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DE-GENDERING STEM: - BEST PRACTICES FROM A CASE STUDY OF A WOMEN'S UNIVERSITY IN AFRICA

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ABSTRACT

The attainment of sustainable development through achieving the 17 sustainable development goals (SDGs) calls for a robust and inclusive talent pool in Science, Technology, Engineering and Mathematics (STEM) with innovative capacities to relentlessly harness current and future opportunities (National Academy of Sciences, 2006). Whilst it is acknowledged that women represent an under-tapped resource and lost opportunity for the STEM sector, the persistent gender gap, particularly in Africa, is not helping the situation. At an estimated average of 24% participation in STEM-based programmes and careers, the full potential and contribution of African women and girls is yet to be realised in all STEM sub-disciplines, sectors and levels. Cognisant of the multiplicity of causal factors to the status quo, closing the participation gap requires holistic interventions from government, industry, academia and the wider society. The paper leverages on the success of the Women's University in Africa in mainstreaming gender, resulting in an 86.2% female participation rate in programmes offered by the University to draw lessons that can be used to increase the participation of women in STEM. The WUA case demonstrates "what can work" regarding building and sustaining female representation in STEM. Critical lessons learnt from the WUA case include innovative and dedicated leadership, targeted curriculum, flexible programme offerings and mentorship to instil the courage and confidence so needed by females to succeed.

Keywords: Sustainable development goals, STEM, female representation

Introduction

Africa lags behind in socio-economic development, a situation that can be redressed by developing a robust and inclusive talent pool with the capacity to harness Science, technology, engineering, and mathematics (STEM) (Cheryan, etal., 2009; Singh, 2011). However, there exists a gender gap worldwide, characterised by female underrepresentation in higher education and in high level professions (Goldin et al., 2006; National Academy of Sciences 2006). Yet, educating women at higher levels should necessarily be considered as a powerful development strategy because of the ripple effect and positive impact it has at the

individual, household and societal levels (Brook, 1997). Peri et al. (2015) have linked this gap to limited aggregate productivity; describing the women's under-tapped human capital as a “lost opportunity” considering that women and men constitute an equal share of the world's population (Dasgupta and Stout, 2014) and that both sexes possess similar intelligence levels, but have varied capacities that can be leveraged for wholesome and rapid development (Taiwo, 2014).

Although in general terms, there has been a marked reduction in the gap between female and male learners participating in higher education, female participation in STEM disciplines remains an area of great concern particularly in Africa (Acheampong, 2014; Boateng, 2017; Chikunda, 2010; Mkude, 2011; Morley, 2010;), eliciting the need for concerted research efforts (e.g., Barres 2006; Williams and Ceci 2015). At an estimated average of 24% participation in STEM-based programmes and careers, the full potential and contribution of African women and girls is yet to be realised in all STEM sub-disciplines, sectors and levels. The figures vary from country to country with Ghana reporting a 22% female student STEM representation (Atuahene and Owusu-Ansah, 2013) and Zimbabwe reporting that 19% of female students graduates in STEM, compared to 39% of male students (World Economic Forum, 2016). To make matters worse, according to OECD (2017), the prognosis for closing the gender-gap in STEM education and the labor market will remain persistent according to a study on the occupational aspirations of 15-year-old adolescents.

The causal factors to this state of affairs are many and vary according to socio-economic, cultural and gender socialisation contexts but are not necessarily biological (Dossi et al., 2019; Odhiambo 2011). Many researchers content that a range of environmental factors such as: poor implementation of gender policies; lack of political will from the highest offices, stereotyping, cultural practices, teaching methods, lack of skilled and gender-sensitive teachers, lack of networks of female role models and family-peer-school-societal influences contribute to the proliferation of gender disparity (Eccles, 2015; Holth and Mellström, 2011; Leslie et al., 2015; Parson, 2016; Rosenthal et al., 2013; Sinnes and Loken, 2014). Men are incentivised and socialised to perform well in STEM (Burton, 1986) a feat that is considered too burdensome for their female counterparts who in turn consider the STEM environment as hostile and masculine-oriented (Stoilescu and McDougall, 2011). Similarly, scholars have attributed the STEM gender divide within education institutions to structural challenges caused by power relations and gendered experiences often starting in secondary school and continuing up to higher and tertiary education institutions (LaCosse, Sekaquaptewa, and Bennett, 2016).

