

Female Students' Accessibility in Science, Technology, Engineering and Mathematics (STEM) Disciplines in Tanzanian Universities

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Abstract: *This study investigates the Accessibility of female students in Science, Technology, Engineering, and Mathematics (STEM) disciplines in Tanzania. Despite global efforts to promote gender equity in STEM fields, women's representation in these disciplines remains limited, particularly in developing countries such as Tanzania. The study aims to explore the key factors contributing to the underrepresentation of female students in STEM and suggests potential strategies to enhance their Accessibility. The analysis draws upon existing literature, reports, and governmental publications on female students' participation in STEM disciplines in Tanzania. The findings reveal several significant factors that hinder female students' Accessibility to STEM disciplines in Tanzania. These factors include cultural and societal norms that discourage girls from pursuing STEM education, limited access to quality educational resources, insufficient support systems, socioeconomic barriers, and the absence of female role models in STEM fields. To address these barriers, the study suggests potential strategies such as promoting gender-responsive educational policies, enhancing the quality and availability of STEM education, creating mentorship programs and networks, and fostering partnerships between academia, industry, and government. These strategies aim to provide female students equal opportunities, encourage their interest in STEM, and empower them to pursue careers. By analyzing existing secondary data, this research sheds light on the challenges faced by female students in accessing STEM education in Tanzania. The findings can inform policymakers, educators, and stakeholders about the barriers and potential solutions to enhance the Accessibility and participation of women in STEM disciplines, thereby fostering gender equality and contributing to Tanzania's overall development and progress.*

Keywords: *Female students, Accessibility, (STEM) Disciplines, Underrepresentation, Tanzania.*

Background to the study

Internationally, female participation in STEM disciplines remains alarmingly low, with a rate of less than 30%, and a further decline to less than 25% in hard sciences (Hill et al, 2010). Africa, including Tanzania, faces a pronounced gender imbalance in STEM, particularly in Engineering, where only one in four students was female as of August 2020. Comparatively, the situation in Tanzania reflects the broader African challenge, with minimal female participation in STEM disciplines. The urgency of this issue is underscored by the fact that Africa, and by extension Tanzania, stands to lose out on a significant portion of its potential workforce in Science and Technology. In Tanzanian Public Universities, the need for a comprehensive understanding of the factors contributing to the low accessibility of female students to STEM disciplines is crucial (Johnson, 2019).

In response to the global challenge and recognizing the need for gender equity in STEM education, the Tanzanian government and universities have put in place gender equity interventions in the form of gender policies in education, affirmative actions, and initiatives to engender tertiary institutions, remedial disciplines, interfaculty transfers, financial aid, and self-sponsored programs (SSP) to mainstream gender equity into STEM disciplines (Kapinga et al, 2018). Additionally, the examination of gender policies addressing sexual harassment, accommodation for female students, the presence of gender equity units, gender forums, gender committees, and gender task forces will provide insights into the holistic approach adopted by Tanzanian universities to create an inclusive environment for female students in STEM (Abdullahi et al, 2021)

Furthermore, the performance of girls in the Advanced Certificate of Secondary Examination (ACSE), is a key determinant for access to university education and STEM professional programs in Tanzania (Brown, 2019). The need to understand the specific challenges female students face in secondary education and their implications for pursuing STEM careers in Tanzanian universities is a critical aspect that merits investigation. Understanding these challenges is essential for developing targeted strategies and policies to address the gender gap in STEM education in Tanzania, ensuring the nation benefits from the full potential of its diverse talent pool in Science and Technology (Komba et al, 2020).

Statement of the problem

Despite efforts to promote gender equality in education such as Affirmative Action, and the introduction of self-sponsored programs (SSP), offering financial aid, gender sensitization, and outreach programs towards female participation in universities, there is still evidence of underrepresentation of female students to STEM (Science, Technology, Engineering, and Mathematics) disciplines in Tanzania, resulting in a significant gender disparity within these fields (Kapinga et al, 2018). Only 3.4% of female students in Tanzania were enrolled in STEM-related programs at the tertiary level compared to 21.6% of male students (TCU, 2022).

