. It is a strategy for making girls' and women's, as well as boy's and men's, concerns and experiences an integral dimension of the design, implementation, monitoring and evaluation of policies and programmes so that girls and boys and women and men benefit equality, and inequality is not perpetuated (UNICEF 2017). Contextually, gender mainstreaming is a strategy which ensures that male and female students are treated equally in class to achieve an unbiased expected goal academically. There is a need to complement the gender mainstreaming strategy with targeted interventions to promote gender equality and women's empowerment, particularly where there are glaring instances of persistent discrimination of women and inequality between women and men.

Gender equality implies that women and men, girls and boys have equal opportunities to realize their full potential, human rights and dignity. Gender equality is, therefore, the equal valuing by society of the similarities and the differences of men and women, and the roles they play. It is based on women and men being full partners in the home, community and society (UNICEF 2017). Equality does not mean that women and men will become the same but that women's and men's rights, responsibilities and opportunities will not depend on whether they are born male or female. In most societies there are differences and inequalities between women and men in responsibilities assigned, activities undertaken, access to and control over resources, as well as decision-making opportunities (UN WOMEN, 2001). According to Sibani (2017), gender inequality is a socio-cultural phenomenon that divides people into various categories such as male and female with a very high bias placing one specifically less than the other. Despite a wide range of efforts to promote gender equality, women remain under-represented in STEM Education.

Science, Technology, Engineering and Mathematics (STEM) Education is an education that creates critical thinkers, increases science literacy, and empowers the next generation to be innovators (Agommuoh & Ndirika, 2018). According to Ugwuada (2011), STEM is a curriculum based on the idea of educating students in four specific disciplines - science, technology, engineering and mathematics in an interdisciplinary and applied approach. The author stressed that rather than teach the four disciplines as separate and discrete subjects, STEM integrates them into a cohesive learning paradigm based on real-world applications. STEM education is the gate way to socio-economic advancement, industrial development and a road to self-reliance (Danmole, 2011). STEM Education is about encouraging girls to think as innovators. Learning to think and solve problems like scientists and engineers can equip girls with the knowledge, confidence and creativity to address major challenges in their communities. Unfortunately, Education systems have allowed gender divides to be perpetuated and this has caused girls to be marginalized in STEM Education. Studies have shown that science and technology in Nigeria is challenged by low enrolment, negative

attitude of teachers and students, gender stereotype, lack of fund, poor academic achievement among others (Oguama and Ede, 2014, Oguama, Onuoha and Ugwuoke, 2019). The 21st century learning and teaching strategies must go beyond the conventional ways of dispensing knowledge and rote memorization to one in which the students take more responsibilities of learning while the teacher becomes a facilitator of activities (Adetola, 2018 and Oyedele, 2015).

Consequently, any instructional intervention and strategy aimed to correct low enrolment, negative attitude of teachers and students, gender stereotype and poor achievement in science and technology should be able to aid learners to extract meaning and understanding for themselves. Therefore, the process of learning and practicing the STEM education requires instructional strategies which instill in students a passion for inquiry and discovery and fosters skills such as persistence, teamwork and application of the acquired knowledge to solving problems. Learners need to be made to construct their own knowledge and ideas which enables them to attain self-development and fulfillment in life. For girls and women, this crisis includes difficulty accessing quality learning opportunities in Science, Technology, Engineering and Mathematics (STEM) subjects traditionally ascribed to and dominated by boys and men and lower levels of achievement in digital skills (UNICEF 2020).

