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IMPROVING FEMALE STUDENTS' ENROLMENT IN STEM DEMANDS POLICIES THAT ALIGN THE SOCIAL AND TECHNICAL ASPECTS OF THE PROBLEM

CENTRE FOR DEVELOPMENT ALTERNATIVES

KONRAD ADENAUER STIFTUNG

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Improving Female Students' Enrolment in STEM Demands Policies That Align the Social and Technical Aspects of the Problem

Winnie Watera

This brief explores promising policy alternatives for increasing female students' enrolment in science, technology, engineering and mathematics (STEM). Increasing female student enrolment in STEM is poised to be a precursor to bolstering the chances of employment and economic inclusion for women, as most new employment opportunities demand STEM-related skills. Therefore, this policy brief was conceived from a context of gender equality and women's empowerment. The study finds that limited female students' enrolment in STEM is attributed to social factors as much as it can be explained by the technical limitations in the education system. Despite this reality, existing policy interventions have focused mainly on the technical attributes, for example, improved funding, increase in recruitment of science teachers, enhancing school science infrastructure etc.[1] However, little or no regard is paid to underlying social constraints that limit female students' enrolment in STEM. This brief recommends that educational policies should prioritise a response to the social factors such as negative gender stereotypes, a gender-inclusive curriculum and prejudiced teacher attitudes that hold girls away from enrolment in STEM disciplines.

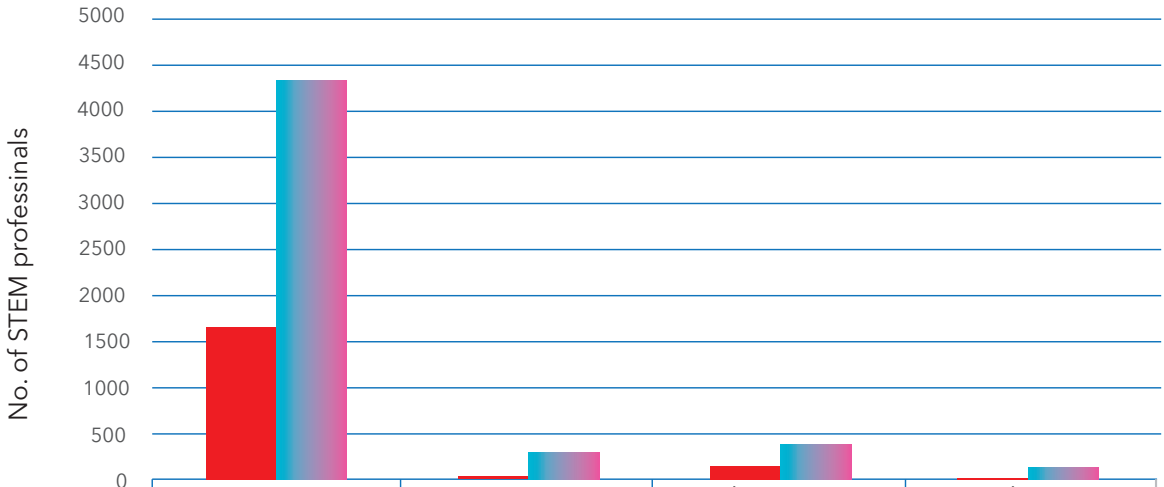
1. Introduction

Female students continue to be disproportionately represented in science, technology, engineering and maths (STEM) disciplines in Uganda despite the overall improvement in STEM enrolment. This problem is acknowledged in government documents like the Gender in Education Policy, 2016. The policy notes that while there is an almost equal number of males and females enrolled in computing, economics, the arts, management and the social sciences, there continues to be a strong male bias in agriculture (81%), forestry (72%), science (69%), veterinary medicine (82%) and education (75%) in tertiary and higher learning institutions.[2] The Visitation Committee on Makerere University (Uganda's largest and oldest public university) [3] in 2017 reported a 9.2% (3,412) enrolment rate of female students in STEM.[4] Generally, enrolment of female students in non-STEM disciplines was four times more than the enrolment in STEM disciplines at the university.

This notwithstanding, the 2018 Busitema University[5] provisional admission list features only 402 (31%) female students out of the 1,267 students admitted for STEM courses at degree and diploma levels. The STEM disparity in educational enrolment manifests at the professional level through the corresponding female professional registration numbers, as at June 2018, with the Uganda Medical and Dental Practitioners Council (29%), the Uganda Institution of Professional Engineers (16%), the Pharmaceutical Society of Uganda (31%) and the Registered and Practising Architects (24%), among others.