These figures point to a problem that raises concerns about female participation in STEM disciplines in Tanzanian universities and confirms that past interventions have not worked to increase female access and participation in STEM. These concerns form the basis of this study whose overriding objective is to explore interventions that might help to address the problem of gender disparity in the access and participation of female students in STEM disciplines. As Tanzanian society embraces technology as a tool for development, leaving out the majority of the population from STEM disciplines has potentially negative implications for the attainment of an industrialized nation as proposed in Tanzania's Vision 2030. In addition, the continued low participation of women in STEM disciplines means that any benefits that have been shown to accrue from increased female participation in STEM, including contribution to increased productivity and socio-economic development might be difficult to realize. The essence of this study is, therefore, to explore interventions for encouraging female students' access and participation in STEM disciplines in public universities in Tanzania to recommend viable interventions.

The following objectives guided the study:

- i) To examine the current state of female students' accessibility in STEM disciplines in Tanzanian Public Universities.
- ii) To identify the key factors influencing the limited accessibility of female students to STEM disciplines in Tanzania public universities.
- iii) To evaluate existing educational policy interventions that influence trends in female students' accessibility to STEM disciplines in Tanzania public universities.

Theoretical Framework

This study was anchored on two theories of theoretical postulates namely; Social Cognitive Career Theory (SCCT) and Stereotype Threat Theory. The two theories provide comprehensive frameworks for deciphering the complex dynamics that contribute to gender disparities in STEM education by considering the current state of female students' accessibility in STEM disciplines, key factors influencing the limited accessibility, and inadequate educational policies and interventions in the universities. In the context of this study, SCCT guides the examination of the current state by emphasizing the role of personal and environmental factors in career choices. Enrollment rates and representation of female students in STEM fields can be understood through SCCT's lens, which highlights how societal expectations and self-perception influence career aspirations. Stereotype Threat Theory, meanwhile, elucidates the impact of negative stereotypes on academic performance, contributing to the observed disparities in Science and Mathematics at the secondary level (Steele & Aronson, 1995). In terms of key factors, both theories contribute to identifying key factors influencing limited accessibility. SCCT emphasizes the importance of self-efficacy, suggesting that societal perceptions and gender norms can hinder female students' confidence in pursuing STEM disciplines. Stereotype Threat Theory highlights how negative stereotypes act as barriers, influencing choices and academic performance, thereby shaping the factors contributing to limited accessibility (Bandura et al, 2001). Additionally, SCCT becomes instrumental in evaluating existing policies by emphasizing the need for interventions that enhance self-efficacy. The theory advocates for initiatives promoting positive role models and mentorship, essential elements in addressing the limitations identified in educational policies. Stereotype Threat Theory further emphasizes the need to counteract the detrimental impact of stereotypes embedded in policies to create an environment conducive to female students' success in STEM (Lent et al, 2018).

The integration of SCCT and Stereotype Threat Theory provides a comprehensive framework for examining, understanding, and addressing the complex challenges surrounding female students' accessibility to STEM in Tanzanian Public Universities. These theories offer nuanced perspectives, guiding the development of effective policies and interventions for fostering a more inclusive STEM environment.

RESEARCH METHODOLOGY

This study adopted a mixed-methods approach, combining both theoretical and empirical research methodologies. This hybrid design aims to comprehensively explore the multifaceted aspects of female students' engagement in Science, Technology, Engineering, and Mathematics (STEM) disciplines within specific Tanzanian public universities.

The study was carried out in three selected public universities in Tanzania namely; the University of Dar es Salaam (UDSM), Sokoine University of Agriculture (SUA), and Mbeya University of Science and Technology (MUST). The universities have been purposively selected as first; they have a mandate to implement government policies on female accessibility in STEM disciplines. The

universities were purposively selected based on their strong traditions in STEM orientation, STEM facilities, and high student enrolments (TCU, 2020). They provided contexts that were representative of the other public universities.

The target population for this study was 1680 third-year female students in STEM disciplines, registrars in charge of academic affairs, affirmative action directors, deans of faculties offering STEM disciplines, and female faculty members teaching STEM disciplines. In addition, a small group of male students in STEM disciplines were also targeted for their views on female participation in STEM disciplines. All these were sampled from the selected universities.

