African Population and Health Research Center

SUPERVISION AND MENTORSHIP OF WOMEN IN SCIENCE, TECHNOLOGY, ENGINEERING AND MATHEMATICS' POSTGRADUATE PROGRAMS IN SUB-SAHARAN AFRICA

FINAL TECHNICAL REPORT

IDRC Project Number: 109144-001

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March 2020 – April 2025

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ABBREVIATIONS & ACRONYMS

APHRC	African Population and Health Research Center
CUE	Commission for University Education
ESRC	Ethics and Scientific Research Committee
FGD	Focus Group Discussion
HEI	Higher Education Institutions
IDI	In-depth Interview
IUCEA	Inter-University Council for East Africa
NACOSTI	National Commission on Science Technology and Innovation
SDGs	Sustainable Development Goals
STEM	Science, Technology, Engineering, and Mathematics
SSA	Sub-Saharan Africa

EXECUTIVE SUMMARY:

In Sub-Saharan Africa (SSA), the promotion of high-quality postgraduate training in Science, Technology, Engineering, and Mathematics (STEM) disciplines is essential for advancing research evidence and attaining Sustainable Development Goals (SDGs). Despite its critical importance, women and girls face significant obstacles leading to their underrepresentation in STEM fields, including gender stereotypes and unsupportive environments. Acknowledging these challenges, a five-year study was initiated to explore the participation and experiences of women in postgraduate STEM training and careers in SSA.

The African Population and Health Research Center (APHRC), in collaboration with the Inter-University Council for East Africa (IUCEA), conducted a 60-months project that commenced in March 2020 and was completed in April 2025. The primary aim of the project was to examine the participation and experiences of women in postgraduate training in STEM programmes in universities in East Africa, with a focus on improving the quality of supervision and mentorship within the region. By addressing systemic barriers and promoting equitable practices, the project aimed to cultivate a more diverse and inclusive landscape within STEM disciplines, aligning with global efforts towards achieving the Sustainable Development Goals (SDGs) and promoting inclusive economic development in the region.

The project utilized a mixed-methods approach comprising a scoping review, qualitative interviews, and quantitative analysis of secondary data to comprehensively grasp the status of gender equality in STEM education and careers in East Africa. Data collection included 66 in-depth interviews, five focus group discussions across five East African nations, and an online survey distributed to 898 participants. Analysis of the data uncovered significant gender gaps within STEM fields, with women representing over 44% of respondents across the five countries. Secondary data analysis underscored substantial gender disparities in STEM postgraduate enrollment and graduation rates, indicating persistent challenges encountered by women in accessing and progressing in STEM-related education and careers. The data analysis identified key barriers hindering women's participation in STEM, such as societal perceptions, limited access to mentorship, and inadequate employment opportunities.

The data obtained was validated in five national stakeholders' workshops conducted in Burundi, Kenya, Rwanda, Uganda and the Republic of Tanzania. This led to the convening of a regional stakeholders' workshop in Kenya whose aim was to consolidate the national results of the study, and to co-create gender-lensed supervision and mentorship strategies and a related framework for postgraduate training in the East African region. More specifically, recommendations stemming from the findings of the study were pivotal during the co-creation workshop, where regional stakeholders reviewed the data and formulated the gender-lensed Supervision and Mentorship Framework for postgraduate training in the East African Region. The objective of this framework was to enhance gender equity and inclusivity in STEM education and careers, ultimately contributing to sustainable development in East Africa. The piloting of the gender-lensed supervision and mentorship strategies and framework for postgraduate training in East Africa was conducted in three universities: the Masinde Muliro University of Science and Technology, Kenya, Light University of Burundi, and Uganda

Martyrs University, Uganda. Summary results of the piloting exercise are presented in this report.

The gender-lensed Supervision and Mentorship Framework was finalized, adopted, and approved by the East African Community, through the Inter-University Council for East Africa (IUCEA) in 2024. It has also been disseminated to the stakeholders, through a workshop held in November 2024 and uploaded as a policy on the IUCEA's website. It is available on this LINK.

Alongside the policy document, the project team also produced 6 knowledge outputs - i) *The Co-Creation and Validation Report*, ii) *Kenya Data Validation Report*, iii) *Rwanda Data Validation Report*, iv) *Tanzania Data Validation Report*, v) *Uganda Data Validation Report*, and vi) *Burundi Data Validation Report*. All the knowledge products have been assigned their own unique Digital object Identifiers (DoIs) and uploaded on the APHRC Knowledge Portal (https://knowhub.aphrc.org/handle/123456789/1967).

Five manuscripts were also submitted for publication in open-access peer-reviewed journals. The paper titles and the respective peer-reviewed journals where they were submitted are presented under project outcomes.

1. PROJECT INFORMATION:

Start date: March 2020 End date: April 30, 2025

Duration (months): 61

Principal Investigator: Dr. Evelyn N. Gitau (The PI changed in March 2024 to Dr. Florah Karimi after the departure of Dr. Evelyn N. Gitau from APHRC)

Project implementing agencies: African Population and Health Research Center in partnership with the Inter-University Council for East Africa (IUCEA).

2. GOAL AND KEY OBJECTIVES:

The project's overall goal was to examine the status of gender equality and gender gaps in postgraduate training in STEM programs and subsequent careers in East Africa.

The primary objective of this project was to generate evidence on the supervision and mentorship experiences of women in STEM postgraduate training, and to identify best practices and benchmarks to inform gender-lensed related strategies and guidelines for postgraduate training in the East African region. The specific objectives were:

a) To quantify gender gaps in STEM post-graduate training programs in IUCEA member universities.

b) To determine supervision and mentorship models that promote women's participation in postgraduate programs in IUCEA member universities.

c) To establish supervision and mentorship policies and guidelines that promote women's participation in STEM post-graduate training in IUCEA member universities.

d) To design and pilot a supervision and mentorship intervention that encourages participation and retention of women in postgraduate STEM-related programs in East African universities.

The research findings provided valuable insights for the creation of a gender-sensitive approach to supervision and mentorship, which would enhance the quality, experience, and outcomes of women participants (faculty and students) enrolled in STEM-related postgraduate training programs. Additionally, the results would be useful in the revision of the Standards and Guidelines for Postgraduate Studies in East Africa to address the specific challenges that women face in terms of mentorship and supervision in postgraduate programs. By identifying and addressing these gender-specific barriers, the revised guidelines and policies would further help promote gender equality and inclusivity in STEM fields.

3. PROJECT STUDY APPROACH:

The project was specifically conducted within the academic settings of IUCEA member Universities that were offering STEM post graduate courses in East Africa (Kenya, Uganda, Tanzania, Rwanda and Burundi) where STEM postgraduate courses included Master's and

Doctor of Philosophy (PhD.) programs. The research component drew data from 50 Universities, 20 in Kenya, 2 in Rwanda, 6 in Burundi, 14 in Uganda and 8 in Tanzania. These universities provided crucial data sets, facilitating a comprehensive analysis of the status of gender equality within STEM education and careers in East Africa.

a) Definition of STEM

The STEM categories were defined as per the International Standard Classification of Education (ISCED) 2011. This framework organizes educational fields into science (including life sciences, physical sciences, mathematics, statistics, and computing), engineering (encompassing construction, manufacturing, and architecture), and related subfields such as agriculture, forestry, fishery, veterinary medicine, and health sciences. However, we made a slight adjustment in our categorization approach, through which science was subdivided into life sciences, physical sciences, and health and welfare. Mathematics was independently considered as a distinct field of education, while computing was positioned under the broader domain of Technology. Engineering, manufacturing, and construction categories were adopted in accordance with the guidelines set forth by the International Standard Classification of Education (ISCED) 2011, with no alterations made.

b) Study Design

The study employed mixed-methods research, combining qualitative and quantitative research components. The use of mixed methods approach enabled not only to quantify gender gaps in STEM post-graduate training programs in IUCEA member universities but also explain the mechanism or practices that lead to the observed disparity thus strengthening the study's conclusions The research employed a fully mixed concurrent equal-status design, a methodology elucidated by Schoonenboom and Johnson in their paper on Constructing a Mixed Methods Research Design. This approach seamlessly integrated qualitative and quantitative methods alongside secondary data collection from universities. It encompassed the simultaneous implementation of various data collection techniques, including online surveys, focus group discussions, and in-depth interviews, while also gathering existing quantitative data such as enrollment and graduation statistics from academic institutions offering postgraduate STEM courses.

Simultaneously, in-depth interviews (IDIs) and focus group discussions (FGDs) were conducted to delve deeper into the experiences, perspectives, and challenges faced by women in STEM postgraduate training and careers. These qualitative methods allowed researchers to explore nuanced insights, uncover barriers, and understand the socio-cultural dynamics influencing gender equality in STEM fields. We also conducted a scoping review to establish the breadth of available evidence on factors facilitating or inhibiting women's participation in postgraduate STEM training, and advancement in STEM careers and synthesize the available evidence on supervision and mentorship of women in STEM training and careers in East Africa. Finally, we conducted a document analysis on policies and guidelines for gender in(equality), supervision, and mentorship about women's participation in STEM.

c) Data Collection

i. Quantitative data

Between 2022 and 2023, we collected data from five East African countries: Kenya, Uganda, Rwanda, Tanzania, and Burundi - gathering information on enrollment, graduation rates, and the makeup of STEM faculty from the registrar's offices at universities and various academic director's offices in select institutions. Simultaneously, we conducted an extensive online survey targeting diverse stakeholders including doctoral students, faculty members, early career researchers, registrars, postgraduate training coordinators, departmental heads, and representatives from pertinent national agencies and ministries engaged in postgraduate training and research across East Africa, as part of a comprehensive study.

Respondents were requested to specify their country of study and origin, and to provide insights on gender equality, supervision, and mentorship in STEM postgraduate training and careers. Respondents were also asked to indicate their area of expertise, which was subsequently categorized into Science, Technology, Engineering, or Mathematics disciplines, aligning precisely with the study's objectives.

ii. Qualitative Data

Primary data on experiences of women in STEM was collected from women participants through 66 in-depth interviews carried out in Rwanda (13), Kenya (11), Burundi (14), Uganda (15), and Tanzania (13). Most of the respondents had a background in Sciences constituting 42.38%, followed by Engineering, Manufacturing, and Construction with 25.37%, Health and Welfare with 20.90% and Agriculture with 5.97%. There were 3 (4.48%) respondents who did not specify their fields.

Additionally, five focus group discussions, one held in each country, were convened, each consisting of 10-12 women representing diverse disciplines within STEM and varying levels of education and career advancement. Respondents in the focus group discussions were drawn from faculty members and postgraduate students in STEM disciplines, selected from different departments across East African universities offering STEM postgraduate programs. To ensure a thorough comprehension, we employed a purposive sampling method to carefully select respondents with substantial expertise in matters pertaining to gender equality, the supervision and mentorship of female students, and early career experiences in STEM.

d) Data validation

Data gathered from Rwanda, Burundi, and Uganda in 2022 and from Kenya and Tanzania in 2023 underwent validation through in-country workshops, which were attended by approximately 35 to 40 participants in each country. These validation sessions brought together researchers, faculty members, postgraduate STEM students, officials from ministries, and representatives from science regulatory councils. The validation workshops aimed to achieve several objectives:

1. Presenting preliminary findings from the study on "*Participation and Quality of Experiences of Women in STEM.*"

2. Discussing key study findings and formulating recommendations.
3. Gathering feedback from stakeholders on enhancing the representativeness of the research area's data.
4. Discussing, refining, and adopting strategies for gender-lensed mentorship and supervision within East Africa.

During the validation workshop, participants offered valuable insights on ways of increasing participation in online surveys and enhancing STEM-related postgraduate training in East Africa. Lastly, there was consensus among participants regarding the importance of ongoing advocacy for increased female representation in STEM. They stressed the necessity of gender equity in STEM education for collective development.

e) Data Analysis

i. Online data analysis

Data from an online based survey was analyzed in MS Excel to assess the background characteristics of respondents, status of gender equality, and factors that contribute to participation of women in STEM in East Africa.

ii. Secondary data analysis

The secondary data on enrolment and graduation as well as faculty level data was analyzed using Excel to study the trends over 10 years from 2011 to 2020. The secondary data analysis aim was to quantify the gender gaps in STEM post-graduate training programs in East African Universities. The comparative analysis looked at gender parity in student enrollment and graduation in the various STEM related post-graduate disciplines in the region.

iii. Qualitative data analysis

Qualitative data on experiences of women in STEM in East Africa was collected mainly through in-depth interviews and focus group discussions. The related audio recordings were transcribed verbatim by the research team using MS Word. Three research officers cleaned and cross-checked all transcripts for credibility, authenticity, and reflexivity. The team exported the clean transcripts into NVivo Software version 12 for data management and analysis. We conducted an open inductive thematic analysis following the multistep process. This process involved:

1. Reading and re-reading the interviews, followed by initial meetings to discuss preliminary ideas.
2. Coding the data line by line and individually sorting the codes.
3. Identifying emerging themes and holding meetings to compare and discuss them.
4. Reviewing the emergent themes at the level of coding excerpts and in relation to the entire data set, ensuring internal homogeneity and external heterogeneity.
5. Defining and naming the key themes.

4. PROJECT FINDINGS, OUTPUTS AND OUTCOMES:

This segment offers a comprehensive summary of the project's outputs and outcomes, in line with the set objectives.

Objective 1: Determining the levels of gender equality in STEM-related postgraduate training and careers in East Africa

First, we sought to understand the challenges and barriers to leadership that women face in STEM postgraduate training and careers. Our initial focus was to gain insight into the difficulties and obstacles that women encounter in their pursuit of leadership roles in STEM postgraduate training and careers. Despite efforts to enhance the experiences of women, a multitude of challenges continue to impede their participation in these fields.

One of the significant issues was the existence of inequitable opportunities for career advancement, which disproportionately affected women in comparison to their male colleagues. As women took time off around childbirth, they often returned to find that their male peers had made progress in various academic achievements, such as completing projects, securing grants, and publishing research, resulting in earlier promotions. Unfortunately, promotion panels did not consider maternity leave as a legitimate reason for career gaps and therefore did not waive promotion requirements. As a result, the presence of maternity leave alone did not adequately address the obstacles that women face in their academic advancement.

> "It is like you are walking on a string trying to balance everything because you don't also want your career to be left behind when you see males don't ever rest, they are just going on. So, you feel pressured to remain in this career while also trying to juggle with other things you have always wanted to do. For example, I gave the example of starting a family" (*IDI, Rwanda).*

Several initiatives and actions had been taken to enhance the participation of women in leadership positions within STEM postgraduate training and careers. Nonetheless, there were certain obstacles and challenges that disproportionately disadvantaged women compared to men. Some of these challenges stemmed from societal norms that prioritized men as decision-makers in both family and institutional settings. Consequently, men often developed a sense of entitlement, which hindered women from obtaining equal opportunities to assume leadership roles. In some cases where women had been granted leadership roles, men became a hindrance and created difficulties, thus burdening their female counterparts.

> "Maybe let's say you are working in a department where there could be men who find it difficult to accept female leadership. Sometimes you may find such a person may not agree with what you are doing or what you say but then it's not necessarily everybody, it could be one. But that could also happen with a man who has a male colleague who doesn't necessarily agree with him. Those are more personality issues" (*IDI, Burundi).*

The leadership question was corroborated by findings from the survey. Although a fifth of the respondents felt that leadership roles were designed to attract only men, this perception was associated with the gender of respondents.

Second, we sought to understand the policies and guidelines that influenced women's participation in STEM post-graduate training in East Africa. In the online survey, 66.5% of respondents felt there were effective policies in place to guide the supervision of STEM postgraduate students. However, there were significant variations in the country, with respondents from Kenya constituting almost half of all who voted yes to this question (45.5%), and Burundi and Uganda having 13% and 18% respectively.