1 *Gender in Education policy, 2016*
2 *Ibid.*
3 *Best universities in Africa*
4 *Out of 37,059 (17,434 [47%] female and 19,625 [53%] male), only 3,412 (20%) of females were enrolled in STEM compared to the 8,408 (43%) males*
5 *Busitema University has as its focus Science Education with emphasis on instruction in the agricultural sciences, agricultural mechanisation and agribusiness*

Figure 1: Gender differentials in STEM professions in Uganda



	Doctors	Engineers	Pharmacists	Architects
Female	**1674**	**59**	**178**	**46**
Male	**4325**	**299**	**396**	**149**

Source: Respective professional registration records in 2018

It is important to note that most professionals in Uganda are not formally registered, mainly owing to lack of minimum requirements for registration. In this case, far fewer women get registered.

Various government plans, policies and strategies, including the National Science, Technology and Innovation Policy, 2009, the National Science, Technology and Innovation Plan, 2012/2013- 2017/2018, and the Ministry of Education and Sports (MoES) National Strategy for Girls' Education (NSGE) in Uganda (2014–2019) acknowledge the challenge of limited female students in STEM. However, the interventions proposed and implemented according to these plans address STEM education from the general point of view and without factoring in gender dynamics.

While interventions to increase general STEM education enrolment focus on technical aspects such as increased funding, increased numbers of science teachers and enhanced science school infrastructure, increasing female students' enrolment in STEM education demands interventions in the social aspects of the problem.

2. Rationale for Increasing Female Enrolment in STEM

Enrolment in STEM disciplines has been linked to improved chances of employment, considering that most emerging jobs are in the science and technical sectors such as information technology (IT), construction, mining, medicine, energy and geological explorations, to mention but a few. At the macro level, higher labour force participation by women offsets the shrinking workforce in general, including STEM sectors.[6] Moreover, increased labour participation can contribute to increases in GDP and to reduced poverty.[7] At the micro level, it can lead to increased household income and a corresponding improvement in social status.[8] This notwithstanding, principles of equity in education must be upheld.[9]

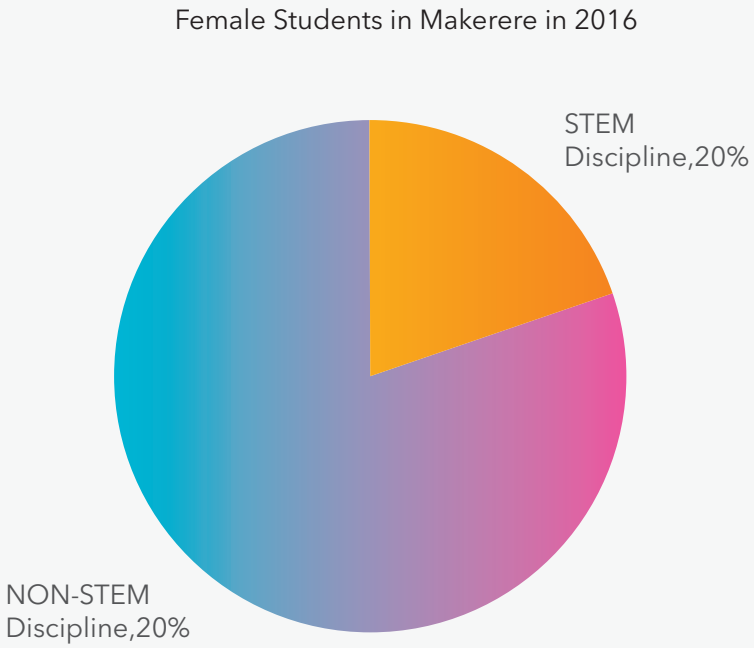
Uganda has prioritised energy, infrastructure development, industrialisation, as well as oil exploration as major development strategies. The existing and planned infrastructural projects are expected to create several job opportunities both directly and indirectly, particularly in the science and technical disciplines. Blended with the existing efforts to promote local content, more Ugandans are expected to access job opportunities in these sectors. However, if women are to have an equal chance of accessing the emerging opportunities, increasing their enrolment in STEM is necessary.

