Strategies for Inculcating Gender Equity in Mathematics Classrooms for Enhancement of Learners' Problem-Solving Skills.

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DOI: https://dx.doi.org/10.47772/IJRISS.2023.70814

Received: 30 June 2023; Revised: 17 July 2023; Accepted: 20 July 2023; Published: 15 August 2023

ABSTRACT:

The report released in 2022 by United Nations Educational, Scientific, and Cultural Organization (UNESCO) shows that globally, female enrolment is at least 88% at primary and secondary school levels. The 88% is an indicator of good progress in gender equality in education. Of concern, however, is gender equity in Mathematics classrooms. Internationally set goals, Education For All (EFA) Goal 5, Millenium Development Goals (MDGs) Goal 3 and Sustainable Development Goals (SDGs) Goal 4, all focus on gender equity. This study aims to raise awareness about strategies and practices for gender equity in teaching and learning Mathematics. The study uses inclusion and exclusion criteria, a literature review, and empirical data analysis. Evidence suggests that gender equity in Mathematics improves critical thinking skills and increases gender balance in Mathematics education. The researchers recommend further study on strategies for integrating gender equity in Mathematics classrooms.

Keywords: Gender equity, problem-solving, collaborative learning

INTRODUCTION

The effort of global institutions to combat social injustice and gender inequity and inequality is gaining momentum, with a Global Education Monitoring (UNESCO, 2022) report reporting at least 88% female enrolment. The progress reports of Education for All (EFA) (UNESCO, 2015) and the Millennium Development Goals (MDGs) show that out of the world's total population of all school-going children, at least 57 million are still out of school. Also, the issue of gender equity is still a major challenge in many nations.

The Sustainable Development Goals (SDGs), which were introduced to supplement the previous goals, also meant huge challenges, especially during the COVID-19 crisis. Addressing these concerns, global educational institutions have written plans to improve and strengthen gender balance in education. In 1990, UNESCO launched a ten-year plan with six (6) goals, for attainment Education for All (EFA) by the year 2000. The six (6) goals were: i) early childhood care and education; ii) universal primary education; iii) youth and adult skills; iv) adult literacy; v) gender parity and equality; and vi) quality of education.

In EFA goals 5 and 6, they stressed the importance of gender equality and quality education. The world further expands the quest for improvement in all sectors of life by developing two subsequent plans, the Millennium Development Goals (MDGs) and the Sustainable Development Goals (SDGs). There were eight (8) goals of the MDGs: i) eradicate extreme poverty and hunger, ii) achieve universal primary education, iii) promote gender equity and empower women, iv) and v) reduce child mortality and improve maternal health,

vi) combat HIV/AIDs, malaria and other diseases, vii) ensure environmental sustainability, and viii) develop a global partnership for development. MDGs 3 emphasises the promotion of gender equality. The most recent global goals of development are the Sustainable Development Goals (SDGs). There are 17 goals, with goals 3, 4, 5, and 16 stressing the need for good health and wellbeing, quality education, gender equality, peace, justice, and strong institutions in the world.

The Kenya Vision 2030, under the social pillar, the government of Kenya pays special attention to gender sensitivity intervention and voucher systems in response to global concerns. It has recently come to the attention of international community that gender equity is a defining characteristic of an inclusive society that recognises and appreciates the contributions made by all its members. It is also an important factor in the consolidation of democracy. As a result, gender equity has emerged as one of the most prominent issues in the ongoing efforts for reform in education around the world.

According to Mawarti and Nurlaelah (2020), Mathematics education is one of the tools for achieving the Sustainable Development Goals (SDGs). They argue that developing strong problem-solving skills in learners through Mathematics education can or will easily speed up the process of achieving the SDGs. The researchers added that integrating and implementing social justice and gender equity in Mathematics classrooms is one of the surest ways of achieving all seventeen goals of the SDGs. It is important that, in order to develop a strong analytical and critical thinking skills, build effective problem-solving skills in learners, and also improve society, gender equity be taken seriously in all aspects of education, especially in Mathematics classrooms (Vale et al., 2016; Vale et al., 2020).

Mathematics educators and curriculum developers consider social justice and gender equity in Mathematics classrooms as an important component in teaching and learning of Mathematics. Problem-solving, which is at the heart of teaching and learning of Mathematics is not only a process skill, but also as a teaching strategy. Spielman (2008), Ty (2011), Wang and Degol (2016), Morris and Jacobi (2022), have described instances of social injustice and gender inequities and how these have impeded the ability of learners in problem-solving in Mathematics classrooms. The findings of Akala and Divala (2016) and Akala (2019), show that some group of individuals believe that men and women are fundamentally different, and as such, society should treat people based on their gender, especially in institutional settings. These beliefs and perceptions have, over the years, promoted social injustice and gender inequities and inequalities (McCray, 2022; Morris & Jacobi, 2022). Despite efforts to increase enrolment and attainment for female learners in education, social injustice and gender inequity remain a major impediment for female learners in Mathematics education.