We conducted a scoping review, which entailed a critical examination of policies and guidelines aimed at promoting women's participation in STEM training and careers in Kenya. Policy documents and guidelines were scrutinized from IUCEA member universities to identify those that related to supervision and mentorship and that promoted women's participation in STEM postgraduate training. Pairs of reviewers carefully considered the relevance of all materials before including a source document in the study, especially for grey literature. A general appraisal of the paper or document was conducted to assess whether it fully developed the aspects required or if the information was implicit and hard to extract or evaluate. Additionally, for all included systematic and scoping reviews, an evaluation of the quality of evidence was conducted using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) Checklist. A standard data extraction tool was used by team members responsible for data collection.

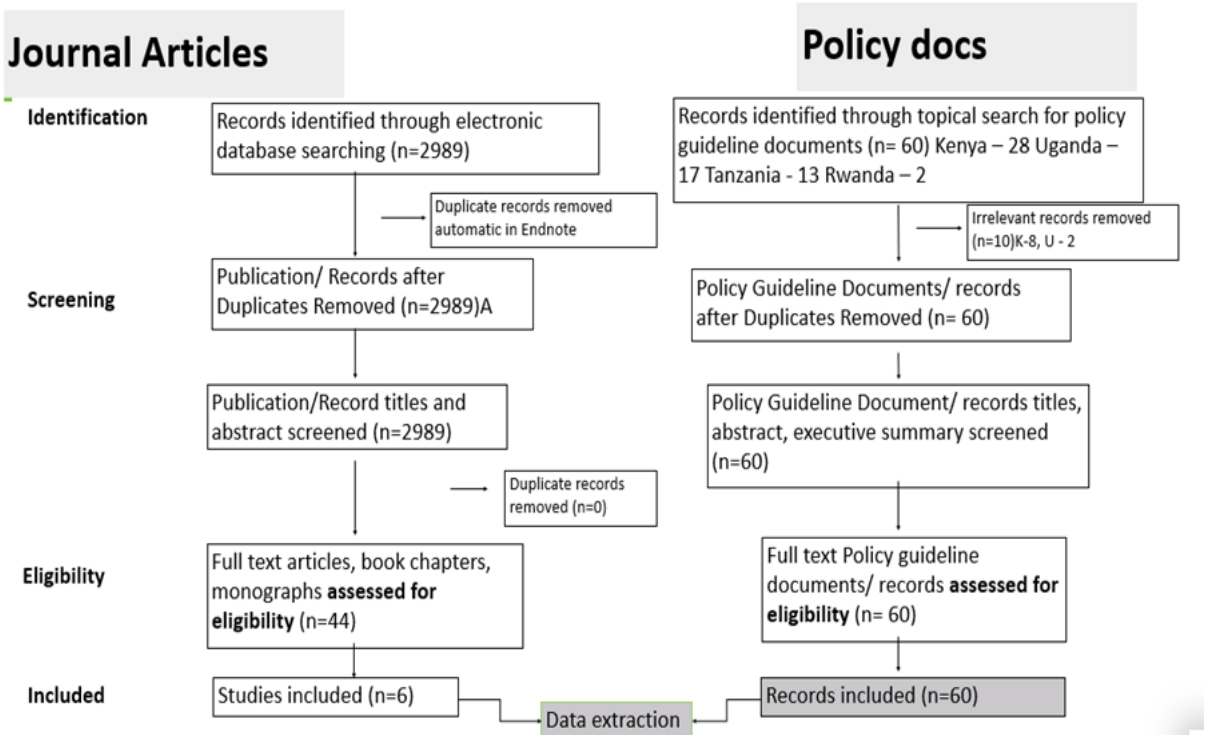

Figure 1: Prisma diagram of Journal and Policy document analysis

a. Results from the journal articles scoping review

The electronic database search initially yielded 2,989 journal articles, but after screening them for eligibility based on predetermined criteria, only six articles were deemed relevant and met the inclusion criteria for the scoping review.

According to the journal articles examined in the scoping review, societal expectations and family responsibilities are major barriers for women pursuing careers in STEM. Women are often discouraged from pursuing STEM programs due to gender stereotypes and expectations that prioritize their roles as caretakers and homemakers. Additionally, women are often expected to take on the majority of family responsibilities, such as caring for children or elderly relatives, which can make it challenging to balance work and family life.

To address these barriers and increase representation of women in STEM, several strategies were highlighted. One of the most important strategies was the availability of funding or scholarships specifically for women, as this can help to reduce financial barriers that may prevent women from pursuing STEM education and careers.

Table 1: Summary of journal article findings from the Scoping Review

Author/Year	Title	Supervision factors	Mentorship factors	Factors contributing to STEM training careers	Factors inhibiting STEM training careers
Liani et al, 2021	An intersectional gender analysis of familial and sociocultural drivers of inequitable scientific career progression of researchers in Sub-Saharan Africa	None	Lack of positive role models who had succeeded in their careers without sacrificing marriage and family	• Use of technology to enhance access to opportunities by women • Employing web technology could help alleviate some of the difficulties faced by some women who face constraints to participate in scientific-mobility oriented activities	• Normative scientific career progression that is structured around the idea of spending extra time at work renders women time poor due to the familial and societal expectations. • Unequal gender division of labor within the family and informal rules of gendered social norms, values and stereotypes in society. • Conformity to societal values which stress the centrality of marriage and motherhood for women. Additional time demands for language minority research scientists further amplifying the time pressure for francophone women. • Women who prioritized their career clock explained that their relationships have suffered.

Okwach Abagi, Olive Sifuna and Salome Awuor Omamo, 2009	Chapter 15. Professional women empowered to succeed in Kenya's ICT sector Okwach Abagi, Olive Sifuna and Salome Awuor Omamo in **African Women and Icts Investigating Technology, Gender and Empowerment** **Ineke Buskens** and **Anne Webb** Bloomsbury Academic 2009	Supervisors who provide flexible working arrangements and equal opportunities seen as favorable for career advancement.	• Female mentors in ICT as transformative inspiring confidence and providing career navigation strategies. • Initiatives like industry networking events and corporate mentorship schemes critical for skill-building and professional visibility. • Informal women's professional groups offer emotional support and resource-sharing.	• Early exposure to ICT in schools and targeted scholarships for women increase entry • Companies with gender-inclusive hiring practices and leadership training programs help retain women. • Women who persist despite barriers often have strong self-efficacy and family encouragement • Growing mobile and internet penetration creates new opportunities for women in tech-driven roles.	• Stereotypes like "ICT is for men" discourage girls from pursuing tech education • Sexual harassment, pay gaps, and exclusion from decision-making seen as challenges. • Conflicting demands of caregiving and long work hours force some women to leave the sector • Few women reach senior roles due to glass ceilings and lack of sponsorship • Uneven access to reliable electricity and internet in rural areas hinders participation in STEM.
Mukhwana A.M et al/2020	Factors which Contribute to or Inhibit Women in Science, Technology, Engineering, and Mathematics in Africa	Supervisor support identified as a facilitator to excellence in STEM	• Mentorship and role models as a facilitator of excellence in STEM	• Presence of mentors and role models as well as supervision. • Negotiability of work schedule. • Availability of funding for research & innovation. • Opportunities for leadership development. • Giving hiring preference to under-represented group members with similar salaries. • Existence of pregnancy leave & childcare policies	• Societal norms labelling STEM as "male-dominated" discourage girls from participating. • Harassment, pay gaps, and lack of promotions create hostile environments for women. • Poor infrastructure in schools disproportionately affect girls in rural areas. • Unpaid caregiving responsibilities often force women to abandon STEM careers. • Weak enforcement of gender equity laws and policies fails to address systemic barriers.
Salome Awuor Omamo, 2009	Chapter 16. Reflections on the mentoring experiences of ICT career women in Nairobi, Kenya: looking in the mirror Salome Awuor Omamo In **African Women and ICTs Investigating Technology,**	Effective supervision involves guidance, feedback, and career development support. Many women in ICT sector experience limited supervision due to male-dominated	• Mentorship is a critical factor for women's success in ICT, providing emotional support, skill development, and networking opportunities. • Lack of female mentors in STEM fields is a recurring issue forcing women to navigate	• Early exposure to STEM leads to women succeeding due to encouragement from family and teachers. • Scholarships, training programs, and workplace policies promoting gender equity plays a positive role.	• Cultural biases discourage women from pursuing or remaining in ICT careers. • Family responsibilities and societal expectations disproportionately affects women's career continuity. • Absence of senior women in STEM fields

	Gender and Empowerment **Ineke Buskens** a nd **Anne Webb** Bloomsbury Academic 2009	workplaces where their growth is not prioritized Poor supervision leads to isolation and lack of clarity in career progression for women.	male-centric environments without role models • Successful mentorship relationships are often informal, with mentors offering visibility for mentees in professional spaces.	• Collaboration with other women in ICT helps sustain motivation and share resources.	perpetuates a cycle of underrepresentation. • Limited access to training, funding, and career advancement opportunities hinder progress.
Ruth Meena and Mary Rusimbi, 2009	Chapter 17. Our journey to empowerment: the role of ICT In **African Women and Icts Investigating Technology, Gender and Empowerment** **Ineke Buskens** a nd **Anne Webb** Bloomsbury Academic 2009	Supportive supervision in ICT workplaces can enhance women's career growth by providing clear guidance, resources, and opportunities for skill development. Lack of gender-sensitive supervision in male-dominated tech spaces often leads to women being overlooked for promotions or challenging initiatives. There are positive supervision experiences when managers actively encourage women's participation in decision-making and leadership roles.	• Mentorship is pivotal for women's empowerment in ICT, helping them navigate systemic barriers and gain confidence. • Formal and informal mentorship programs with peer mentoring are found to be effective. • Absence of female mentors in STEM fields is a recurring challenge, leaving many women without relatable role models.	• Access to ICT education early encouraged women to pursue careers in the field. • Scholarships, NGOs, and women-focused tech initiatives play a key role in fostering participation • Many women succeed due to resilience and self-driven learning despite societal pushback.	• Stereotypes about women's technical abilities limits their opportunities in STEM education and employment. • Lack of affordable ICT training, internet access, and funding hinders women's entry and advancement. • Societal expectations around caregiving responsibilities force women to abandon or pause STEM careers.
Babalola, du Plessis and Babalola, 2021	Insight into the Organizational Culture and Challenges Faced by Women STEM Leaders in Africa	Women in STEM leadership often face biased supervision, where male-dominated hierarchies undervalue their contributions Many workplaces lack structured	Lack of senior women in STEM limits access to role models who understand gender-specific challenges.	• Exposure to STEM in school is critical for career entry. • Companies with scholarships helps retain women in STEM	• Work-life imbalance disproportionately pressured women from pursuing or advancing in these field. • Inadequate funding, training infrastructure, and geographic disparities limits access to STEM education

		supervision frameworks to ensure fair performance evaluations and career growth for women			

b. Results of the policy document analysis

In addition to the journal articles, we also identified and screened 66 policy documents based on predetermined eligibility criteria for inclusion in the scoping review. As depicted in Figure 2 below, the findings from the policy review reveal that 48% of the policies specifically address women, indicating a clear acknowledgment of the importance of gender diversity across various sectors. Moreover, 57% of the policies discuss gender disparities and the inclusion of underrepresented groups, demonstrating concerted efforts to tackle systemic issues.

Recruitment and retention strategies, along with their implementation, were highlighted in 30% of the policies as critical areas to focus on. Additionally, 18% of the policies emphasized the necessity for research funding and grants specifically tailored for women, recognizing the challenges they encounter in accessing resources. Only 20% of the policies included sections on formal training for mentors/supervisors in best practices and feedback mechanisms, suggesting a need for greater emphasis in this aspect. Furthermore, 2% of the policies underscored student-centered learning approaches, while 5% mentioned the provision of technical support as a need to complement the supervisory experience. Lastly, 20% of the policies proposed recommendations or models grounded in empirical research, indicating a growing trend towards evidence-based policy development.

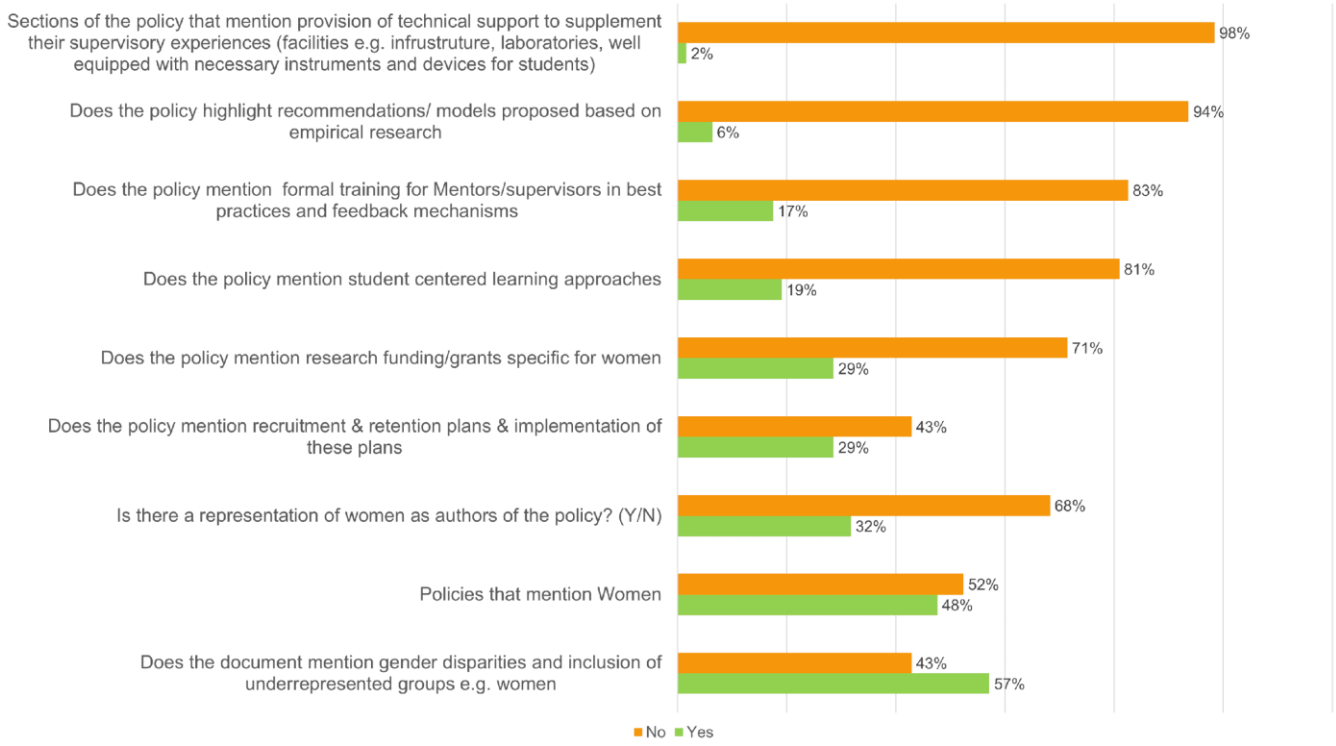

Figure 2: Results of the policy document reviews

The findings from the policy review indicate an increasing acknowledgment of the significance of gender diversity and inclusion across various sectors. The attention given to gender disparities, underrepresented groups, and the explicit mention of women reflects a growing commitment to promoting gender equity in policy formulation. The indication of inadequacy in formal training for mentors and supervisors, student-centered learning approaches, and provision of technical support for students communicated the need for greater attention to be given to these areas. The emphasis on empirical research in some policies also underscored the importance of evidence-based policy development. In conclusion, while progress towards gender equity is evident, there remains a substantial need to address systemic barriers hindering women's participation and achievements in STEM disciplinary areas.

c. Demographic distribution of study respondents

To assess the levels of gender equality in STEM related post-graduate training and careers in East Africa, we leveraged secondary data collection from universities affiliated with IUCEA and an online survey that was circulated to postgraduate students, faculty and researchers working in STEM departments in universities and research institutions affiliated to IUCEA in East Africa.