6 Kinoshita and Kochhar (2016). She is the answer. International Monetary Fund: Finance & Development, Vol. 53(1)
7 Huth, L. (8 March 2018). Women: The catalyst for economic growth: Women around the world still face obstacles to fully participating in the workforce, limiting a country's potential growth.
8 McGinn, K. L. & Oh, E. Gender, social class and women's employment. Current Opinion in Psychology Vol. 18, pp. 84-88
9 Wilson, C., Taylor, J., Kowalski, S., and Carlson, J. (2010). The relative effects and equity of inquiry-based and commonplace science teaching on students' knowledge, reasoning, and argumentation. Journal of Research in Science Teaching, 47(3), 276-301

3. Explanations for Limited Female Students' Enrolment in STEM

The dominant argument suggests that females choose not to pursue STEM careers because of a sheer lack of interest. This assertion holds true only to the extent that the lack of interest in STEM by female students is a symptom of a larger social issue. There is overwhelming evidence that women are socialised away from STEM disciplines and this is linked to gender roles and gender division of labour (generally the work, tasks and responsibilities that are assigned to women and men in their daily lives). In Uganda, like in most countries, house chores like cleaning, cooking, washing clothes and everything that relates to sustaining the household like fetching water or wood fuel as well as small-scale agriculture for self-sustainment, are typically female tasks even when the woman has a paid job outside the home. On the other hand, more technical house tasks, like dealing with electrical or mechanical equipment, is traditionally considered a male job. The social constructs at household level tend to manifest in the labour market as well as in education and training, where undertaking different disciplines is heavily segregated along gender lines.[10]

Figure 2: Female student enrolment by discipline



Source: Visiting Committee to Makerere University, report, 2017

There is no dispute that female students are underrepresented in STEM disciplines in Uganda. However, it must also be emphasised that constraints on female students' enrolment in STEM are largely social. Yet social aspects like negative gender stereotypes, prejudiced teacher attitudes and a gender-biased curriculum, among others, have not attracted due attention among policy makers to warrant expedient policy interventions. Several policy interventions initiated by both state and non-state actors address technical aspects in STEM education. A lot of effort has been exerted towards addressing issues like limited funding to science disciplines, shortage of science teachers, lack of teacher pedagogical skills and lack of school science infrastructure, among others. Examples include the SESEMAT programme which began in 2005 to improve the teaching ability of science and mathematics teachers at secondary level and improve performance in the subjects and which has trained over 6,000 teachers, and the compulsory science policy in Ugandan schools.

10 International Institute for Labor Studies (2008). The gender division of labor. Torres R. (Eds.). World of Work Report: Income Inequalities in the Age of Financial Globalization.

4. Social Aspects Affecting Female Students' Enrolment in STEM

A host of research studies on female students in STEM expound greatly on the effect of negative gender stereotypes. Stereotypes such as women are not bright, women do not do or excel in science subjects, sciences are for boys, women lack interest in science, women are weak, STEM is nerdy, boring and dirty etc., can influence how the female students are treated and, in turn, elicit behaviours from the female students that are consistent with those stereotypes. In addition, stereotype threats where female students' performance or actions are viewed through the lens of a negative stereotype also reinforces the stereotype. Generally, stereotypes tend to exert a direct influence on the behaviour and thought process of the stereotype holder.[11] Negative stereotypes, therefore, can transfer to girls and play a critical role in girls' development of STEM attitudes and interests.[12] It may be for this reason that female students in an all-girls learning environment thrive in what has been traditionally regarded as male-dominated subjects, free from gender bias or social pressure from boys.[13]