Researchers have identified social justice and gender equity as two critical dimensions for improving learners' problem-solving skills in Mathematics. These constructs, according to Ergasheva (2021), are crucial because they improve learners' attitudes towards learning, encourage more learners of diverse socio-economic status to take part in Mathematics and help students develop their capacity for critical thinking and problem-solving. This paper focuses on gender equity in teaching and learning Mathematics and its influence on learners' problem-solving skills. It is based on a review of literature that focuses on gender equity in teaching and learning Mathematics. The objective of the study is to identify strategies for integrating gender equity in teaching and learning Mathematics.

LITERATURE REVIEW

Gender equity in teaching and learning Mathematics

According to Rodriguez Martnez et al. (2020) and Rodriguez and Suriel (2022), gender inequities have impeded the progress of Mathematics education, particularly in problem-solving, making Mathematics appear more favourable for male learners. As a result of this, all Mathematics educators and researchers

should get involved in creating awareness of the importance of gender equity in Mathematics classrooms, as well as ensuring that both male and female learners perform well in Mathematics at all levels of education. Gender equity as a global concern was incorporated by the Organisation for Economic Co-operation and Development (OECD) in reviewing and integrating equity into their curriculum (For, 2021).

Gender equity refers to the idea that all people, regardless of gender, should have equal opportunities, treatment, and outcomes. Rodriguez and Suriel (2022) described equity as involving and creating a level playing field where individuals of all genders have equal access to resources, opportunities, and rights and where any gender-based barriers or discrimination are addressed and eliminated. In education, specifically in Mathematics education, it implies creating an equitable learning environment that is inclusive, supportive, and motivating for all learners, regardless of gender (Andreasson et al., 2015; Idin & Donmez, 2017).

An equitable learning environment in a Mathematics classroom implies a situation in which learners are given equal opportunities to succeed regardless of gender, social background, or prior experiences (Xenofontos, 2019). The National Council of Teachers of Mathematics (NCTM) (2008) emphasises that equity does not imply that every student receives equal education; rather, fair and adequate adaptations should be implemented to encourage equal access and accomplishment for all learners. Equity and access are no longer on pages or in the minds of individuals; rather, they are an action-based approach in Mathematics classrooms (NCTM, 2018; Staley, 2020).

In teaching problem-solving and integrating an equitable learning environment, the teacher should put into practice the following: the use of a variety of teaching methods and materials that will meet the diverse needs of every learner in the classroom; the development and design of an engaging assessment for all learners by using different assessment tools and methods; the creation of awareness of cultural diversity in the classroom; the development and incorporation of strong collaborative learning so that each learner will feel a part of the class; and the activation of equal participation in class discussion without any form of discrimination (Gretter et al., 2019; Fuller et al., 2021). McCray (2022) stressed the importance that a Mathematics teacher in an equitable learning environment should demonstrate empathy for all learners, support their learning process, and the development of creativity and critical thinking skills.

The term equity, in the context of Mathematics education, is a fundamental principle that seeks to ensure that all learners have access to quality Mathematics education and can achieve full potential in problem-solving, regardless of background, race, ethnicity, and socio-economic status (Morris & Jacobi, 2022). It implies, for instance, providing resources for needy students so that they can attain the same levels as others. The National Council of Teachers of Mathematics (NCTM, 2008; NCTM, 2018) and (Berry & Larson, 2019) emphasise that equity in Mathematics means having strong and high expectations and wide opportunities for every learner in the classroom setting. Learners with diverse needs have access to learning resources, learning opportunities, and support to enable each learner reach full potential.

Strategies for integrating gender equity in teaching problem-solving

Research evidence shows that female learners' self-efficacy and attitudes towards Mathematics are strongly influenced by parents, teachers, and peers (UNESCO, 2017; Accenture, 2017; Breda et al., 2020). The findings of these studies made it very important that gender equality be included in problem-solving instruction to guarantee that learners have an equal and independent opportunity to learn and achieve. Radd (2021) presents five (5) practices for equity-focused leadership in the classroom: i) promote a mindset in all members of the class so that each learner will learn at an exceedingly high level; ii) create an inclusive environment that allows learners to feel safe, valued, and cared for; iii) provide all learners access to effective, high-quality curriculum that is both academically rigorous and culturally responsive or relevant; iv) create systems and structures that equitably distribute learning resources; and v) consider the impact of decision-making and policy on historically marginalised or stereotyped groups.