A diverse array of researchers, faculty, and postgraduate students from Science, Technology, Engineering, and Mathematics (STEM) departments in universities and research institutions participated in the online survey. The survey spanned a duration of two years, from May 18, 2021, to May 18, 2023. A total of 839 responses were received; 57 were from non-East African

countries and 71 were from non-STEM fields thereby bringing the total of valid survey responses to 711.

The online-based self-administered survey focused on various aspects, including the background characteristics of respondents, the status of gender equality, factors contributing to women's participation in STEM, and related strategies. Of the 839 responses collected from participants across five countries, 711 were from individuals enrolled in STEM programs. Table 2 is a breakdown of the characteristics of the online survey respondents:

Table 2: Characteristics of online survey respondents

Characteristic	N	%
Willingness to participate	**711**	
Age		
15-24	115	(16.2)
25-34	274	(38.5)
35-44	224	(31.5)
45-54	67	(9.4)
55-64	23	(3.2)
>64years	8	(1.1)
Country		
Kenya	250	(35.2)
Burundi	148	(20.8)
Uganda	110	(15.5)
Tanzania	103	(14.5)
Rwanda	100	(14.1)
Gender		
Male	394	(55.4)
Female	314	(44.2)
Prefer not to say	3	(0.4)
Marital Status		
Single	303	(43.6)
Married	389	(54.7)
Divorced/Separated	14	(2.0)
Widowed	5	(0.7)
Religion		
Christian	658	(92.6)
Native	3	(0.4)
Hindu	1	(0.1)
Muslim	48	(6.8)
No religion	1	(0.1)
Living Setting		
Urban	486	(68.4)
Peri -Urban	112	(15.8)
Rural	113	(15.9)

Field of Study		
Science (Biological sciences, physical sciences, health sciences, laboratory, and allied health)	392	(55.1)
Technology	69	(9.7)
Engineering	53	(7.5)
Mathematics	192	(27)
Agriculture	5	(0.7)
Highest Education		
Bachelor's degree	258	(36.3)
Post graduate diploma	27	(3.8)
Master's degree	291	(40.9)
Doctoral degree	135	(19.0)

A total of 711 valid responses were received from the online survey. Most of the respondents were male (55.4%). On average, respondents were aged 34 years old with a standard deviation of (10.1). The largest category of respondents was between 25-34 years (38.5%). On the other hand, most of the respondents were married (54.7%).

As shown in Table 2, most of the respondents specialized in the Sciences (55.1%), encompassing fields such as Biological Sciences, Physical Sciences, Health Sciences, Laboratory and Allied Health. One-third of the participants were undergraduate students, slightly higher than a third (40.9%) were master's holders, and PhD holders accounted for 19%, while 3.8% held postgraduate diplomas suggesting a diverse mix of academic levels within the survey population.

Most of the respondents who completed the survey were from Kenya (35.2%) followed by Burundi (20.8%), Uganda (15.5%), Tanzania (14.5%) and Rwanda (14.1%). Table 3 below provides the demographic characteristics of respondents of the in-depth interviews (IDI).

Table 3: Demographic Characteristics of Respondents in In-depth Interviews

Item	**Categories**	**IDIs (per country)**					**Total**
		Burundi	**Kenya**	**Rwanda**	**Tanzania**	**Uganda**	
Level of education	Masters	1	2	6	2	2	13
	PhD	13	9	7	12	13	54
Organization	University	12	8	12	14	12	59
	STEM-related research	2	3	01	0	3	8

Job designation	University faculty/Researcher	7	10	13	1	7	38
	Leadership position	7	1	0	13	8	29
Field of study	Science	6	8	9	7	9	39
	Mathematics	4	0	3	1	4	12
	Engineering	4	2	0	3	2	11
	Technology	0	1	1	3	0	5

All participants of the qualitative in-depth interviews (IDI) were women in STEM departments, and were either postgraduate students, or held a master's or PhD level of education and were working as either faculty or researchers in universities and research organizations in East Africa (Table 3). Most of the respondents 84.6%, held PhD degrees while 19.4% held master's degrees. Universities had a bigger representation (88.1%) compared to those in STEM-related research (11.9%). Most of the participants (56.7) were from university faculty or research, compared to those who were in leadership positions (43.9%). Science was the most represented field at 58.2%, followed by Mathematics at 17,9%, and Engineering at 16.4% and Technology at 7.5%.

Table 4 below provides a breakdown of the number of FGD participants in the five East African countries. There were five FGDs carried out among 56 women participants, ranging from 9 to 13 in each country. The participants included postgraduate students, lecturers, professors, institutional directors, deans and researchers in STEM fields.

Table 4: Breakdown of the number of focus group discussion participants per country

Country	**Number of FGDs**	**Number of participants**
Burundi	1	13
Kenya	1	11
Rwanda	1	11
Tanzania	1	12

Uganda	1	9
Total	**5**	**56**

d. Gender distributions and perceptions on STEM disciplines in East Africa

The study highlighted the gender distribution in STEM disciplines of postgraduate training in East Africa. More specifically, the study assessed the distribution of women and men at both master's and doctoral levels, and in the specific fields of Science, Technology, Engineering, and Mathematics (STEM) across the East African region. In particular, the study focused on enrollment and graduation patterns among women and men in STEM postgraduate training programs. The study further aimed to identify potential disparities and address barriers that may have hindered the full participation and advancement of individuals of both genders in these fields.

We engaged stakeholders, including policymakers, educators, employers, and advocacy groups, to validate the data obtained and to co-create strategies and initiatives that had the potential to promote gender equity and inclusivity in STEM education, employment, and leadership.

Furthermore, studying gender disparities in STEM disciplines helped shed light on societal attitudes, cultural norms, and systemic factors that might have influenced individuals' choices and opportunities within these fields. By fostering a more inclusive and equitable environment, efforts were made to ensure that individuals of all genders had equal access to opportunities, resources, and support systems necessary to thrive and succeed in STEM disciplines in East Africa.

Respondents were asked about their perceptions regarding the gender distribution in STEM disciplines as shown in Figure 3, with all categories indicating that more men than women enrolled in STEM courses.

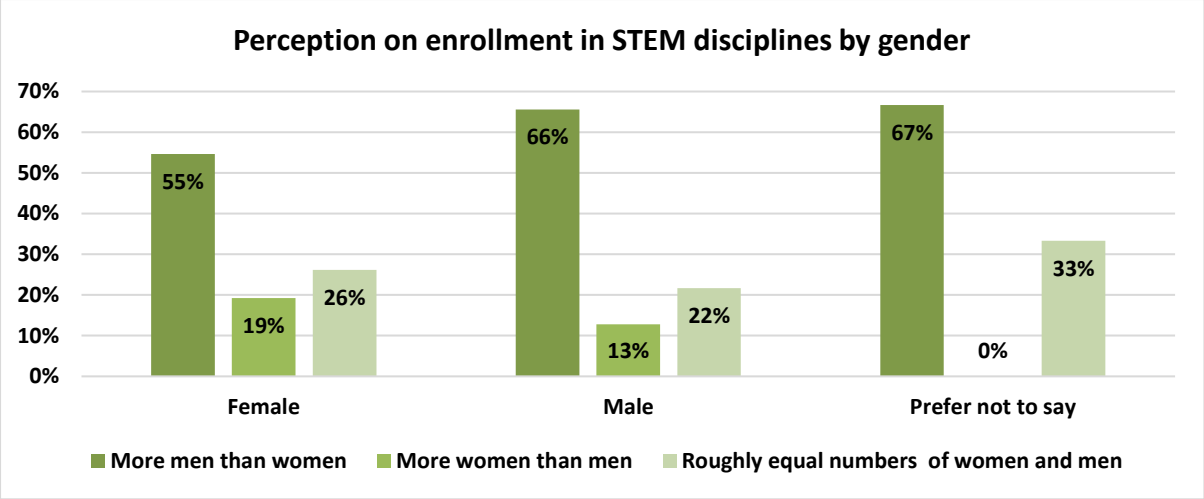

Figure 3: Perception of enrollment in STEM disciplines

Secondary data on postgraduate students' enrollment further confirmed this observation, revealing a notable discrepancy in the enrollment of female students compared to their male counterparts (Table 5). For example, in Burundi, only 10.8% of female students enrolled in STEM master's degree programs over a 10-year period (2010 – 2020). In Kenya, the female enrollment rate stood at 42.7%, much closer to parity but still falling short of the 50% mark. This disparity underscores a significant and concerning gender gap that persists within the STEM postgraduate enrollment landscape of the region.

Table 5: Gender distribution at master's level

	Kenya	Uganda	Tanzania	Rwanda	Burundi
Universities sampled	20	14	8	2	6
Total number of students enrolled with STEM Masters' degree	15296	11619	14528	8811	1094
Total number of female students enrolled with STEM Masters' degree	6529	3509	3903	2485	119
Proportion of female Students enrolled with STEM Master's degree	42.7%	30.2%	26.9%	28.2%	10.8%

Additionally, the enrollment of female students in STEM doctoral programs remains disproportionately low, especially in Burundi, where merely 1.9% of students pursuing STEM PhD degrees are female (Table 5). Data from the other four countries also showed very low

proportions of female students enrolled into STEM PhD degrees with Kenya leading with just slightly over a third while the other countries had proportions of between 25.4% and 27.6%.

Table 6: Gender distribution at PhD level

	Kenya	Uganda	Tanzania	Rwanda	Burundi
Universities sampled	20	14	8	2	6
Total number of students enrolled with STEM PhD degree	2528	821	5309	690	53
Total number of female students enrolled with STEM PhD degree	914	227	1391	175	1
Proportion of female Students enrolled with STEM PhD degree	36.2%	27.6%	26.2%	25.4%	1.9%

Insights gathered from qualitative interviews underscore the significance of gender equality within STEM disciplines. Study participants identified four primary areas of concern, including awareness of gender equality status, practices fostering gender equality in STEM education and careers, obstacles impeding equal participation of men and women in STEM, and the extent and dynamics of women's involvement in STEM, as outlined below,

i. Awareness of gender equality status

There was a unanimous acknowledgment among the participants regarding their awareness of gender equality within STEM fields. They demonstrated a clear understanding of the prevailing gender equality status in STEM. However, participants emphasized that women continued to be underrepresented in STEM-related careers. While we acknowledge the progress made in promoting gender equality within STEM, it's evident that women remain significantly underrepresented in STEM-related careers. Despite our awareness of the existing gender equality status, the disparity persists. Below are some statements that were gathered from the study participants:

> "In any case, in Burundi, I think that at the level of our university, the percentage of women has never exceeded 30% and in scientific subjects, it is even less. That is the general average. In Biology, at one point, there were only two women with a PhD. One has already retired, and I am also leaving in a year. There is no female successor after us" (*IDI, Burundi).*

> "For me, I find that in general there is still a clear gap between the number of people who have a master's degree and a PhD in Science, Engineering and Math. There is a clear gap between men and women. There are still too many men compared to women who reach those stages" (*FGD, Rwanda).*

In the qualitative interviews conducted as part of our research, participants offered valuable insights into the factors that could foster gender equality in STEM disciplines. After analyzing the qualitative interview data, we were able to identify the hindrances and prevailing practices

consistently emphasized by the participants as crucial contributors to promoting gender equality within the STEM fields. As follows.

ii. Practices promoting gender equality in STEM training and careers

Intrinsic Motivation: Participants emphasized that having self-belief was a significant factor in motivating women to pursue and thrive in STEM courses. They pointed out that self-motivation was particularly valuable for success in the STEM fields, which is largely dominated by men. This is also demonstrated through the following statements from the study respondents:

> "I have a habit of imposing myself when I believe in something. I have ambitions and I do everything so that it can be achieved. I wanted to come to the end of my career with the last rank of Professor, I got it. So, I think the environment was also favorable to my aspirations and ambitions. It wasn't easy but when you impose yourself when you know what you want, I think things work out well" (*IDI, Burundi).*

> "You have to stand on your feet and insist that you are going for your further studies regardless of the circumstances and it takes a lot of heart. So, you must stand your ground, otherwise you can never progress because it feels that it is you who takes care of any small thing in the house" (*FGD, Uganda).*

Scholarships Targeting Women in STEM: Participants emphasized the crucial role of scholarships tailored specifically for women in STEM. These scholarships served as essential resources that enable women to overcome financial barriers and pursue higher education in STEM fields. The study participants underscored the significance of such scholarships in empowering women and expanding their opportunities within STEM, as provided in the following statement:

> "All the scholarships we put out require a sentence showing that women are the most encouraged to apply (*FGD, Rwanda).*

Evolving Perceptions of Gender Stereotypes in STEM: Changing perceptions of gender stereotypes in STEM was reported to enhance women's participation in STEM. Further findings indicate that policies and programs supporting gender equality in STEM have been of significant boost to women's participation in STEM. The following excerpt details how gender stereotypes are changing in Rwanda.

> "What is being done is that the government of Rwanda has put a lot of effort into making girls realize that they are capable and can make it. In the former years, girls were told that they could not. However, right now there is a campaign that is saying that girls can study science, are capable of studying mathematics and help the country in its development" (*FGD, Rwanda).*

Parental and family support: Support from parents and family members for girls pursuing STEM education was notably emphasized, particularly during their undergraduate and

graduate studies. Additionally, during postgraduate studies, especially at the doctoral level, spousal and family support for childcare emerged as crucial for enabling women in STEM to progress in their training and careers. The statement below from one of the respondents further substantiates this point:

> "I have been fortunate; my mother is a primary teacher of mathematics and science. So, from a young age, I was exposed to math, and she coached and encouraged me. I can say that having the support of women in science, having a supportive husband at the family level and support at the workplace from your colleagues and head, having the support is important in progression" (*IDI, Uganda).*

Mentorship during studies: Participants stressed the importance of having mentors during STEM education. They noted that mentors play a significant role in guiding STEM postgraduate students to effectively complete their academic endeavors, as pointed out below by one of the respondents,

> "As I said, we need more role models of women who have developed their careers to encourage girls. The ladies have to fight and work double time to compensate for the time that society takes from us as mothers" (IDI, Burundi).

Peer mentorship was also considered as an enabler to women's participation in STEM postgraduate training programs in East Africa. According to the participants, peer mentorship programs that offered valuable support and guidance to students, particularly women, navigating STEM education and careers, fostering a sense of community and empowerment. Another identified enabler was belonging to mentorship and leadership programs for women in STEM. According to the study participants, participation in mentorship and leadership programs specifically designed for women in STEM provided valuable opportunities for skill development, networking, and career advancement.

Having mentors during STEM basic education was also considered an enabler to women's participation in STEM postgraduate training later in their lives. According to the participants, early exposure to mentorship opportunities during basic education would inspire and empower young girls to pursue STEM subjects and careers, laying a strong foundation for future success. Moreover, having female STEM teachers was considered essential. According to the study participants, female STEM educators served as role models and mentors for students, particularly young girls, encouraging their interest and participation in STEM disciplines.

Equal Pay Policies: Study participants reported that policies ensuring equal pay for equal positions encouraged women's participation in STEM. Additionally, institutional and government policies aimed at promoting women's involvement in STEM were highlighted as instrumental in reducing barriers to participation. The statements below from the study respondents further illustrate this point:

"When it comes to remuneration, I think I happened to be lucky because where I am working is well-structured in terms of how they're employing engineers. So, there is no difference whether you are a man or a woman" (*IDI, Kenya).*

"In Uganda, there is no disparity, I don't think women are given less salary than men in our kind of setting. So long as you are doing the same thing then the distribution of salaries is the same (*IDI, Uganda).*

During the qualitative interviews, study participants also identified various additional factors that could facilitate gender equality in STEM fields.