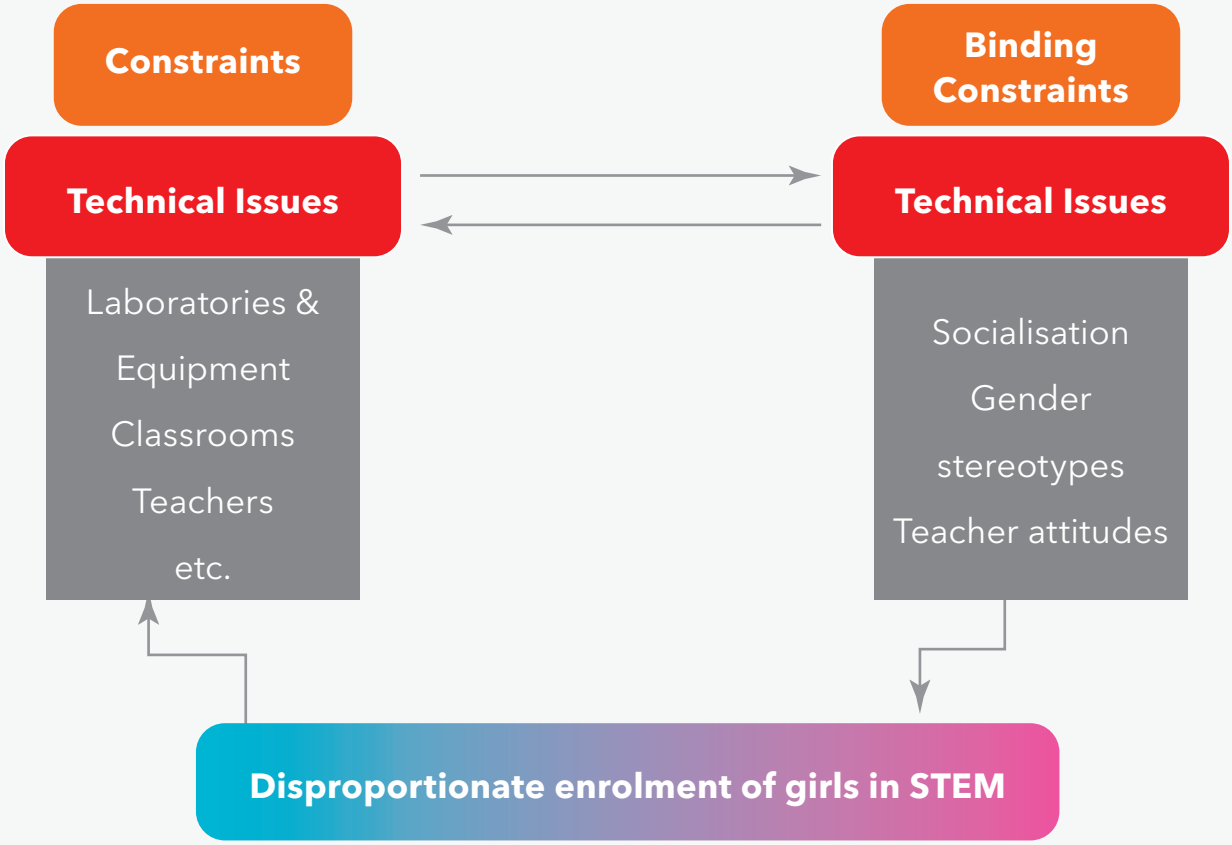
The other eminent and yet often overlooked social problem for female students' enrolment in STEM education are prejudiced teachers. Prejudiced teachers, informed by stereotypical and patriarchal notions of the abilities of female students as a social grouping in sciences, exacerbate the already fragile situation.[14] There are many stereotypes of how girls and boys are raised and treated, at home, at school, and in the professional world. This likewise translates into how they are taught in the classroom, where teachers traditionally have lower expectations of and biases against female students.[15] In some instances, the strategies used by science teachers, especially in co-educational schools in the teaching-learning process, tends to empower the boys much more than the girls, thus creating different experiences for the two groups of students. Uganda being a patriarchal society, teachers' perceptions of males and females become crucial for their relations with students, and consequently for students' academic outcome.[16] The prevailing tendency of teachers to respond unfavourably to female students in STEM education largely impacts their attitudes, interests, persistence and, ultimately, achievement in STEM.[17]

Research has proved that better student-teacher relations increase student academic performance and enrolment.[18]

The education curriculum and textbooks used to teach students continue to reinforce gender biases amongst students and teachers who interact with it. Research in gender and education shows much evidence that within schools, textbooks play a significant role in the gender socialisation of children.[19] According to the Gender in Education Statistics Profile by the Uganda Bureau of Statistics (UBOS), the Uganda National Curriculum Development Centre (UNCDC) has been revising the primary education curriculum since 1992 to make it more gender-responsive as part of the primary education reform. However, these efforts are yet to materialise. Misconceptions that gender is synonymous with girls and that gender-sensitive pedagogy is time-consuming are common in education.