In line with Radd's five (5) practices of equity-focused leadership in the teaching and learning of problem-solving, this study identifies key strategies for integrating gender equity in teaching and learning Mathematics, especially problem-solving: i) avoiding gender stereotypes in teaching problem-solving; ii) encouraging all learners' involvement and collaboration in the teaching and learning process of problem-solving; iii) offering a role model in teaching and learning problem-solving; and iv) allowing self-reflection in Mathematics classrooms. Gender stereotypes are views that Mathematics is a course of study for males, wherein teachers and parents often expect less from female learners in terms of their ability to problem-solving (Acharya et al., 2021). According to researchers, the stereotype is mostly culturally motivated (Fan et al.,2019). Teachers must avoid using gender-biased terminology or instances that perpetuate gender stereotypes in Mathematics classrooms.

In order for teachers to impact the learning experiences of learners, regardless of their gender differences, it is important to use problem-solving situations that include both male and female learners in a range of positions. Ginevra & Nota (2015) emphasised that gender stereotypes should be avoided in the Mathematics classroom since they affect learning and achievement. They added that these characteristics in the classroom can have a negative impact on learners' self-esteem, school engagement, and competence in Mathematics. It is important to encourage participation in problem-solving activities for all learners. In 2007, the National Centre for Education Research, US Department of Education, highlighted five (5) effective evidence-based practical teaching guides: i) teach girls that academic abilities are expectable and improvable to enhance confidence in their abilities; ii) provide with prescriptive feedback about their performance, focussing on the process of learning, the strategies used during learning and the effort made; iii) expose girls to female role models to challenge negative stereotypes and promote positive beliefs about their abilities; iv) create a classroom environment that sparks curiosity and fosters long-term interest through project-based learning, innovative tasks, and technology; and v) provide opportunities for girls to engage in the learning process. It is important that teachers encourage female learners to pursue Mathematics careers (Halpern et al., 2007).

According to Fuller et al. (2021), teachers who are well-grounded in effective teaching strategies can help promote high levels of motivation and increase self-efficacy and critical thinking abilities in female learners in Mathematics classrooms. Continuous motivation, a strong sense of belonging, and inclusion in all tasks without discrimination, will support gender equity in the classroom, which in turn will promote learners' self-efficacy, critical thinking skills, and problem-solving skills. Creating an environment that encourages participation in teaching problem-solving is crucial, for it guarantees that all learners are engaged and motivated to learn (Rudhumbu, 2014; UNESCO, 2019). Teachers may be able to encourage classroom participation by employing tactics such as relevant issues, cooperative learning, differentiated teaching, technology, feedback, success celebration, and risk-taking during the teaching and learning process.

Classroom participation strategies encourage learners to solve problems in small groups and promote collaboration, communication, and teamwork. They also promote differentiated instruction, provide different levels of problems, give learners choices, and provide various ways for learners to demonstrate understanding of the concepts. The use of technology further enhances learners' experiences and makes it easier for teachers to provide feedback; celebrate successes; encourage risk-taking; and provide a safe and supportive environment. Researchers believe that the surest way to create a supportive classroom climate in which all learners feel comfortable sharing their thoughts and opinions, is by promoting productive dialogue among learners in collaborative learning (Gillies, 2019). Teachers are encouraged to avoid ignoring or disparaging learners' ideas and instead, give positive comments that assist learners in increasing their abilities in solving problems.

METHODOLOGY

This paper is based on a review of journal articles, books, book chapters, and published research using inclusion and exclusion criteria as the method. According to Patino and Ferreira (2018), inclusion and

exclusion criteria are method by which research participants are grouped and selected based on certain characteristics that will support the study. Hornberger and Rangu (2020) described this criterion as important to all kinds of research because, according to them, it helps direct the researcher in the selection of respondents that are significant to the study. The researchers used the inclusion and exclusion criteria in selecting journal articles, books, book chapters, and published research based on gender equity in teaching and learning Mathematics, particularly problem-solving. The year of publication of an article was also one of the considerations.

Creswell (2014) outlines a five-step process for analysing data from reviewed articles: i) becoming familiar with the data; ii) coding; iii) developing themes; iv) evaluating; and v) naming these themes. The five (5) steps in the process were summarised into three (3) by Popenoe et al. (2021): i) identifying data that answer the research questions; ii) thematically organising the data; and iii) synthesising, analysing, and presenting the data. The results of the data analysis were compiled and synthesised, in line with the objective of the study.