Three sample techniques were used in the study: simple random sampling, stratified sampling, and purposive sampling. The criteria of strength in STEM orientation, STEM facilities, and student enrollment served as a guide for purposeful sampling. Out of the 10 public universities that were in existence at the time of the study, three universities which are UDSM, SUA, and MUST were chosen. These three were regarded as the other public universities' representatives. STEM departments and all the key informants included registrars, deans of STEM disciplines, STEM female faculties, directors of gender and affirmative action, and female students pursuing STEM discipline who were also purposively sampled. This is because the researcher was interested in getting specific respondents that bear attributes that could achieve the study objectives and are in line with survey study procedures that require the inclusion of informants with information concerning the study area (Kothari, 2020). Second, stratified sampling was used to sample students pursuing STEM disciplines into five different areas, namely; Bachelor of Science, Engineering, Agriculture, Computer Science, and Health Sciences. Once stratified this way, random sampling was employed to select female students and female faculty and deans in each stratum. Simple random sampling ensures that every respondent has an equal chance to participate in the study. All the registrars in charge of academic affairs and the affirmative action directors were included in the sample.

Primary data were collected using two main tools, namely; questionnaires and interviews. Secondary data was collected from existing sources such as government reports, academic journals, published studies, and statistical databases. These sources provided a comprehensive overview of the current state of female students' accessibility in STEM disciplines. These tools generated both qualitative and quantitative data.

PRESENTATION OF FINDINGS, INTERPRETATION AND DISCUSSION

Objective one focused on examining the current state of female students' accessibility in STEM disciplines in the sampled Public Universities from 2018 to 2023. Female students are underrepresented in STEM disciplines at less than 35% of STEM enrollments with lower enrollments in hard sciences. Higher enrollments were recorded by the Tanzania Commission of Universities (TCU) in soft sciences at 65% at UDSM as a case institution. The above findings show that female students are more attracted to soft sciences as a result of perceived stereotypes of the femininity of the disciplines and attractiveness to the job market. Hard sciences attract fewer due to low cut-off point requirements by universities.

Objective two, the study established that there are key factors influencing the limited accessibility of female students to STEM disciplines in Tanzania's public universities. Firstly, societal perceptions and deeply ingrained gender norms contribute significantly. Traditional expectations often dictate gender roles, fostering an environment where STEM fields are perceived as more suitable for male students, thereby dissuading female students from pursuing these disciplines. Second, the scarcity of female role models and mentors in STEM exacerbates the challenge. The absence of visible and successful women in these fields limits the aspirational scope for female students and may impact their self-efficacy, as per the Social Cognitive Career Theory (SCCT). The lack of relatable figures reinforces stereotypes about the unsuitability of women in STEM careers. Third, Educational infrastructure and resources also play a pivotal role. Inadequate facilities, limited access to well-equipped laboratories, and a dearth of educational materials can act as deterrents for female students considering STEM disciplines. These disparities in resources contribute to an uneven playing field, disadvantaging female students and impeding their effective engagement in STEM education. The study established that initiatives promoting positive role models, challenging stereotypes, and improving educational resources are crucial steps towards creating a more inclusive environment for female students in Tanzania's public universities, fostering increased accessibility to STEM disciplines.

Finally, the key findings from the third objective were that despite the Tanzanian government and universities, gender equity policies and interventions, there is still low participation of female students in STEM disciplines. The existing educational policy interventions included an Affirmative Action policy, financial aid, and mentoring programs. First, the study established that the absence of targeted measures may inadvertently perpetuate barriers hindering full participation in STEM education. Second, the study reported that the absence of mentorship programs limits the exposure of female students to inspirational figures who can bolster their confidence and aspirations. There is a need to strengthen Science Career guidance and mentoring programs in both secondary schools and Universities. Negative attitude developed by female students and societal stereotypes of masculinity in STEM disciplines begins at lower levels of education. Third, there aren't enough female STEM faculty members and science teachers in secondary schools to serve as mentors and role models for female students interested in STEM fields. The study found that more female STEM faculty members and secondary school science instructors are needed to serve as mentors and role models for female students

pursuing STEM fields, which will improve student performance in these fields. Fourth, the study found that financial aid and the current affirmative action policies have unintentionally added barriers, which may hinder the goals of female students who want to pursue STEM fields. Fifth, the study found that STEM fields will appeal to more female students if they have gender-neutral curricula and learning settings. The respondents advocated for the establishment of feminist-leaning, gender-neutral learning settings. Ultimately, research revealed that several obstacles, including sexual harassment, pregnancy-related disruptions, and family obligations, confront female students in higher education. For the underprivileged female STEM students who frequently leave college, the government and academic institutions should create STEM policies and interventions.

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