- ***Time flexibility during studies*:** Participants emphasized the importance of flexible study schedules to accommodate the diverse needs of both male and female students, enabling greater participation and engagement in STEM disciplines.
- ***Embracing technology and innovation:*** According to the participants, *l*everaging technology and innovation in STEM education and research could create more inclusive and accessible learning environments, fostering equal opportunities for both genders.
- ***Promotion requirements:*** According to the participants, transparent and equitable promotion criteria were essential to ensure that both men and women had equal opportunities for career advancement within STEM fields.
- ***Presence of gender equality units and centers in universities:*** According to the study participants, establishing dedicated units and centers focused on gender equality within universities could provide resources, support, and advocacy to address gender disparities in STEM.
- ***Partnership with other scholars*:** According to the participants, collaboration and networking with other scholars, both male and female facilitated knowledge exchange, professional development, and mentorship opportunities for women in STEM.
- ***Learning in mixed schools:*** The participants emphasized that co-educational learning environments promoted diversity and inclusivity in STEM education, challenging gender stereotypes and fostering collaboration and teamwork among students of all genders.
- ***Conducive environment*:** According to the study participants, creating a supportive and inclusive learning and work environment within STEM institutions was crucial for attracting and retaining talented individuals of all genders.

The findings indicated the need for women to have equal participation in STEM when it comes to contribution of skills, experiences, and practices. Besides, the findings showed that women played significant leadership roles in STEM fields which included deans, heads of departments and other decision-making roles. This is further illustrated in the following quotes.

"On the academic side, for example, we share the same tasks. For example, I am the head of the department, some men are not, while there are departments that are held, there are men who

hold departments, and there are also women, which shows that we are subject to the same status" (*IDI, Burundi).*

"Generally, what is happening in institutions reflects empowerment nationwide. My opinion is that there have been equal opportunities for people to get into policy-making positions as far as STEM is concerned implying that when you get an institution of higher learning the opportunity of finding a female in an office is as high as finding a male" (*FGD, Uganda).*

It was further noted that women in STEM desire mutual respect and valued contributions to their work. On the other hand, Women's participation in STEM is the bridge to obtaining societal gender equality.

> "What I can tell you is that you really see a lot of people value it because it is not something many women achieve. We are few so if you luckily get there indeed the value is there. Value is there because it is not easy yet" (*IDI, Rwanda).*
>
> "We are telling women to step up and go into governance and government where actually decisions are made which affect women scientists. They will affect me. For example, how much money is given to research by the government? And yet we are signatories for the various declarations but how much goes into it? But that decision is made in a decision table far away from where I am and women must sit on those tables*" (IDI, Kenya).*

Suggestions for women's participation in STEM were also reported by study participants. Contrary, it emerged that a lack of gender-disaggregated publications can negatively impact women's participation in STEM. In general, mentorship and societal support were highlighted as critical enablers to women's participation in STEM postgraduate training in the East African region. Additionally, the availability of technological support and ease of access to electronic platforms such as Zoom led to a reduction in time wastage meant freeing more time for their families. The pandemic also offered opportunities for some research as it hampered other types of research:

"There was research work that we couldn't do because of the pandemic but also there was research work which came up as a result of the pandemic. There were opportunities that came up during COVID like test kits, we received training in molecular and also got more staff to support, yeah there were opportunities" *(IDI, Kenya).*

iii. Barriers to equal participation of men and women in STEM.

Participants shared insights about significant obstacles that impede gender equality in STEM. According to the accounts of study participants,

Societal perceptions of STEM and entrenched gender stereotypes in East Africa act as obstacles, constraining women's involvement in STEM education and careers. As unveiled by study participants, STEM disciplines have traditionally been regarded as male-dominated

fields. Additionally, respondents highlighted how women's engagement in multiple gender roles and the division of labor contribute to unequal opportunities for career advancement.

> "When I consider my field, which is physics, the challenges are primarily linked to the Burundian issue. People do not appreciate women who have done science. Even the men who work with us have the impression that we are inferior to them. Even the students we lead, sometimes, at first sight when they see you; they have the impression that you don't know the subject, that you don't master it. It is the stereotype of the community" (*IDI, Burundi).*

> "Unfortunately, when we go to the schools where the teacher is teaching an engineer is portrayed as a man, there is no role model for a girl child you understand. For women, the picture they would portray is a picture of a cook or nurse. They instill from childhood that the small professions are for women while the bigger ones of scientists are for men, so the child grows up thinking that those big positions are reserved for men" (*FGD, Uganda).*

> "For instance, getting the scholarship and having to go out there for women we have families. Like for me I had a 3-year-old son, and it was very difficult for me to go out there without my family I remember asking some other peers of mine to apply for a scholarship and they told me we cannot just leave our young family behind to go for a PhD course" (*IDI, Kenya).*

*T*here were also assumptions about limited educational levels. More specifically, certain STEM subjects may be wrongly perceived as only being taught at the bachelor's level, discouraging women from pursuing advanced studies in those fields.

The limited representation of women *in STEM at basic education levels* mainly due to societal pressures directing them towards social sciences and arts, thereby contributing to gender disparities in postgraduate STEM training across East Africa. This is substantiated in the statement below by one of the participants:

> "In general, we don't have enough women in STEM, even when they started in secondary school, we have observed that they prefer to go in those social skills and subjects. This makes it hard to have women in STEM at the postgraduate level because many of them end up going to social sciences and nursing*" (IDI, Rwanda).*

There was particularly limited access to basic education in rural areas. More specifically, women in rural settings were most likely to encounter barriers to accessing basic STEM education, perpetuating inequalities in educational attainment.

In addition, there were gender-related stereotypes and perceptions that hindered women's participation in STEM fields in high schools. Throughout the interviews, it emerged that stereotypes and perceptions in high school that STEM subjects belong to boys and men

deterred girls and women from participating in STEM training. This contributed to a lack of self-confidence and interest in STEM training by many women, as illustrated below:

> "For many years, there have always been fewer female students doing science, that is, chemistry, and physics subjects hence affecting the number of girls admitted into the university in science fields. Again, that's a reflection of what is happening in high school many times. Many of the girls don't like science subjects. There is also the historical perspective where more boys than girls were in schools and so it is just sort of like at the bottom there were always fewer students and fewer girls participating in science" (IDI, Kenya).

> *"It's the mentality that women believe that science is too complicated when it's not. Such words do not encourage them also. They will tell you here that mathematics is very complicated, and physics is too hard, so we stay in it, and we don't try to see if we are capable or not. So, it's the prejudiced mentality of facing science subjects" (IDI, Burundi).*

> ***Poor implementation of gender policies, coupled with insufficient monitoring and evaluation mechanisms:*** The results of both the scoping review study and qualitative interviews emphasized that the failure to implement gender policies, along with inadequate monitoring and evaluation measures, hindered women's access to equitable support in STEM education. Additionally, it was noted that the absence of local scholarships restricted women from participating in postgraduate STEM training, as women in East Africa often find themselves on the economic margins. Moreover, family-level poverty posed a significant barrier for women to pursue education beyond the basic levels. The limitations resulting from supportive gender-lensed policies are further substantiated in the statement below:

> "I mean there are those policies, yet the policies are very clear in the human resource manual that you are entitled to except that its implementation is not uniform. Those appointed by the government in political positions are beneficiaries while the rest are denied. Those policies on childcare exist but implementation is poor, that is out of my experience" (*FGD, Uganda).*

Discrimination and ineffective gender laws were also cited as obstacles preventing women from accessing resources and opportunities to enhance their postgraduate STEM training, as illustrated in the quotes below:

> "But as far as benefits are concerned, we don't have the same benefits because we as women are discriminated against in some way. For example, as regards the payment of family allowances, or certain benefits such as medical care; sometimes we, as women, do not have the same benefits and we consider that this can hinder our development" (FGD, Burundi).

> "Regarding the equality of resources in our country, I think that women still have a problem because the law has not yet facilitated access to and control over resources. And when I talk about resources, I mean family assets and resources" (IDI, Burundi).

Lack of employment opportunities to absorb few women in STEM was also considered a major barrier for women's participation in STEM. In addition, few opportunities for further studies locally in select disciplines restricted women from progressing in STEM training and careers as supported by the following quote:

> "Jobs are not readily available because engineers will work in field projects with private sector organizations. I don't have an answer on the comparative analysis of the salaries, but I know some engineering graduates who are unemployed after completion" (*IDI, Uganda).*

During the qualitative interviews, participants further highlighted other factors that inhibited women's participation in STEM postgraduate training. These insights provided further understanding of the complexities surrounding gender equality in STEM fields, as highlighted by the informants. While not as prominent as the primary factors, these additional considerations shed light on nuanced challenges and barriers that contribute to the broader landscape of gender parity within STEM disciplines.

- ***Lack of mutual support among women:*** Women may not always support each other, leading to a fragmented support network and hindering collective progress in STEM.
- ***Toxic work environments****:* Many STEM workplaces maintain environments that are hostile or unwelcoming to women, impeding their ability to thrive professionally.
- ***Sexual harassment****:* Women often encounter sexual harassment in STEM settings, creating uncomfortable and unsafe working conditions.
- ***Regional geopolitical factors****:* Geopolitical dynamics in certain regions may further exacerbate gender disparities in STEM education and employment opportunities.
- ***Poor infrastructure****: I*nadequate infrastructure, both physical and institutional, can limit women's access to STEM education and career advancement opportunities.
- ***Biological needs****:* Biological needs, such as restroom breaks, may be overlooked or inadequately accommodated in STEM settings, disproportionately affecting women.
- ***Limited representation in leadership roles****:* Women are often underrepresented in leadership positions within STEM fields, limiting their influence and opportunities for advancement.
- ***Gender pay gap****:* Women in STEM fields typically receive lower remuneration compared to their male counterparts, perpetuating economic inequalities.
- ***Lack of female mentors and role models****:* The absence of female mentors and role models in STEM can hinder women's professional development and aspirations.
- ***Low self-confidence and interest among women***: Social factors may contribute to lower self-confidence and interest among women in pursuing STEM careers.

- ***Limited research funding for women****:* Women may face challenges in accessing research funds and resources necessary for their academic and professional endeavors in STEM.
- ***Lack of family support****:* Unsatisfactory familial support systems may discourage women from pursuing STEM education and careers.
- ***Insufficient career guidance****:* Many women may lack awareness of available STEM courses and career paths due to inadequate career guidance resources.
- ***Inflexible career choices for publicly sponsored students***: Women sponsored for STEM education by public institutions were likely to face limited flexibility in their career choices, constraining their options and aspirations.
- ***Gender-blind lab infrastructure****:* Lab facilities and resources were not likely to be designed with gender-specific needs in mind, creating inequities in access and usability.
- ***Gender-Blind Scholarships****:* Some scholarship programs were not considerate of, or did not address gender disparities, further marginalizing women in STEM fields.
- ***Excuses and mental conditioning****:* Societal norms and expectations were likely to lead to the internalization of stereotypes and excuses, deterring women from active participation in STEM.

iv. Challenges owing to gender roles during COVID-19 pandemic

From the online survey, the majority of the respondents indicated that the pandemic had affected their work (73.2%; n=386). Research progress or deadline for submission of thesis affected 73.9% of the respondents. About 60.7% of respondents indicated that their domestic responsibilities during the pandemic had increased, while 31.8% indicated they remained the same. There were statistically significant gender variations in COVID-19 related changes to domestic responsibility (P = 0.012) with (81.5%; n=386) of respondents reporting a decrease in domestic responsibilities being men. Women were associated with increased domestic responsibilities during the COVID-19 pandemic (P = 0.033). Female respondents reported distractions and delays because of working from home as they had to multitask as caregivers as well as work. Most of the respondents used technology to attend virtual classes, receive feedback on their thesis and defend their research work as a means of overcoming COVID-19 related challenges. The quote from in-depth interview data showed there was an improvement in the e-learning platforms, with universities and organizations investing to ensure students and staff are connected during the COVID-19 lockdown. This has had a positive impact in terms of less time wastage, which was the case before, for instance in traffic jams.

"I welcome the online learning and teaching that COVID has caused because this is something that we were overlooking that was already overdue" (*IDI, Kenya).*

v. Overall summary on supervision and mentorship experiences of women in STEM postgraduate training in East Africa

Recognizing the vital role that effective supervision and mentorship played in postgraduate students' academic and professional development, we sought to understand both the positive

and negative experiences of women pursuing STEM postgraduate training in the region. The key supervision and mentorship experiences are outlined below:

Supervision Experiences

According to the respondents, having a supervisor who was well-aligned with their research area and sensitive to socioeconomic, cultural, and gender challenges provided them with a highly supportive environment. On the other hand, supervisors who offered both scientific guidance and emotional support were seen as particularly beneficial. The women valued the supervisors who were able to relate with them on a personal level, and those who demonstrated ability to discuss personal challenges, such as balancing family and academic responsibilities. They also valued supportive supervisors who were sympathetic and accommodating to their personal circumstances. Moreover, the women appreciated the supervisors who were understanding during their pregnancy periods. Such empathetic support fostered strong relationships and was instrumental in enabling women to navigate challenges and succeed in their research work and postgraduate training, despite the challenges of motherhood. The respondents observed that proactive supervisors who reached out to them and ensured timely progress made a noticeable difference in their progression. On the other hand, effective policies and leadership were considered helpful in ensuring that the students were accountable, and that they met timelines set before them.

Despite the positive gains of supervision, there were several negative experiences. Sexual harassment emerged as a significant factor that negatively impacted the women's supervision experience. On the other hand, female students often faced self-doubt, particularly when juggling family and societal responsibilities. This self-doubt, if unnoticed, had the potential to lead the students to drop out of their postgraduate training and to focus on other duties such as childcare and family responsibilities. A lack of alignment between the supervisee and the supervisor also negatively contributed to the women's experiences in supervision. Supervisors whose interests and expertise did not align with their supervisees' research areas discouraged the female students and, in some cases, obstructed them from completing their postgraduate degree programmes. Some female students were negatively affected by supervisors who lacked adequate time to provide guidance and timely feedback, which consequently delayed their completion of the postgraduate training, and in some cases led them to abandon their studies. On the other hand, supervisors who were not sensitive to the unique needs of women and lacked an awareness of gender-specific socio-cultural norms and discrimination negatively affected the students. The lack of recognition of the different rights, roles, and responsibilities of women further led to biased and inequitable support. It was observed that when supervisors failed to adopt a gender-sensitive approach to the supervision process, it resulted in an unsupportive and discriminatory academic environment, adversely affecting the supervision process, and progress and well-being of women. These perspectives also support those of other authors who have identified power dynamics and related gender and intersectionality aspects as barriers to quality supervision and research.

Mentorship Experiences

The project revealed several positive aspects of mentorship that significantly contributed to women's success. The importance of strong interpersonal connections and supportive relationships were highlighted as having a good mentorship experience for women. The respondents considered effective mentors as fostering trust and collaboration, providing both professional guidance and personal encouragement. The study also found that mentorship, which included regular feedback, counselling, and motivation, was particularly impactful.

Good mentors aided in academic progress and created a supportive environment that encourages perseverance. This support helped mentees overcome challenges and motivated them to assist others facing similar difficulties. Strong mentorship focusing on personal and professional development emerged as another key finding. Additionally, mentorship that emphasized skill development, such as academic writing and research collaboration, was found to enhance professional capabilities.