The under-representation of girls and women in STEM is deeply rooted in unequal gender norms that tell us that girls are not cut out for subjects that require problem solving and an inquisitive mind. Gender differences in STEM education participation at the expense of girls are visible as early as in early childhood especially in science and math related subjects (UN, 2016). Girls according to Horansky (2020) appear to lose interest in STEM subjects with age, particularly between early and late adolescence. This decreased interest affects participation in advanced studies at secondary-level. Gender gaps in STEM education participation become more obvious in higher education where female students represent only 35% of all students enrolled in STEM-related fields of study at this level globally (UNESCO, 2021). Girls deserve to access an education that prepares them for the jobs of the future and to be ready and equipped to participate in the Fourth Industrial Revolution (UNICEF 2020). This is necessary because girls need an education that goes beyond literacy and numeracy but one that equips them with the tools to equally and actively participate in solving the complex challenges our world faces. To give all girls opportunities to learn, achieve and excel in science, technology, engineering and mathematics, we need to enhance the use of innovative instructional strategies that are student-centered in education systems for gender-responsive STEM learning in every classroom.

Innovative Instructional Strategies for Promoting Gender Equality in STEM Education

Innovation is the act of introducing something new in any given system or society. Innovation is a technology-related phenomenon associated with product and process dimensions (Aniaku, Ngwu and Ugwu, 2021). Product and process in education are concerned with developing methods of teaching and learning environments that may help learners to build the required 21st century skills, become flexible, self-directed, social, productive and responsible (Prensky, 2014 and Madia, Sukarmanbl and Yoke, 2014). Innovative instructional Strategies are teaching methods where teachers act as moderators, facilitators, coaches and mentors, allowing learners to be at the center of the teaching and learning by being actively engaged in the lesson process to construct meaningful knowledge (Mamman, 2019). Innovative Strategies allow learners not only to learn from their presenters but from their

peers (Kamen, 2013). They enhance achievement, critical thinking, foster creativity and increase retention, thereby helping to develop high self-esteem in learners and enabling learners to have greater appreciation for others to create an agreeable environment for learning. Some of these innovative instructional Strategies are discussed below:

Peer Tutoring

Peer tutoring or peer-led teaching is one of the innovative instructional strategies under co-operative teaching which is based on social-constructive theory of Vygotsky that emphasizes the role of social interaction in the development of cognition. Peer tutoring is a flexible peer mediated approach that involves students acting as academic tutor and tutees, whereby higher academic performing peers are paired up with lower performing peers to review critical academic concepts under the supervision and guidance of a class teacher (Hott, Walker and Sahni, 2012). Studies by Ezenwosu and Nworgu (2013) on the efficacy of peer tutoring on students' achievement indicated that students taught Biology using peer tutoring performed significantly better than those taught using conventional method of teaching indicating that peer tutoring promotes cognition. The result also showed that gender differences were insignificant. This implies that peer tutoring as an instructional strategy also helps to enhance gender equality in STEM education. This is in line with the studies by Ogundola (2017) on Effects of Peer Tutoring Strategy on Academic Achievement of Senior Secondary School Students which showed that there was no significant difference in students' gender.

Concept Mapping

Concept mapping was developed as an innovative instructional strategy to improve science teaching and learning through active involvement of the learner in the learning process. Concept mapping was developed by Novak and his associates at Cornell University in 1992. Concept mapping simply means a diagrammatic representation of concepts using arrows to indicate their relationships in order to represent a new knowledge structure. It may be defined as a schematic device for representing a set of concept meaning embedded in a framework of preposition (Ngwu, 2021). It helps both the teacher and student to pay attention to the major concepts in any given topic. For instance using the topic cell, the major concepts may include: cell wall, protoplasm, cytoplasm, nucleus and vacuole. After listing these major concepts, they are then arranged hierarchically. The most general concepts are placed high up in the hierarchy while the concrete or specific concepts placed below. The construction of the maps can be regarded as a creative activity. The construction is done by the teachers bearing in mind his educational objectives at each point in time. Students can also be asked to construct concept maps as a learning activity. In this regard, Nworgu, 2009 suggested the following guidelines that can assist students in the construction of concept maps:

- Note the keywords, phrase or ideas from lesson or text.
- Arrange them in a hierarchy- from general concepts to specific concepts.
- Draw circles using arrows or lines.
- Provide examples if possible at the end of each branch.
- Cross-link hierarchies or branches where possible (pp70).