11 National Research Council (US) Committee on Aging Frontiers in Social Psychology, Personality, and Adult Developmental Psychology. (2006). Opportunities lost: The impact of stereotypes on self and others. Carstensen, L. L. and Hartel, C.R. (Eds.). When I'm 64 (80-91)
12 Shapiro, J. R., and Williams, A. M. (2011). The role of stereotype threats in undermining girls' and women's performance and interest in STEM fields. Sex Roles, 66(3-4), 175-183
13 Park, H., Behrman, J. R. and Choi, J. (2018). Do single-sex schools enhance students' STEM (science, technology, engineering, and mathematics) outcomes? Economics of Education Review Vol 62, pp. 35-47
14 Denith, A. (2008). Smart girls, hard-working girls but not yet self-assured girls: The limits of gender equity politics. Canadian Journal of Education, 31(1), 145-166
15 Nabbuye, H. (24 July 2018). Gender assumptions that challenge a quality education for girls in Uganda. Gender Plus Development
16 Assimwe, J. A. (2013). Compulsory science policy: Enhancing gender equality in education? A case study of academic achievement in Uganda. MIER Journal of Educational Studies, Trends & Practice, Vol. 3(2), pp. 183-194
17 Friedrich, A. Flunger, B., Nagengast, B. Jonkmann, K., and Trautwein, U. (2015). Pygmalion effects in the classroom: Teacher expectancy effects on students' math achievement. Contemporary Educational Psychology, Vol. 41, pp. 1- 12
18 Marzano, R. J., Pickering, D., and Pollock, J. E. (2001). Classroom instruction that works: Research-based strategies for increasing student achievement. Alexandria, VA: Association for Supervision and Curriculum Development (ASCD).
19 Barton, A., and Sakwa, L. N. (2012). The representation of gender in English textbooks in Uganda. Pedagogy, Culture & Society, Vol. 20(2), pp. 173-190

Figure 3: Conceptual framework for limited female students' enrolment in STEM



Source: Author's own conceptualisation

5. Assessing Existing Policy Interventions

STEM policies, plans and strategies, such as the National Science, Technology and Innovation Policy, 2009, the National Science, Technology and Innovation Plan, 2012/2013- 2017/2018, and the Ministry of Education and Sports (MoES) National Strategy for Girls Education (NSGE) in Uganda (2014–2019) have attempted to address the technical aspects like infrastructure and science teacher numbers. However, girls' enrolment in STEM, which is mainly a social issue, is often left unaddressed. For instance, the policy interventions have put a lot of emphasis on human resource development and capacity-building with little or no emphasis on gender-responsive pedagogy. Gender-responsive pedagogy is important because gender-responsive teachers understand and respond to the specific needs of girls and boys in the teaching-learning process. On the technical side, there is a general lack of collection and generation of STEM statistics and indicators to show the status of STEM in the country, the trends of STEM activities and the STEM gender dynamics and their impact on socio-economic development. Thus, the information to inform STEM policy formulation and implementation and monitoring of programmes is generally lacking. This form of programming, planning and budgeting ultimately perpetuates gender imbalances in STEM. On the other hand, the indicators could also promote awareness legitimisation of the STEM problem by politicians, policymakers and the public. The debate on female students in STEM would benefit from the availability of aggregated data.

6. Policy Recommendations

i. Gender-responsive training for the teachers should be a priority in teacher training courses and programmes. It is important to equip teachers with knowledge, skills and attitudes to empower them to respond adequately to the learning needs of girls and boys through using gender-aware classroom processes and practices. Eliminating gender-biased tendencies perpetuated by teachers in classrooms presents the opportunity to develop female students' attitudes and interests in STEM.

ii. A purposive shift from the current curriculum that reinforces gender stereotypes in general life and portrays females as socially different and inferior to males to a gender-inclusive curriculum. Mathematics and science textbooks and other learning materials that convey gender biases should be deliberately removed from among students' learning materials. A curriculum that does not postulate socialised gender roles as normal, emphasises women role models as much as male ones and promotes gender parity should be adopted.

iii. Integration of more female teachers into science teaching goes a long way in promoting the persistence of female students in STEM. There is a low percentage of female teachers (23.6%) at the secondary school level and of female lecturers (30%) in public universities in Uganda,[20] which further disadvantages girls by creating gaps of role models, counsellors and advocates. The benefit of seeing same-sex experts is driven by greater subjective identification and connectedness, which, in turn, predicts enhances self-efficacy, domain identification, and commitment to pursue STEM careers. More importantly, females' own self-concept and self-esteem benefit from contact with female experts.[21]

20 Gender in Education Sector Policy 2016

21 Stout J. G., Dasgupta N., Hunsinger M., and McManus M. A. (2011). STEMing the tide: Using ingroup experts to inoculate women's self-concept in science, technology, engineering, and mathematics (STEM). Journal of Personality and Social Psychology, 100(2), 255–270.

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