Constructive feedback and iterative improvements facilitated by mentors contributed to the mentee's academic proficiency and publication quality. Moreover, the benefits of effective mentorship extended beyond academic success. The respondents observed that mentors who motivated and guided their mentees significantly influenced their career trajectories, helping them progress from junior to senior academic positions. This continued support and inspiration highlighted the long-term impact of mentorship. These views corroborate with those in other studies that highlighted the role of mentorship in strengthening mentees' academic performance, intrapersonal and interpersonal skills, and professionalism. In general, mentors who actively promote STEM education, especially for women, and provided personalized encouragement, were considered to play a crucial role in fostering diversity and inclusion in these postgraduate training. Mentors who emphasized values such as responsibility, integrity, compassion, and excellence were also found to significantly contribute to the mentee's professional and personal growth.

Mentors who delegated significant responsibilities and offered strategic advice were highly valued, as they demonstrated commitment to nurturing their mentees' growth. Such trust and collaboration were considered essential for building enduring professional relationships. Mentors who were available, listen actively, and provide constructive feedback contributed to a positive and productive mentoring experience. Accordingly, mentors who engaged in activities such as monthly group meetings, especially for under-represented groups, addressed specific issues, including gender disparities, and provided valuable resources for their support. This form of mentorship supported career development and fostered a community of practice among early-career professionals. These observations were in accordance with those of others that elevate the benefit of mentorship in providing personal and emotional support, alongside networking opportunities.

Despite the positive aspects, some negative experiences were identified in. They included misalignment between the mentors and mentees' expectations, lack of sufficient engagement,

commitment and support, and inadequate time investment from the mentors, which had also been reflected in other studies and had potential to lead to missed opportunities for professional growth among the mentees.

Objective 2: To determine supervision and mentorship models that promote women's participation in postgraduate programs in IUCEA member universities

Results from the Scoping Review revealed that supervision and mentorship models in STEM remain largely underdeveloped not just in the East African region but in the larger low- and middle-income countries. There were, however, mentorship and supervision models in other regions of the world that could provide valuable lessons for East Africa. Initiatives in Europe and North America including peer-mentoring programs and structured mentorship pairings, had shown substantial improvement in women's retention and progression in STEM careers.

Despite supervision and mentorship models being largely non-existent in East Africa, there were two ongoing promising programs whose lessons could contribute to advancing mentorship and supervision within East Africa's institutions. The programs were the Consortium for Advanced Research Training in Africa (CARTA) that offers training seminars for PhD supervisors on how to supervise and mentor doctoral students, while a similar program – the AAS Mentorship Programme – is being implemented by the African Academy of Sciences.

The online survey assessed perceptions of existing supervision and mentorship models in East Africa. A significant portion of respondents, comprising two thirds (66%), reported being in a supervisory relationship (n=367). Among students, supervisor gender distribution was relatively balanced, with 32% having supervisors of the opposite gender, 31% sharing the same gender as their supervisors, and 34% having both male and female supervisors. However, among faculty, the majority had both male and female supervisors (73%), while 9% had supervisors of the opposite gender, and 14% shared the same gender as their supervisors.

Our focus was specifically on determining whether supervisor or mentor gender affects the quality of these relationships. Combining overall perceptions of supervisors and supervisees, 65.5% of respondents felt that supervisor or supervisee gender did not affect the quality of their supervisory relationship, while 33.9% believed it did. However, this finding was not statistically significant (p=0.6).

In terms of mentoring relationships, fewer respondents were involved compared to supervision (52.1%, n=281). The majority were in "both male and female mentorship relationships" (56%), while only 20.5% had mentors of the opposite gender and 23.5% had mentors of the same gender. While 56% felt that gender did not affect the mentorship relationship, 41.5% believed that gender positively influenced it. Interestingly, the gender of the mentor or mentee did have a significant effect on the mentorship relationship ($p = 0.049$).

We also examined whether there were enough potential female supervisors and mentors to serve as role models. Regarding supervision, slightly less than half of the respondents agreed that there are enough potential female supervisors (45.8%). Though not statistically significant, this finding raises concerns about the quality of supervision services available to women in STEM.

Concerning role models, a majority felt that there are few female role models (71.2%, n=212). The perception of sufficient role models varied significantly by nationality (p =0.014), with respondents from Burundi reporting the greatest scarcity (91.7%), followed by Rwanda (87.8%), Kenya (69.4%), and Uganda (58.7%). This scarcity of mentors is evident in the following excerpt:

"I've never had a mentor. […] Probably that is why I do not even know what it is all about. I have found my way around. Like I wouldn't say I have anyone to look up to. I think I have never had since my A levels. That is a long time. I think I am my own person. I make my own mistakes and live by them" **(IDI, Kenya).**

Objective 3: To establish supervision and mentorship policies and guidelines that promote women's participation in STEM post-graduate training in IUCEA member universities

A total of 5 data validation workshops were conducted between 2022 and 2023 in all the 5 study countries. The data validation workshops had the main objectives largely as follows:

a) To present the preliminary findings from the study.
b) To discuss the key findings and formulate recommendations.
c) To gather feedback from the key stakeholders on how the data can be more representative of the research area; and
d) To discuss, improve and adopt a framework for mentorship and supervision within East African countries.

Through the validation workshops, key stakeholders from each country were able to gain insights into the early findings of the study. After the presentation of the preliminary data, they were able to dive deeper into the data and collaboratively devise recommendations grounded in the research results. Finally, participants engaged in critical dialogues on the development and adoption of a supervision and mentorship framework suited for the East African context. This framework was expected to play a pivotal role in supporting individuals, pursuing STEM pathways, fostering growth, and addressing gender-related challenges within th field.

a) Validation Workshop in Rwanda

In Rwanda, the study's findings uncovered a notable gender imbalance in the enrollment and graduation rates for STEM Masters and PhD programs. There were higher numbers of men both enrolling and completing these programs compared to women. The variations observed in

the data were primarily attributed to the 2013 amalgamation of previous constituent institutions to establish the present-day University of Rwanda (UR), along with the subsequent rise in the offerings of master's programs. A significant rise in women in STEM Masters and PhD students from 2019 to 2020 was linked to the inauguration of 4 centers of excellence, that focus on promoting the quality of education and Science, Technology, Engineering, and Mathematics (STEM). Against this background, workshop participants engaged in the task of coming up with essential components and strategies that should be included in a supervision and mentorship framework as captured below:

i. Important aspects of supervision in Rwanda

Stakeholders in the workshop identified important aspects about supervision including, supervisor-supervisee relationship; supervisor capacity (experience, expertise, facilitate resources, information etc.; formal agreement (responsibilities, expectations, terms); accountability of both supervisor and supervisee, gender-sensitive supervision; supervisee's freedom to choose supervisor;(vii) limited supervisory ratio to improve supervision quality; laboratory availability for fields reliant on laboratories and associated resources.

ii. Important aspects of mentorship in Rwanda

Important aspects of mentorship identified included - training of mentors; holistic development of the mentee (personal, professional etc.); mentor motivation; legal framework that defines and protects the rights, responsibilities, and expectations within the mentor-mentee relationship; culturally sensitive and resonant mentorship; consensual mentor-mentee relationship; commitment from both mentors and mentees; mentor availability and approachability; and dynamic mentorship (adjustable and evolving).

iii. Separation of mentorship and supervision

Stakeholders in Rwanda addressed the issue of whether mentorship and supervision should be separated or combined. There was a suggestion for mentorship and supervision to be intertwined for the overall efficiency of the mentorship process. Other suggestions included a need for a clear demarcation between mentorship and supervision since mentorship is a more informal, relationship-driven support system, while supervision is a structured, goal-oriented process. Clear demarcation would allow for clear boundaries and expectations of each role. Other thoughts bordered on the distinction between the two roles being contingent upon the infrastructure put in place by institutions. It was suggested that if an institution can create a well-defined, efficient framework that supports and clearly delineates both roles, then combining them may have more merit, otherwise keeping them separate may augur better.

iv. Aspects missing from the draft framework

Participants were presented with a draft supervision and mentorship framework that had been developed based on the study's preliminary findings. They interrogated the aspects that they thought were missing from the draft framework and the following aspects were put forth:

integration of mentorship into institutional policies; emphasis on the importance of trustworthiness and bond between mentors and mentees; time commitment expectations for both mentors and mentees; lack of reference to ongoing training concerning mentorship; and inclusion of the need for mentors to be familiar with adult learning methods and principles.

v. Measuring indicators of effective supervision and mentorship

Suggestions for how indicators of effective supervision and mentorship should be measured were provided as follows: there should be consistent documentation and reporting on both supervision and mentorship activities; tracking interactions; guidance provided; and milestones achieved to ensure a clear record of progress and engagement. Additionally, student/mentee progress reports should be reviewed, validated and approved by the respective supervisors to serve as a form of quality control and ensure alignment of how supervisors and mentors understand and assess the mentorship process, and development and implementation of a structured roadmap for both mentors and supervisors detailing their roles, responsibilities, and desired outcomes from the mentoring relationship. The full data validation report for Rwanda can be found **HERE**.

b) Validation Workshop in Burundi

In Burundi, study findings revealed a clear disparity in female representation in STEM programs, particularly at the PhD level. Despite more women enrolling for Master's degree programs, the number of women enrolling in PhD programs remained low. Furthermore, even in STEM faculties, women were not represented at the same level as men. Survey results showed that men were more likely to be enrolled in postgraduate programs in Burundi. The scarcity of female teachers in STEM faculties was also identified as an issue affecting mentorship and role model programs for girls in STEM. Recommendations from the study emphasized the need to have more female mentors in the East African region and the importance of addressing gender disparities in STEM-related postgraduate training and careers. This could be achieved by promoting access to education and resources for women; encouraging girls to pursue STEM careers; and creating a more inclusive work environment in STEM industries. By doing so, African countries would maximize the potential of all members of society and contribute to the growth and development of the STEM field.

From the study's findings, key questions were posed to the stakeholders concerning aspects of supervision and mentorship in Burundi. The stakeholders' discussions are captured below:

i. Important aspects of supervision in Burundi

Stakeholders discussed the responsibilities, activities and indicators of success in a supervision relationship. Responsibilities of supervisors included training (teaching and guiding the supervisee) and accompaniment (to orient, correct, encourage and guide the supervisee). Indicators of success were proposed as the success of the supervisee; production of high-quality work (such as research publications; and adherence to workplans (completing study programs on time). The supervisor's own research and professional development was also listed as an

indicator of success in this role. On the other hand, the supervisee's responsibilities included studying and completing assignments on time while completing activities (incorporating supervisor suggestions and recommendations in their work, regular progress reports, to be innovative, and to work in teams with other students). Indicators of success include success of the supervisee such as producing high-quality work for publication and demonstrated collaboration skills in working with other students as part of a team.

ii. Important aspects of mentorship in Burundi

Participants indicated that mentors could be professors, supervisors and other professionals whose responsibilities included guidance, orient, correct, advice and support. The domains where they are to carry out the responsibilities include the academic, industrial, social, economic, political, and religious domains. Indicators of success were listed as number of mentees; quality of life standards; career and academic progression; and increase in networks. The mentee, largely accepted as the student had designated responsibilities including accepting learning, applying lessons learned, submitting progress reports, and respecting the supervisor. Indicators of success include receiving academic certifications at the end of the program; academic progression; and improvement in living standards.

iii. Separation of supervision and mentorship

Regarding whether supervision and mentorship should be separated or combined, stakeholders opined that separation of these two aspects is not a universal approach and may not work in all situations. It was found to be better that each institution assess its own needs and determine the best approach to support students in their academic and professional development. Furthermore, it was noted that at the master's level, students often required a mentor to help them identify their strengths and develop the competencies necessary for success in their future careers. However, at the PhD level where students typically had a more concrete understanding of their research interests and career goals, it would be possible to integrate both mentorship and supervision into the academic program. The full data validation report for Burundi is available **HERE**.

c) Validation Workshop in Uganda

In Uganda, the data showed a slight increase in the number of women enrolled in master's programs but their transition to PhD programs remained low. Additionally, the number of male students enrolled in master's and PhD programs was significantly higher compared to their female counterparts. There was also disparity in women representation in STEM faculties with fewer numbers of women lecturers in Engineering, Technology, and Mathematics with higher numbers evident in Health and Welfare courses. The study identified factors promoting and hindering gender equality. Factors that promoted gender equality included motivational support from institutions; flexible working schedules; availability of gender equality units within institutions; family support during early career stages; presence of mentors and effective leadership; and opportunities to challenge gender stereotypes. On the other hand, factors that hindered gender equality included socially constructed gender stereotypes; paucity of women

mentors and role models; limited pool of women mentors and supervisors; workplace discrimination affecting opportunities and promotions; and inequitable scholarship opportunities that did not accommodate women's family responsibilities, thus hindering career progression.

Stakeholders considered aspects of supervision and mentorship in Uganda and whether the two aspects should be separated or combined. The discussions are captured below.

i. Important aspects of supervision in Uganda

Actors in supervision were identified as the supervisor and the supervisee. The supervisor's responsibilities included training (to teach and guide) and accompaniment (to orient, correct, encourage, track progress, care and lead). Indicators of success were presented as the success of the supervisee and a publication record for the supervisor. On the other hand, the responsibilities of the supervisee included studying and completing their assignments on time while being diligent; submitting reports regularly; incorporating the supervisor's recommendations in their work; and embodying teamwork with other colleagues. Indicators of success included the supervisee coming up as a critical thinker; independent researcher; gaining the ability to write grants; having good leadership skills; overall success; possessing good decision-making skills; and a publication record.

ii. Important aspects of mentorship in Uganda

Mentors were identified as university professors, academic supervisors among other professionals. The main responsibilities for mentors included guiding, supporting, and advising the mentee in various aspects such as academically, socially, and economically among others. Indicators of successful mentors included having more mentees; improvement in life standards, academic; and career progression. Mentees on the other side had their roles listed as accepting instructions; applying what they learn; submitting their reports regularly; and possessing humility towards their mentors. Indicators of success included receiving academic merits at the end of the program; career and academic progression; as well as improving their life standards.

iii. Separation of supervision and mentorship

Stakeholders discussed whether mentorship should be separated from supervision during the training of postgraduate students in STEM. Suggestions included that mentorship should be separated from supervision because most supervisors in universities were overwhelmed with supervision of many students especially in private universities. The standard guidelines on supervision in Uganda dictated that one supervisor should supervise a maximum of 3 master students and 2 PhD students. However, it was not unusual to have one supervisor supervising up to 15 students thereby limiting the supervisors to play the mentorship role. Stakeholders also emphasized that specialization is one form of perfection and effectiveness of work and therefore stated that actors in the supervision and mentorship domains would do a great job if they performed both roles separately. It was further suggested that separation of supervision and mentorship at the master's level would be important since master's students often require

a mentor to help them identify their strengths and develop the required competencies that are necessary for their future career progression. Similarly, stakeholders emphasized the importance of this separation also for PhD level students since they also needed guidance as they navigate stressful PhD programs. The full data validation report for Uganda is available **HERE**.

d) Validation Workshop in Tanzania

In Tanzania, findings revealed the prevalent low numbers of female enrollment in STEM programs as in the other countries. Only 26.3% of women students had been enrolled at PhD level in Tanzania over a 10-year period. This highlighted the need for measures and initiatives aimed at achieving greater gender parity and inclusivity in PhD programs. Graduation trends further showed a decline in the number of female students graduating with PhD degrees in STEM disciplines at only 25.2%. At master's level however, the data showed a slow and steady rise in the number of female students successfully completing their STEM master's programs. Notably, there was a slight improvement in the gender gap between men and women students in this regard. Regarding representation of women in faculty teaching STEM programs, there were 36.5% of women teaching STEM masters and PhD courses in Tanzania.