RESULTS AND DISCUSSION

In this section, the results obtained from the literature review are discussed and presented as strategies identified for integrating gender equity in teaching and learning Mathematics. These strategies are: a) avoid gender stereotypes in the classroom; b) encourage learners' involvement and collaboration; and c) invite role models to the classroom.

Avoid gender stereotypes in the classroom

Gender stereotypes can limit female learners' interest in, and ability to solve problems. Studies have shown that gender stereotypes do not only limit female learners in achievement, but also deter female learners from enrolling in courses and choosing careers in Science, Technology, Engineering, and Mathematics (STEM). This has led to under-representation of female learners in STEM careers (Leslie et al., 2015; Meyer et al., 2015). According to Bian et al. (2017), gender stereotypes start as early as six (6) years old and influence female learners' decisions and abilities in pursuing STEM careers. Law et al. (2021) presented one of the surest ways of avoiding gender stereotypes in the classroom, encouraging an equitable belief system in the classroom. The researchers sampled 143 participants and found that there was gender bias among the male learners. The growth mindset intervention was found to be important for teachers to protect learners from gender stereotypes in the classroom.

Researchers have ascribed the under-representation of female learners in STEM education and careers to high-level gender stereotypes and biases (Meyer et al., 2015; Mitchell & Martin, 2018). Studies have shown how gender stereotypes have affected the learning outcomes of learners, especially female learners, and how they have influenced their choices in STEM careers (Tsouroufli & Redai, 2021). Teachers need to avoid such situations in Mathematics classrooms from an early age of five (5) years (Bian et al., 2017).

Encourage learners' involvement and collaboration

Mulvey et al. (2020), using the concept of research collaboration, stressed the importance of collaboration in research. Applying this concept to teaching and learning, teachers need to encourage all learners, regardless of upbringing, to get involved and work together. According to McNamee and Moscheta (2015), education is a social construct in which every learner must interact. In a collaborative learning environment, learners learn with fewer gender biases, which in turn promotes equity (Venet, 2021). Therefore, teachers must encourage learners to get involved in the teaching and learning process as well as work in groups as a way of integrating gender equity in Mathematics classrooms.

Invite role models to the classroom

Through invitation of role models to the classroom, teachers help to motivate female learners as well as eliminate or reduce low self-esteem among female learners (Zachmann, 2019). In the process of integrating gender equity in the teaching of problem-solving, teachers should use role-modelling strategies for female learners to show that any learner can pursue any STEM career. According to Burgess et al. (2015), the presence of strong female role models in the classroom has a beneficial effect on the aspirations and academic accomplishments of young women. The researchers use the case of medical education, wherein they emphasise teaching by example, which they attribute to factors that develop learners' attitudes, values, and professional competencies. The study concluded with the findings that 88% of the respondents perceived teaching by role modelling as an important factor for improved learning. Teaching problem-solving through role modelling is one of the ways to promote gender equity in Mathematics classrooms. Research findings have shown that this is one of the most effective ways of breaking the gender gap in STEM careers as well as the under-representation of female learners in STEM careers (Verdugo-Castro et al., 2021).

CONCLUSION

It is concluded from this review that gender equity is a key construct to support learning process in Mathematics classrooms, especially problem-solving. The findings are in line with those of Andreasson et al. (2015), in which they emphasized on the importance of pedagogical equity in Mathematics education. According to the definition of gender equity, the underlying truth is that equity in Mathematics education is an integral part of closing the gender gap in STEM education and career paths. Bianchini et al. (2015) consider gender equity as an important discourse that will improve Science, Technology, Engineering, and Mathematics (STEM) education. They recommended the integration of equity in STEM education so that learners can find a safe and conducive environment for making scientific choices and developing critical thinking skills. The findings of Ghosh et al. (2020) support this paper's conclusion because they concluded that female learners had better attitudes towards gender equity than male learners. The fascinating thing is that they recommended a growing interest in creating continuous and consistent awareness of the importance of gender equity in Mathematics classrooms.

It is imperative that teachers work towards promoting gender equity in Mathematics classrooms by adopting teaching strategies that enhance representation, inclusiveness, empowerment, and equity. The strategies can be implemented by avoiding gender stereotypes, encouraging learners' involvement and collaboration in the teaching and learning process, and offering role-modelling teaching. According to Moè et al. (2020), gender stereotypes influence learners' performance on cognitive tasks. Solving word-problems is one of the cognitive tasks, so teachers must avoid gender stereotypes in all forms of teaching and learning Mathematics. This study concludes that the integration of gender equity in the teaching and learning of Mathematics is very important and helps to improve learners' ability in problem-solving and ultimately better achievement in Mathematics. The researchers recommend further study on strategies for integrating gender equity in Mathematics classrooms.

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