Concept mapping as an innovative strategy has been proven to be efficient in mainstreaming gender. For instance, the studies by Sakiyo & Waziri (2015) on Concept Mapping Strategy: An

Effective Tool for Improving Students' Academic Achievement in Biology showed that there is no significant difference on students' gender. Therefore, concept mapping instructional strategy helps in enhancing gender equality in STEM education.

Blended Learning

Blended learning involves the effective combination of different modes of lesson delivery, models of teaching and styles of learning which are exercised in an interactively meaningful learning environment. Blended learning courses combine multimedia and classroom learning activities and uses digital resources in an optimal way in order to improve students' learning outcomes (Kizlik, 2017). Blended learning combines the best features of classroom interaction and multimedia based teaching method. Blended learning offers the learners convenience and the ability to control their learning pace. Academic researchers suggest that blended learning gives learners a more comprehensive understanding of the course content. This is because, blended learning allows learners to interact with instructors and fellow learners which supports social learning. This instructional strategy therefore gives both male and female students equal opportunity to promote gender equality in STEM education. This is in agreement with the study of Udoh & Udo (2020) on effects of blended learning and expository instructional strategies on senior secondary school students' performance based on the concept of atomic structure which showed that there is no significant difference in students' gender. Similarly, the study of Abdelraheem & Ahmed (2015) on effects of Activity Based Blended Learning Strategy on Prospective Teachers' achievement and motivation also proved that blended instructional strategy helps to achieve gender equality in STEM education.

Games and Simulations

This is one of the innovative instructional strategies in teaching. A game can be regarded as a structured activity with a set of rules for the play involving two or more number of students, who interact towards achieving certain objectives. On the other hand, simulation is a working representation of the actual thing involving students in a kind of role play. According to Encyclopedia of Education, (1964) a simulation in an operating model reproduces social phenomena consisting of a set of interrelated variables which function in the same way as the actual system. Simulation enables students to explore things when the reality may be too difficult, expensive, dangerous, too fast or too slow to process. Simulation possesses a high degree of maturity with the reality in a reduced form. In games, the participants take decisions portraying the picture of actual situation in an enjoyable manner yet involving competition as well as specified rules (Nworgu, 2009). In simulation, there may be no competition involved or a winner emerging rather a changed condition may be achieved by the various participants. In some situations, the two terms may be combined to read simulation games and this is activity reflects both decision-making as well as real life elements of simulation. Studies of Ugboduma, Ezeamaenyi, & Ogbu (2012) on effect of simulation- game cards on the teaching and learning of simple interest, profit and loss in Enugu state junior secondary schools revealed that games and simulation is a good instructional strategy for enhancing gender equality in STEM education.

However, the Nigerian educational objectives as outlined in the National Policy on Education (Federal Ministry of Education (FME), 2013) among other objectives are aimed at exposing students to the: acquisition of appropriate skills, abilities and competences both mental and physical as equipment for the individual to live in and contribute to the development for the

individual to live in and contribute to the development of his society. To actualize and sustain the educational objectives, the STEM education in Nigeria lays emphases on learner-centered instructional strategies. Hence to encourage better achievement of students in sciences under STEM, need arises for the use of innovative instructional strategies which are gender friendly and can encourage gender mainstreaming in STEM education.

Recommendations

This paper therefore recommends that STEM teachers should be encouraged to use innovative instructional strategies which are gender friendly in delivering science (Biology) instructions to encourage student active participation in classroom activities and enhance their academic achievement.

It also recommends that intensive in-service programme on the use of innovative instructional strategies should be organized through workshops and seminars for practicing teachers. Also, STEM teachers should be allowed to visit schools that are utilizing innovative practices to observe new method and materials in action.

Government should set up gender units/centers in various states of the country to address issues related to gender equality in STEM education.

Conclusion

Innovative instructional strategies have the potential to motivate and enhance students' participation in classroom activities. The use of innovative instructional strategies lays emphasis on hands-on-minds-on activities and child centeredness in teaching and learning. When teachers and students fully embrace innovative instructional strategies, male and female students' academic achievement will be greatly enhanced thus encouraging gender mainstreaming in STEM education.

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