Based on the study findings, stakeholders discussed the draft supervision and mentorship framework. Stakeholders were requested to rank in order of priority the desirable characteristics of a supervision and mentorship relationship. Stakeholders also discussed whether supervision and mentorship should be separated or combined. Summarized discussions are captured below.

i. Desirable characteristics for supervision

A total of 10 desirable characteristics for supervision were ranked in the order of priority. After the ranking exercise the characteristics were ranked as follows- knowledgeable; available for consultation and provides feedback; limits supervisory ratio to improve quality of experiences; availability of a large pool from which to choose a supervisory; equipped laboratories and lab teams; has tracking mechanisms; provides supportive feedback; adheres to timelines; gender-sensitive supervision; and caring and concerned.

ii. Desirable characteristics for mentorship

Stakeholders enumerated 9 desirable characteristics for mentorship. They are trained (but with the right attitude and commitment); mentorship in lower schools and universities; large pool of mentors to choose from; committed to women's progression in STEM; advises and guides strategically; offers training in leadership; mentor is available and approachable; sufficient time commitment; and dynamism.

iii. Separation of supervision and mentorship

Regarding whether supervision and mentorship should be separated or combined, stakeholders observed that there is clear distinction between supervision and mentorship. They observed that supervision was typically framed within contractual agreements and specific guidelines, whereas mentorship is characterized by informal, mutually guided relationships focused on problem-solving. Participants proposed to have measurable indicators to monitor the success of mentorship initiatives. Such indicators would help gauge the level of interpersonal support and guidance inherent in mentorship, in contrast to the more structured and rule-based nature of supervision. The full data validation report for Tanzania is available **HERE**.

e) Validation Workshop in Kenya

In Kenya, the findings showed that as of 2020, only 39% of women had enrolled in STEM courses compared to 61% of men. This revealed a gender gap that was consistent in both enrollment and graduation trends for STEM courses. In Kenya, disparity extended to urban and rural areas where most institutions offering STEM courses were found to be largely located in urban areas. This left children living in rural areas without role models and this had potential to cause lack of inspiration to pursue STEM careers. The data also revealed that there was a paucity of supervisors forcing supervisors to supervise many students thereby lowering the quality of supervision. It was also found, through qualitative interviews, that supervisors tended to pick male students due to a notion that female students take long to graduate, and this affected women's experiences on supervision.

Stakeholders enumerated desirable supervision and mentorship characteristics as captured below.

i. Desirable supervision and mentorship characteristics

Desirable supervision characteristics include being supportive; caring; concerned; empathetic; committed; considerate; knowledgeable; gender-sensitive; adheres to timelines; available for consultation among others. On the other hand, desirable mentorship characteristics include sacrificing time; resourcefulness; being able to apply positive pressure; mentee driven; able to offer leadership; ability to maintain link after graduation; dynamic; and able to offer strategic direction.

ii. Prioritized supervision and mentorship characteristics

Stakeholders were presented with thirteen desirable characteristics of supervision: - option of a large pool to choose a supervisor; knowledgeable; committed; timeliness; available for consultation; supportive; caring; concerned; empathetic; considerate; ability to apply positive pressure; has a tracking mechanism; and applies gender-sensitive supervision. At the end of the exercise, stakeholders prioritized through voting 4 factors that they thought were crucial to be included in a supervision and mentorship framework: These were commitment; empathetic; knowledgeable; and availability of a pool of supervisors to choose from. For mentorship,

stakeholders through ranking and voting prioritized 4 desirable mentorship characteristics, notably empathy; resourcefulness; ability to advise strategically; and mentee driven. The full data validation report for Kenya is available **HERE**.

Objective 4: To design and pilot a supervision and mentorship intervention that encourages participation and retention of women in postgraduate STEM-related programs in Eastern African universities

After the convening of 5 country data validation workshops that were conducted between October 2022 and June 2023, a regional two-day collaborative and validation workshop focused on finalizing the development of a supervision and mentorship framework for East Africa was convened in Kenya from August 31 to September 1, 2023. The workshop brought together a diverse group of 60 influential stakeholders from various sectors including university rectors, government representatives, faculty leaders, PhD students, and research regulatory bodies across East Africa. Their collective objective was to craft a comprehensive gender-responsive framework for optimal engagement of women in STEM-related post-graduate training and careers in East Africa. The framework had been drafted from the data that had been collected in the 5 countries and enhanced during the country data validation workshops conducted in each of the countries.

Leveraging the desirable characteristics identified during the validation workshops, participants in the cocreation workshop identified exemplary practices and benchmarks to shape a regional framework for gender-responsive mentorship and supervision. The primary aim was to ensure consistent adherence to high-quality, gender-sensitive supervision and mentorship practices across Higher Education Institutions (HEIs) in East Africa. Stakeholders' proposed components of the gender-responsive supervision and mentorship framework, coupled with accompanying guidelines and recommendations, were integrated into the framework's development for East Africa.

a) Consolidation of supervision and mentorship strategies for STEM postgraduate training in East Africa

The stakeholders recommended an integration of mentorship with supervision into existing policies, standards and guidelines at the postgraduate level. They also recommended the establishment of supportive structures and breaking of gender stereotypes to create a more inclusive and supportive environment for supervision and mentorship of women in STEM postgraduate training in East Africa. The following supervision- and mentorship-related strategies were considered necessary to optimize women’s participation in STEM postgraduate training in East Africa:

i. Effective Supervision Strategies

Supervisors needed to be aware of gender differences, issues, and inequalities, and consider them during supervision, recognizing how gender roles and responsibilities affected individuals' students and their academic trajectories, as well as how to address these disparities appropriately.

Effective supervision relied on the supervisor's attributes. Supervisor needed to possess both technical expertise and can understand and address the unique challenges faced by supervisees, particularly women. These attributes included commitment, availability, empathy, knowledgeable, competence in research and disciplinary area, support, care, concern and consideration, as well as the ability to provide constructive feedback. Supervisors who demonstrated a genuine interest in their students' development and created a supportive environment had the potential to significantly impact on their academic and professional trajectories.

Considering the opinion of students during the allocation of supervisors allowed them to have supervisors whose styles of leadership and supervision aligned with their specific needs and preferences. This choice empowered students, fostering a sense of autonomy in their educational journey. It also increased the likelihood of students finding supervisors who could offer personalized guidance and support, tailored to their individual circumstances.

Facilitation of effective supervision relationships through clear contractual agreements was considered essential. These agreements needed to be aligned to the expectations, responsibilities, and commitments of both the supervisor and supervisee. Such formalized structures would ensure accountability and clarity, preventing misunderstanding and promoting a professional relationship. This facilitation needed to include provision of resources and support systems that enabled students to engage in meaningful interactions with their supervisors, including through regular meetings, workshops, and access to professional development opportunities.

Accountability mechanisms were considered vital in maintaining the integrity and effectiveness of supervision. Regular evaluation and feedback loops were needed to ensure that supervisors and supervisees upheld high standards of conduct and continued to meet the needs of the latter. These mechanisms included peer reviews, feedback surveys, and performance assessments.

Access to comprehensive training programmes for supervisors was considered critical. Such training programmes would equip supervisors with the skills and knowledge required to support students effectively, including understanding gender dynamics, fostering inclusive environments, and employing effective communication strategies. The training programmes would also ensure that supervisors were well-prepared to address the diverse needs of their supervisees.

The development and implementation of robust policies were considered fundamental to institutionalizing gender-sensitive supervision. The required policies needed to address equal access to opportunities, anti-harassment measures, and support for work-life balance, among other aspects. Tracking mechanisms, such as progress monitoring and data collection on supervision outcomes, were considered essential for evaluating the effectiveness of these policies. These mechanisms would provide insights into the impact of supervision, and highlight areas for improvement, ensuring continuous enhancement of practices.

Timeliness in supervision was considered a critical factor in effective supervision. Supervisors needed to be available and responsive, providing timely feedback and support to their supervisees. This responsiveness would enable students to stay on track with their academic and professional goals, addressing challenges as they arise and maintaining momentum in their development. Institutions needed to emphasize the importance of timely supervision and provide structures that facilitated regular and consistent supervisor-supervisee interactions.

ii. Effective Mentorship Strategies

With respect to mentorship, the respondents identified several effective strategies, that included provision of a supportive and gender-sensitive mentorship environment; mentors making practical adjustments to accommodate personal responsibilities; and encouragement to women to mentor other women, while recognizing that effective mentorship can be influenced by either gender. Other effective mentorship strategies included advisory and strategic support from mentors, aligning guidance with the mentee's goals and needs. This included the mentors having relevant experience and a willingness to adapt their approach to the mentee's evolving requirements.

Respondents emphasized the value of mentors who guide their mentees toward leadership roles and provide access to resources. This support involved not only aiding academic progress but also facilitating networking opportunities and leadership development. Maintaining a strong, approachable relationship also emerged as an essential strategy in mentorship. Ensuring mentorship extended beyond academic training to include long-term career guidance and support was also considered to be crucial for sustained success of the mentee.

b) Process of development of the East African regional gender-lensed Supervision and Mentorship Framework

During the co-creation workshop, participants reflected on the presentations that had been made regarding the proposed components of the framework proposed during the country validation workshops. They were to group the components to fit under proposed themes such as resources, quality control, management, stakeholder engagement, and others (or cross-cutting issues). Participants were divided into 5 groups, and they proceeded to develop the principles, standards and detailed guidelines drawing on the IUCEA's Standards and Guidelines for Postgraduate Studies in East Africa (2018) as an example. The groups later

presented the components they had developed showing the general principle, standards, and specific guidelines as well as the role of institutional, regional, and regulatory actors in the operationalization and implementation of the framework component.

The 5 groups were further engaged in identifying specific actors and how these actors would facilitate the implementation of the framework components. Each group was also charged with the task of discussing, agreeing, and documenting actionable suggestions that would apply well in specific country-contexts. A summary of the groups' deliberations is presented below.

- There should be regular training for supervisors (organized by institutions and their management).
- Institutions are required to have budgets for implementing capacity building initiatives to support supervision and graduate students' research (especially women).
- Establishing and strengthening systems and mechanisms for regular and timely monitoring and evaluating of supervision and mentorship.
- Co-supervision of students across institutions should be encouraged.
- Establishing strong academy-industry linkage since STEM stretches beyond academy to the industry.
- Raising awareness of the stakeholders, including students and institutions on the need for and importance of mentorship.
- There is a need to pool efforts and resources among higher education institutions to leverage their capacities to meet the unmet supervision and mentorship needs such as labs, supervisors, etc.
- Mentorship should be institutionalized, recognized and rewarded in any appropriate and possible ways.
- There should be more scholarships and grants that target women scientists both within institutions and by lobbying funders to prioritize women.
- Stakeholder engagement is a prerequisite for the successful initiation and implementation of gender empowerment framework components at all levels (institutional, national, and regional).
- The need to have in place and enforce harmonious policies and guidelines for ensuring gender equality and equity as well as policy measures to ensure effective supervision and mentorship.
- Both supervision and mentorship should be gender responsive and culturally sensitive.
- Sustainability measures and strategies are crucial to make the framework a long-term solution for promoting gender equality and women empowerment.
- Leveraging resources available in different professional associations and industry should be used to address and bridge the gap that exists due to the limited availability of mentors. Through such platforms, mentees can be matched with potential mentors

In summary, the key issues were summarized to include assessment, allocation of resources, formal supervision and mentorship policies, collaborations and networks, follow up, and

sustainability measures This activity was followed by country-based group activities to tailor the recommendations to their specific countries.

c) Co-creation of a gender-lensed Mentorship and Supervision Framework for postgraduate training in East Africa

The co-creation workshop concluded with a preliminary supervision and mentorship framework. The Framework was consequently reviewed internally by the APHRC team and by the team at IUCEA led by the Head of the Quality Assurance and Qualifications Framework Unit at IUCEA. Additionally, the framework underwent additional scrutiny by stakeholders and was subsequently submitted to the IUCEA Executive Committee where it was adopted and approved in the 15th IUCEA's Annual General Meeting of 16th July 2024 in Juba, South Sudan. Upon approval, IUCEA in collaboration with APHRC convened a dissemination webinar to share the Framework with stakeholders in higher education and released a call for interested universities to apply for small grants to pilot the Framework within their institutions. The full report of the regional co-creation workshop is available **HERE**.

Based on the identified strategies, the stakeholders co-created a robust framework for the optimal implementation of the gender-lensed supervision and mentorship strategies for the strengthening of women's participation in STEM postgraduate training in East Africa. The stakeholders underscored the importance of several key components to ensure effectiveness and inclusivity of the gender-lensed supervision and mentorship framework for STEM postgraduate training in East Africa. The components of the framework were considered at institutional, national, and regional levels to ensure a comprehensive and tailored implementation across different contexts. The components of the framework are outlined below:

Execution and Management: The stakeholders considered the need for effective execution and management of the gender-lensed supervision and mentorship framework for STEM postgraduate training in East Africa. Planning, which included setting strategic goals, conducting needs assessments, and integrating gender equity into institutional policies, was considered essential in the execution and management of the supervision and mentorship framework. There was a need for comprehensive planning to align with institutional, regional and national strategic objectives. On the other hand, there was a need for adequate resourcing, which included equitable allocation of funding, equipment, and opportunities, alongside recruitment and strengthening the capacity of staff members who were committed to gender-sensitive practices. This was necessary to maintain operational effectiveness in the execution and management of the gender-lensed framework. In addition, there was a need for the development of an appropriate culture and values that foster an inclusive academic environment that values diversity and promotes gender equity. Leaders also needed to model these values for greater effective execution of the framework. Developing and maintaining efficient systems and organizational structures, alongside cultivating a culture of excellence and instilling core values, was also necessary to reinforce positive behaviors and ethical standards. Furthermore, implementing robust motivation and performance management

systems drove excellence and achieved high levels of staff engagement and productivity. Consequently, there was need for mechanisms to be put in place to motivate the execution of the gender-lensed supervision and mentorship framework, including setting achievable goals, recognizing achievements, and providing incentives for engagement.

Stakeholders' Engagement: The stakeholders highlighted the need for thorough stakeholder mapping and engagement to identify and involve key players, ensuring diverse perspectives are included in supervision and mentorship decision-making processes. Effective communication was emphasized as a means to build trust and facilitate collaboration. Moreover, participation from a broad range of stakeholders was considered to be crucial for robust outcomes to be achieved in supervision and mentorship in STEM postgraduate training in East Africa.

Capacity Strengthening Initiatives: Capacity strengthening for effective supervision and mentorship was considered crucial to maintaining high standards and encouraging innovation. Institutions need to enhance the mentorship and supervision capacities of their staff members and researchers by offering regular training opportunities. Equally important were peer learning initiatives, which fostered knowledge-sharing and collaborative growth, allowing individuals to learn from one another's experiences and expertise. These efforts not only enhanced individual competencies but also facilitated the building of a more cohesive and capable institutional workforce, while promoting gender equity and cultivating quality research. Training and peer learning also prepared the institutions to address complex challenges and achieve their strategic goals with respect to supervision and mentorship. Consequently, this would enhance quality and inclusive STEM postgraduate training in East Africa.

Governance Control, Assurance and Enhancement: There was need for effective governance controls to maintain high standards in research and institutional operations with respect to gender-lensed supervision and mentorship. Recommendations were made for comprehensive gender-lensed policies that would provide clear guidelines and expectations for effective and inclusive supervision and mentorship, ensuring that all related activities aligned with the regional, national and institutional visions, missions, goals and regulatory requirements. Continuous monitoring and evaluation of progress on effective gender-lensed supervision and mentorship was highlighted as essential for tracking progress, ensuring compliance, and identifying areas for improvement. Performance needed to be evaluated with clear and fair criteria. Moreover, it needed to include regular feedback, and monitoring to address any gender-related disparities. Robust gender-lensed supervision and mentorship risk assessment and management strategies were also needed to identify potential threats and develop proactive measures to mitigate them, safeguarding diversity, equity and inclusivity parameters, institutional interests and operational continuity. Together, these efforts would create a supportive and equitable framework for gender-lensed supervision and mentorship in STEM postgraduate training in East Africa.

d) Dissemination of the Supervision and Mentorship Framework for Postgraduate Training and Careers in East Africa

On 1st November 2024, APHRC and IUCEA convened a virtual webinar to disseminate the gender-lensed Supervision and Mentorship Framework for East Africa. The webinar was attended by 160 participants drawn from higher education stakeholders including academics, members of high education commissions, officials from the Ministries of education and health, and university administrators. The Head of IUCEA Quality Assurance and Qualifications Framework Unit, Prof. Michael Mawa, presented on the development process of the Framework, its adoption by the IUCEA's Executive Committee and the objectives of the Framework. Prof. Mawa also expounded on the principles of supervision and mentorship espoused in the Framework which were i) Quality Assurance and Enhancement, ii) Cultural Sensitivity, iii) Collaboration, iv) Ethical Standards, v) Continuous Learning, and vi) Intersectionality. Finally, he elaborated on the key users of the Framework who include students, supervisors, mentors, higher education managers, and quality assurance agencies among others. The Head of APHRC's Research and Related Capacity Strengthening (RRCS) Division, Dr. Florah, Head, presented the four components of the Framework that included i) Quality Controls, Assurance and Enhancement, ii) Execution and Management, iii) Capacity Strengthening Initiatives, and iv) Stakeholders Engagement. The participants in the webinar were given an opportunity to raise questions and these were answered during the webinar. Finally, Prof. Mawa provided the way forward by informing the participants that a call had been launched a few days earlier for universities to apply for small grants to pilot the Framework in their institution. The approved Supervision and Mentorship Framework is available **HERE**.

e) PILOTING OF THE SUPERVISION AND MENTORSHIP FRAMEWORK FOR POSTGRADUATE TRAINING AND CAREERS IN EAST AFRICA

In November 2024, APHRC and IUCEA launched a targeted call to 10 universities within the region, which were the most active and responsive during the implementation of the study to pilot the Framework. Following the call, 6 universities submitted proposals; Kyambogo University, and Uganda Martyrs University (Uganda), Masinde Muliro University of Science and Technology and KCA University (Kenya), University of Dar es Salaam (Tanzania) and Université Lumière de Bujumbura (Burundi). All six universities' applications were evaluated by a proposal evaluation committee made up of representatives from APHRC and IUCEA using a prior-developed scoring matrix. Five of the six universities that submitted proposals were successful. However, only three universities managed to pilot the Framework within the project's timeframe: Masinde Muliro University of Science and Technology, Uganda Martyrs University, and Light University. The other two universities did not pilot the SMF; Kyambogo University (Uganda) pulled out of the piloting citing lack of enough time from the lead applicant to lead the process and University of Dar es Salaam (Tanzania) pulled out due to the institution's long bureaucratic processes that affected implementation timelines.

Below are highlights of the pilots that were carried out in three East African universities:

i. PILOTING OF THE SUPERVISION AND MENTORSHIP FRAMEWORK AT MASINDE MULIRO UNIVERSITY OF SCIENCE AND TECHNOLOGY

Overview on the piloting of the Supervision and Mentorship Framework

Masinde Muliro University of Science and Technology (MMUST) conducted a training workshop to ***Build Capacity for Effective Supervision and Mentorship of Female Postgraduate Students in Science, Technology, Engineering and Mathematics (STEM)*** on 27th February 2025. The objectives of the workshop were to:

- Understand the postgraduate landscape at MMUST especially women in STEM.
- Explore women's participation and experiences in STEM by understanding postgraduate training programmes and career pathways in East Africa.
- Understand the components of the supervision and mentorship framework for postgraduate training programme in East Africa; and
- Reflect on key takeaways from the training and action plans for implementing gender-sensitive supervision strategies in their faculties and departments.

The workshop involved 32 participants: 23 participants and 9 facilitators. Of the 32 total participants, 19 were female and 13 were male. Apart from participants from MMUST, other participants from neighboring universities/colleges: Kaimosi Friends University (KAFU) and Bomet University College (BUC) were also invited to participate in the workshop. In his opening remarks, the **Deputy Vice Chancellor** (Planning Research and Innovations), Professor Peter Bukhala summarized the SMF piloting exercise by saying,

> "*I am confident that once this Framework is adopted by Higher Education Institutions, it will transform postgraduate training programs and careers especially for women. How many females in our university are undertaking postgraduate program and what are the challenges they are facing? Despite acquiring very good grades in high school, girls' performance at the University level continues to drop significantly. As we mentor female students, we need to train them with a view of getting them up to the postgraduate level. We should help and encourage girls to see postgraduate studies as an area in which they can shine and grow in spite of the gender disparity*".

In MMUST, it was noted that there were several initiatives put in place to encourage more women to pursue careers in STEM including scholarships, mentorship programs, and policy reforms to bridge this gap. Female participation on admissions showed an overall fluctuating trend; female admissions had a stronger presence in Masters and Postgraduate Diplolma programs but their participation in PhD programs had decreased over time. This indicated that there were barriers in advancing to higher education levels. The sharp decline in female enrollment in PhD programs by 2023 was a major concern in MMUST and recommendations to address this issue were made during the workshop.

Findings from the post training workshop survey showed that 92.3% of workshop participants agreed/agreed strongly that the training content was relevant to their role in supervision and mentorship, 95.3% indicated that the workshop facilitators were knowledgeable and demonstrated expertise in supervision and mentorship, 95.6% indicated that they felt more confident in applying supervision and mentorship strategies taught in the workshop, and 88.4% indicated that the training highlighted the importance of stakeholders' involvement in supervision and mentorship.

Key lessons learned from the piloting exercise

- There was need for targeted gender-sensitive interventions to encourage more women to pursue and complete doctoral studies at MMUST.
- The university leadership needed to strengthen academic support to:
    - Ensure postgraduate students have the resources and guidance they need to complete their studies successfully.
    - Ensure they have effective mentorship and academic advising throughout their postgraduate journey.
    - Address mental health challenges faced by postgraduate students and provide comprehensive wellbeing services
    - Reduce the financial barriers that contribute to postgraduate student attrition.
    - Equip students with the skills and networks necessary for both academic success and post-graduation career advancement; and
    - Use data to identify and address issues that may impede student progress early in their postgraduate studies ensuring additional institutional policies and the infrastructure are aligned with the needs of postgraduate students.
- At the institutional level, there was poor implementation of gender policies, poor supportive infrastructure, gender pay gaps, flexible career choices among others. At the systemic level, barriers included discrimination of women; lack of mutual support; lack of female mentors and role models; and lack of social support. To address this, MMUST needs to develop policies; offer mentee-driven programmes; build capacity through training of supervisors and mentors; conduct leadership training; and maintain links and collaborations.
- Inadequate staffing led to staff members being overloaded with teaching, leaving little time available for postgraduate supervision and mentoring. Adequate staffing and staff building capacity was urgently needed alongside recognition of staff members engaging in supervision and mentorship of postgraduate students.
- Lack of skilled supervisors stemmed from having few STEM females recruited as staff; rigidity (sticking to the old ways); and inadequate funds. Thus, there was a need to allocate resources for training.
- Stakeholder engagement was a key component of supervision and mentorship and MMUST needed to engage with industry to improve industry-academia linkages. The university, through Memoranda of Understanding, needed to engage with industry ensuring that research carried out had real life implementation.

Recommendations to APHRC and IUCEA to enhance the effectiveness, sustainability, and impact of the Supervision and Mentorship Framework while advancing the participation of omen in STEM fields across East Africa

- *Project Scope and Expansion*
  - **Broaden Institutional Participation:** Expand the SMF piloting to more universities across East Africa, including both private and public institutions to ensure wider adoption of gender-responsive supervision and mentorship practices.
  - **Incorporate more STEM disciplines:** While STEM is a broad field, specific sub-disciplines such as artificial intelligence, biotechnology, and environmental sciences should receive targeted mentorship initiatives.
  - **Regional and Cross-Institutional Collaborations:** Facilitate exchange programs and collaborations between participating institutions to promote best practices in supervision and mentorship.
  - **Integration of Digital and AI-Based Mentorship Tools: Support** the development of AI-driven mentorship platforms that connect postgraduate students with experienced mentors across institutions and industries.

- *Project Duration and Sustainability*
  - **Extend the Implementation Period:** Given the complexity of institutionalizing supervision and mentorship practices, the project duration needed to be extended beyond the pilot phase, allowing universities to fully integrate and evaluate the framework's effectiveness.
  - **Create a Long-Term Mentorship Program:** Establish ongoing mentorship programs beyond the workshop-based approach to ensure continued support for female postgraduate students.
  - **Follow-Up and Impact Assessment:** Conduct long-term tracking of female postgraduate students who have benefited from the program to measure its impact on their academic and career progression.

- *Budget and Funding Support*
  - **Increase Financial Support for Women in STEM:** Allocate more funding for scholarships, research grants, and mentorship-driven capacity-building initiatives aimed at increasing female participation in STEM.
  - **Support Research and Data Collection:** Provide additional funding for universities to conduct research on the effectiveness of supervision and mentorship in enhancing postgraduate completion rates for women in STEM.
  - **Institutional Infrastructure Development:** Support the establishment of mentorship hubs, gender-sensitive research labs, and networking platforms within universities

- *Strengthening Women in STEM Project Priorities*

    - **Address Gender-Specific Challenges in STEM:** Develop policies and interventions that address barriers such as work-life balance, cultural biases, and gender disparities in STEM academia and industry.
    - **Develop Leadership Training for Women in STEM:** Introduce leadership and career development training to prepare female postgraduate students for leadership roles in academia and industry.
    - **Enhance Stakeholder Engagement:** Engage policymakers, industry leaders, and women's rights organizations to advocate for policies that promote gender-inclusive postgraduate training and mentorship.

ii. PILOTING OF THE SUPERVISION AND MENTORSHIP FRAMEWORK AT UGANDA MARTYRS UNIVERSITY

Overview on the piloting of the Supervision and Mentorship Framework

Piloting of the SMF at Uganda Martyrs University (UMU) took place on 28th February 2025 at UMU, Lubaga Campus and involved thirty-seven (37) participants; 12 females and 25 males representing all the faculties in the university. A total of 6 facilitators participated in the training.

At UMU, it was noted that some supervisors and mentors of graduate students had never had any training on supervision and mentorship, and there is a mismatch between postgraduate students' enrollment and completion rate due to inadequate research skills; poor academic writing skills; lack of financial resources; work overload; and poor supervision. There was a need to improve completion rates of postgraduate students via strengthening supervisor-supervisee relationships; promoting ethical and professional supervision practices; establishing structured supervision frameworks with clear milestones; regular reviews; and increasing financial support through scholarships, grants and stipends. It was noted that financial barriers often led to high dropout rates, and providing funding for research related expenses such as data collection, research software, conference costs, and mental wellbeing support would boost students' completion rates.

The gender gap at UMU for postgraduate students would significantly be reduced by establishing scholarships and providing funding for women to specifically encourage their enrollment and retention in postgraduate programs. Gender-sensitive policies and practices could also address gender-based barriers such as flexible study options for women and provide equal opportunities for women in research funding, conference participant, and academic leadership roles.

Key lessons learnt from the piloting included:

- **Supervision and mentorship** of postgraduate students was successful when clear **guidelines** were provided.
- **Effective supervision and mentorship** of postgraduate students was possible, but getting gender parity in enrollment and completion rates depended on a number of factors such as assurance of funding in postgraduate programs.
- In order to effectively supervise and mentor postgraduate students and bridge the gender gap, the supervisors and mentors need to be **equipped** first.
- **Successful implementation of the SMF** needed **concerted efforts,** and **training** on SMF needed more time and had to be done continuously.

Challenges encountered during the piloting included:

- Only a **small number** of supervisors and mentors could be trained in such a small pilot. UMU needed to ensure that all supervisors and mentors undergo such kind of **training**.
- **Training on supervision and mentorship** alone would not address the challenge of the **mismatch between enrollment and completion rate of postgraduate students**. This challenge would be mitigated by **providing scholarships and financial grants to support students; and regular training of supervisors and mentor**s in order to iron out the supervision and mentorship challenges that contribute to the mismatch between high enrollment and low completion rates.

*Following the piloting of the SMF in UMU, the following were proposed as practical steps to institutionalize the SMF in the institution***:**

- Development of a **strategic plan** with regard to supervision and mentorship to enhance **gender mainstreaming**.
- Development of **physical, financial and human resources** for the implementation of the guidelines.
- Development of **mechanisms to motivate** and **recognize faculty members** who show commitment to supervision and mentorship of graduate students – put in place institutional systems for recognizing staff members.
- Put in place **reporting mechanisms** and **dissemination** of supervision and mentorship **reports.**
- Carry out **regular capacity strengthening** based on the needs – need to be decentralized and faculty specific.
- **Monitoring systems** to be developed to ensure quality of supervision and mentorship.
- Provide a **platform for peer-learning, meetings, and workshops** aimed at promoting peer-learning.
- Development of a **framework for identifying stakeholders, level of engagement, roles and responsibilities of each stakeholder and channels of communication**;;
- Have in place **clear plans for stakeholder engagement** - who engages who and on what?
- Development of systems that **identify stakeholder's cultural aspects, define diversity and include cultural practices.**
- Development of a **sustainability plan**.

Immediate next steps are to put in place structures needed to support the implementation of the SMF.

Recommendations for APHRC and IUCEA:

- Provision of **financial support to universities** to conduct SMF training will enable the empowerment of supervisors and mentors in these institutions.

- Provision of **financial support** to students who cannot **afford tuition alongside continuous SMF training** will enable the bridging of high enrollment and low completion rates.

iii. PILOTING OF THE SUPERVISION AND MENTORSHIP FRAMEWORK AT UNIVERSITÉ LUMIÈRE DE BUJUMBURA

Piloting of the Supervision and Mentorship Framework at the Université Lumière de Bujumbura (ULBu) in Burundi took place on 25th April 2025. The workshop involved a total of 33 trainees (25 male; 8 female) and 2 facilitators representing Civil Engineering, Computer Science, Biotechnology, Physics, Mathematics, Health Science, and Environmental Science.

The Training Needs Assessment before the workshop revealed that 44% of those who responded rated their postgraduate supervision skills as "good" but expressed a desire for further training on areas such as thesis guidance, conflict resolution, and effective feedback. About 8% rated their skills as "average" citing gaps in specific areas such as research methodology mentoring and student motivation. Almost 70% (67.7%) indicated having some experience in academic mentorship but wanted to learn more structured approaches to mentoring postgraduate students. About a third (29.7%) rated their mentorship skills as "poor" indicating low confidence in providing academic and career guidance. Regarding gender sensitivity and inclusion in STEM, 81.1% of respondents acknowledged a need for more awareness and practical strategies to support women in research and innovation in STEM fields, while 64.8% were unsure about how to address gender-related challenges in supervision and academic development.

Participants identified several areas where they needed training including gender-sensitive mentoring techniques, advanced supervision skills (research guidance, career mentorship), effective communication and conflict resolution with students, and providing inclusive academic support for women and underrepresented groups.

The workshop which was titled, "***Nurturing future innovators through effective mentorship and supervision***" aimed at enhancing the academic and professional success of STEM students. The primary objective of the training was to build the capacity of supervisors and mentors in STEM fields. At ULBu it was determined that there is great importance in fostering an environment that supports students' academic and professional development through structured guidance and active engagement. Participants were divided into four groups to deliberate on the formation of an institutional framework for mentorship, best practices for supervision, incentives and motivation for supervisors, and digital platforms and technological solutions.

1. Institutional framework for mentorship

A framework for mentorship should be developed and it should clearly define the roles and responsibilities of both mentors and mentees, supported by an institutional policy and a legally-adapted framework. Resources required for this include sufficient human, technical and financial. Key components for success were elucidated as:

- A transparent selection process for mentors
- Mentor training programs
- Personalized mentoring support and objectives
- A network for knowledge sharing
- A steering committee and monitoring tools for continuous improvement

Ethics and professionalism should also be considered since effective mentoring is based on trust, confidentiality, and the mentor's technical expertise in the mentee's field. Gender inclusion where both men and women are involved in mentoring roles is also critical in promoting equal access to opportunities and funding.

2. Best practices of supervision

Some best practices of supervision were identified including establishing strong collaborations between academic institutions and industry players in STEM. Also creating clear legal guidelines for the supervision process as well as setting up ethics committees to address issues that may arise during the supervision process.

3. Incentives and motivation for supervisors

Regarding incentives and motivation for supervisors, recognizing valuable contributions is critical in the mentoring and supervision process. Mentor performance should be incorporated into annual performance evaluation and reducing teaching loads for mentors will allow more time for effective supervision. Commitment to mentorship should also be emphasized as it leads to building trust and dedication to mentoring in the academic space.

4. Digital platforms and technological solutions

Creation of virtual communities using servers to establish online mentorship groups with chat rooms to facilitate communication and collaboration among mentors and mentees would be a value addition to the mentorship spaces. Implementing digital surveys to gather feedback form mentors and mentees can help assess the effectiveness of the mentorship programs. Encouraging the use of free or low-cost solutions and strategic partnerships can help overcome financial barriers.

5. Mentorship and professional integration

Students should be encouraged to work hard, organize their time, collaborative with peers, and seize available opportunities. The university should organize visits to institutions where successful former students are placed to learn from role models.

Recommendations from the group sessions:

1. **Expand discussions on STEM mentorship:** more sessions should be organized to further explore the challenges and solutions around mentorship in STEM, with a particular focus on gender inclusion and technological solutions.
2. **Follow-up sessions:** regular follow-up meetings or workshops should be held to assess progress and share experiences among mentors and supervisors.
3. **Institutional collaboration:** encourage partnerships with industries to ensure practical, real-world applications of mentorship and supervision frameworks.

Key lessons learned throughout the piloting process:

1. **Effective communication is critical**. Clear and consistent communication between mentors, mentees, and institutional stakeholders is essential for the success of mentorship programs. Initial challenges were observed due to a lack of coordination and clarity around roles, which sometimes led to confusion about expectations.
2. **Gender sensitivity and inclusion**. Gender issues remain a key consideration in STEM mentorship. Despite having both male and female mentors, some female students expressed concerns over the gender imbalance in mentorship, noting that more women mentors could enhance the support system.
3. **Institutional buy-in is crucial**. The success of the mentorship framework relies heavily on the institution's support. While there was enthusiasm from faculty members and mentors, some institutional policies and resources had to be adjusted to accommodate the framework's full implementation.
4. **Mentorship structure needs continuous evaluation**. Continuous monitoring and feedback loops are crucial for identifying gaps in mentorship and supervision. The SMF's success was closely tied to the constant evaluation of its impact and adaptability to shifting needs.

Challenges encountered during the piloting

- The timeline allocated for the piloting was tight, limiting the scope of activities that could be undertaken. Some of the planned workshops and training sessions were not fully realized within the initial timeframe.
- Limited budget resources made it challenging to provide sufficient financial incentives to mentors, which could have encouraged more consistent participation and engagement. Additionally, the lack of funds affected the availability of digital tools and platforms for remote collaboration.
- The gender imbalance in both the number of mentors and mentees created challenges in establishing equitable relationships, particularly for female mentees who expressed a preference for female mentors.
- Initial communication breakdowns between mentors, mentees and the administration led to confusion about the roles and responsibilities of participants. Some mentees felt disconnected from their mentors due to unclear guidelines.

Recommendations for APHRC and IUCEA

The following are recommendations from the piloting for consideration by APHRC and IUCEA.

1. **Scope and duration adjustments:** For future phases of the SMF pilot, it is recommended that the timeline be extended to allow for more in-depth discussions and activities, especially with respect to practical applications of the mentorship framework. Adequate time for feedback and adjustments will enhance the program's long-term effectiveness.
2. **Budget considerations:** Future funding should be allocated with greater flexibility to cover digital tools, mentor incentives, and additional administrative support. Collaborations with industry partners and other educational institutions could help offset some of the costs.
3. **Focus on gender-sensitive mentorship:** There is a need for targeted initiatives that promote gender equality within the mentorship framework. This includes ensuring that female students are well-supported by female mentors and actively addressing unconscious bias in mentorship practices. Special focus should be placed on providing gender-specific training for mentors to ensure a supportive environment for women in STEM.

Recommendations for improving Women in STEM Initiatives

1. **Encouraging female mentorship leadership:** Empower female faculty members to take on leadership roles within mentorship frameworks. This can be achieved through capacity-building programs, professional development opportunities, and incentives for female mentors.
2. **Mentorship networks for women:** Establish dedicated mentorship networks for Women in STEM to ensure they have access to a community of mentors who understand unique challenges faced by women in their academic and professional careers.
3. **Long-term evaluation and sustainability:** To ensure the sustainability of the mentorship framework, there should be an established mechanism for continuous evaluation and feedback. Regular follow-up meetings and workshops can be conducted to ensure that mentors and mentees are receiving the necessary support to grow professionally.

5. PROJECT OUTCOMES

Knowledge/ learning outputs from the project are:

a) The Rwanda Data Validation Workshop Report
b) The Burundi Data Validation Workshop Report
c) The Uganda Data Validation Workshop Report

d) The Tanzania Data Validation Workshop Report
e) The Kenya Data Validation Workshop Report
f) The Regional Co-Creation and Data Validation Workshop Report

The policy framework developed from the project is:

a) The Gender-Lensed Supervision and Mentorship Framework (SMF) For Postgraduate Training and Careers in East Africa.

Manuscripts developed and submitted/to be submitted to open-access, peer-reviewed journals:

No.	Manuscript Title	Journal	Status
1	Gender (in)equality, supervision, and mentorship of women in STEM postgraduate training and careers in East Africa: A scoping review.	International Journal of STEM education	Under initial check by the journal editor.
2	Participation and Experience of Women in STEM Postgraduate Training and Careers in Rwanda: The Role of Supervision and Mentorship.	Higher Education for the Future Journal	Undergoing final revisions by first author.
3	Women in Postgraduate Training and Careers and COVID-19 Pandemic: A Phenomenological Study of Navigating Problematic Encounters and Emergent Solutions in Science and Technology Engineering and Mathematics in East Africa.	Journal of Higher Education	Undergoing final revisions by the first author
4	Women's Engagement and Experiences in STEM Postgraduate Education and Careers in Kenya, Tanzania, and Uganda.	Higher Education Journal, Springer Publishers	Undergoing final round of reviews prior to submission to the journal
5	Gender Equality and Women's Participation Experiences in STEM Postgraduate Training and Careers in Burundi.	International Journal of Management in Education	Undergoing final round of reviews prior to submission to the journal

6. KEY EXPERIENCES, CHALLENGES AND LESSONS LEARNED FROM THE PROJECT

Key experiences, challenges and lessons learned during the data collection process are outlined below:

a) There were challenges experienced with respect to **bureaucratic processes**. More specifically,

   i. **Bureaucratic hurdles** within universities and national research approval processes, particularly in Uganda and Tanzania, delayed research progress, affecting survey distribution and access to secondary data.

   ii. **Contracting processes** with universities that submitted successful bids for piloting the SMF took longer than anticipated due to bureaucratic processes within those institutions.

These challenges underscore the importance of **proactive planning, robust communication channels, and building strong local partnerships to streamline**

research processes and mitigate delays. Additionally, they highlight the need for flexibility and adaptability in research methodologies to account for unexpected obstacles. By anticipating potential challenges and establishing clear communication pathways, researchers can ensure that all teams are aligned, and that various concerns are swiftly addressed. This approach not only enhances efficiency but also reduces the risk of setbacks that could impede progress.

b) We employed a **hybrid approach to data collection**, integrating both face-to-face and virtual methods such as self-administered online surveys, secondary data collection, policy and journal reviews, and in-depth interviews. Virtual training sessions were conducted for the research data collection team, who then collaborated closely with regional partners to gather secondary data and conduct face-to-face group discussions. There is a need to continuously **embrace flexible research methodologies** when carrying out projects. More specifically, recognizing the need for flexibility and adaptability in research methodologies to navigate unexpected challenges effectively was critical in this project that commenced during the COVID-19 pandemic. This includes proactive planning, robust communication channels, and the ability to pivot strategies when necessary. Moreover, there is a need for **adaptable approaches** to accommodate **varying national regulatory frameworks** and **operational constraints** across different countries and institutions. This encourages individuals to proactively plan for contingencies, maintain robust communication channels, and pivot strategies when necessary. By embracing flexibility, institutions can mitigate delays in research work, and development and implementation of interventions, consequently upholding ethical standards, and optimizing effective resource utilization.

c) **Data-related experiences and challenges**:

   i. Obtaining **data from universities** proved challenging due to manual record-keeping practices, especially for retrieving older data spanning 8 to 10 years.

   ii. The **quality of data systems** exhibited variance across institutions, with **private universities** generally **equipped** with **sophisticated centralized databases** that facilitate efficient data collection and storage processes. These advanced systems contributed to streamlined operations and enhanced data management capabilities within private university settings. Conversely, **public universities** commonly resorted to **manual data collection methods**, which had potential to present significant challenges when attempting to retrieve secondary data. This reliance on manual processes not only had the potential to introduce inefficiencies but also complicated the retrieval of data from various sources.

   iii. There were limitations regarding **faculty-level data sharing practices** within some institutions, further impeding collaborative research efforts and hindering the dissemination of valuable information across academic departments.

We learnt the importance of implementing digital record-keeping systems to facilitate easier access to historical data among Universities in East Africa. More specifically, we learned the need to:

i. **Implement Digital Record-Keeping Systems:** Universities needed to prioritize transitioning from manual record-keeping practices to digital systems. This would facilitate easier access to historical data, streamline research processes, and improve overall efficiency.

ii. **Invest in digital infrastructure**: Public universities needed to invest in digital infrastructure to improve data management and research efficiency. This included upgrading data systems and providing training to staff on digital tools and methodologies.

iii. **Encourage Faculty-Level Data Sharing:** This facilitated mechanisms for faculty-level data sharing within universities to promote collaboration and knowledge dissemination across academic departments.

d) **Collaboration** with local partners was instrumental, particularly amid the COVID-19 pandemic when travel restrictions were in place.

i. **Partnership** with the **Inter-University Council for East Africa (IUCEA)** facilitated access to member universities, leveraging existing collaborations. **Collaborating with existing networks and organizations**, such as the Inter-University Council for East Africa (IUCEA), to streamline research access and processes is necessary. The partnership with the IUCEA particularly facilitated access to member universities. Leveraging existing networks is also essential in streamlining research processes and enhancing collaboration across institutions and organizations. Networks provide a foundation for sharing resources, knowledge, and best practices, thereby facilitating more efficient and effective research. Enhanced collaboration also promotes the dissemination, validation and adoption of project results and supports the development of innovative solutions.

ii. **Local partners** facilitated team setup, data collection strategies, and research approval processes. From this, we learned the significance of establishing strong partnerships with in-country entities, which can provide invaluable support and expertise, especially during challenging circumstances. These partnerships provide support, local expertise, and a network of partners that can enhance the research process. These partnerships can provide invaluable support, especially during challenging circumstances such as pandemics or bureaucratic hurdles.

iii. Engaging in discussions with **in-country collaborators** provided invaluable perspectives on the intricacies of implementing multi-country studies amidst the backdrop of the pandemic. Particularly, insights from collaborators in Rwanda and Tanzania have shed light on the diverse research system dynamics and

contextual factors influencing research practices and outcomes. These conversations underscored the significance of conducting comparative analyses to identify similarities, differences, and best practices across different research environments. Moreover, they emphasize the importance of fostering collaborative relationships and leveraging local expertise to enhance the validity and applicability of research findings in diverse contexts. Leveraging our partnerships with in-country collaborators facilitated connections with other institutions, enabling the collection of data, despite the COVID-19 pandemic restrictions. The in-country collaborators also facilitated team set-up, data collection, and research approvals, thereby enhancing the validity and applicability of research findings in diverse contexts. Engaging in discussions with the in-country collaborators provided invaluable perspectives on the nuances of implementing multi-country studies amidst the backdrop of the pandemic. In a nutshell, local in-country expertise and support are particularly critical during challenging circumstances, as they provide essential advice, insights and coordination of all required resources.

e) The results of the study were **validated through in-country stakeholder workshops and a regional co-creation workshop in East Africa**. The goal of the stakeholder engagements was three-fold, and was specifically to:
   i. Create awareness on the status and experiences of women in STEM postgraduate training in East Africa, based on obtained data for awareness.
   ii. Solicit buy-in and commitment to the process of promoting gender-lensed supervision and mentorship within the region; and
   iii. Co-create the gender-lensed strategies and framework for the promotion of supervision and mentorship in postgraduate training in East Africa, based on the obtained data.

   These workshops provided critical inputs for developing a comprehensive gender-lensed framework for supervision and mentorship in postgraduate STEM programmes. This collaborative approach ensured that the results were grounded in the real-world experiences and needs of stakeholders, supporting the development of actionable strategies to enhance gender equality in STEM. **Clear communication and regular meetings with relevant stakeholders** ensured buy-in, commitment, and alignment in working methodologies. The **stakeholder engagements** fostered a collaborative environment where expectations were clearly defined, and everyone was committed to the research objectives. This alignment was crucial for the smooth execution of project activities, follow-up, and the successful dissemination of results.

7. CONCLUSIONS

Supervision and mentorship play a critical role in advancing the participation of women in STEM postgraduate training programmes in East Africa, and by extension, SSA. Women

experience challenges that siphon off their advancement in postgraduate training, research and consequently leadership in the region. Key stakeholders drawn from countries within the region identified gender-lensed strategies that were necessary to strengthen supervision and mentorship in STEM postgraduate training and research in East Africa. This led to the co-creation and approval of a gender-lensed supervision and mentorship framework to strengthen support to STEM postgraduate training in East Africa.

The development of the gender-lensed supervision and mentorship framework was not devoid of challenges, especially during the data collection phase of the project. The data collection challenges mainly emanated from delayed country-specific ethical approvals, inevitable closures of academic institutions resulting from COVID-19 period, slow responses to online surveys, and institutional data-related gaps and bureaucracy. The success of the development of the gendered-lensed framework could greatly be attributed to various strategies that were put in place to mitigate against advance effects of the challenges, and to optimize the outputs of the project. The strategies employed included leveraging on existing strategic partnerships with the IUCEA, which had regional convening powers for universities in East Africa. identifying key country-specific collaborators and regularly engaging with key regional and national stakeholders at all stages of the project.

The approved regional gendered-lensed supervision and mentorship framework for postgraduate training in East Africa will need to be implemented at the regional level and cascaded to the national and institutional levels. Leveraging the achievements of this project, it is worth establishing the status and experiences of women in STEM postgraduate training, in addition to the gender-lensed supervision and mentorship strategies and frameworks that would promote their participation in related postgraduate training, research and leadership in the other SSA regions. Relevant researchers and policy actors in postgraduate training would therefore need to consider how to scale up this initiative to the other SSA regions, leveraging the methodological gains, challenges and lessons learned.

Moreover, there is need for additional funds to fully implement the supervision and mentorship framework across institutions in the region, as well as an implementation research project focused on developing a childcare model to support female student mothers in their academic pursuits. These initiatives are crucial for addressing the challenges faced by women in STEM education and ensuring their smooth progression through their studies.

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