Holman, Stuart-Fox and Hauser (2018) garner for wide-ranging strategies for closing the gender divide in STEM inclusive of: dispelling the myth advancing the existence of intrinsic

gender differences in STEM aptitude (e.g. Barres 2006; Bian, Leslie and Cimpian 2017; Machira, 2013); affirmative action as a way of recognising the additional biological and societal demands that impact on the academic and professional achievements of women (Chauraya, 2014; Nicholson, 2015); building positive and stimulating STEM experiences through exposure to female role models, and striving for a representative gender ratio at academic fora through policies and practices (Martin, 2014).

This study was motivated by the resolution of the Conference of African Women in Science and Technology organised by the African Union in 2019 to place more emphasis on setting up more women's universities in Africa after acknowledging and appreciating the success stories of women's universities in Asia. The paper examines the success of the Women's University in Africa and analyses the effect of policy and institutional environment in influencing the personal, instructional and environmental barriers to female participation in higher education. Although the study focuses on female participation in all higher education disciplines, the success garnered in improving female representation forms the basis of recommending practices "that can work" regarding building and sustaining female representation that can be used in STEM. This paper addresses the following questions in the context of the Women's University in Africa:

1. What are the personal barriers that affected individuals prior participation in higher education?
2. What are the institutional interventions and strategies that induced women to enrol and persist in their studies?
3. What lessons can be adopted as best practice to inform policy and practice to address gender disparity in STEM, particularly in Africa?

Situating the Women's University in Africa within the Zimbabwean Context

After gaining its independence in 1980, the government of Zimbabwe has made strides in formulating policies to rid the nation of any manifestations of gender inequalities as evidenced by the country's pro-gender Constitution which in Chapter 2 Article 17 (1) categorically states that:

> *The State must take all measures needed, including legislative measures, to ensure that both genders are equally represented in all institutions and agencies of government at every level; and women constitute at least half the membership of all Commissions and other elective and appointed governmental bodies established by or under the Constitution or any Act of Parliament; and the State and all institutions and agencies of government at every level must take practical measures to ensure that women have access to resources, including land, on the basis of equality with men; and the State*

> *must take positive measures to rectify gender discrimination and imbalances resulting from past practices and policies. (Government of Zimbabwe, 2013 p.20).*

Furthermore, the creation of and dedicated Ministry of Women Affairs, Gender and Community Development, the existence of gender focal points in all government ministries, and the fact that the country is signatory to international conventions on gender, demonstrates the country's firm commitment to addressing gender disparity. In the area of education, the deliberate policies put in place to advance gender equality include the affirmative action policy (1992) wherein the cut-off points for prospective female university students were set at 2 points lower than those for their male counterparts and the National Gender Policy of 2004 (revised in 2017) aimed to promote equal opportunities for women and men in all areas and at all levels.

These policy interventions had positive impact on increasing female participation at different levels of the education system. Noteworthy achievements included the appointment of women to some key leadership positions such as the Chairpersons of the Gender Commission, the Zimbabwe Electoral Commission and the Anti-Corruption Commission. Furthermore, from 2004-2014, Zimbabwe a female Vice President showcasing clearly the Government's commitment toward achieving gender equality and equity.

An area where women remained grossly under-represented is that of educational leadership, thus pointing to the existence of much stronger barriers to leadership (Chabaya, Rembe and Wadesango, 2009). Recognising that higher education is critical to prepare and hone the required discipline-specific, professional and leadership skills and cognisant of the need to advance the government's efforts in closing the gender gap, two prominent female educationists, Professor Hope Cynthia Sadza and Dr Fay Chung approached the Government with a proposal to start a Women's University. Their proposal was granted and the Women`s University in Africa (WUA) was established through a Trust Deed 692/2001 and given authority to operate as a University by the Parliament of Zimbabwe through Statutory Instrument 130 of 2004 (Charter).

The University started operating as a private university in 2002 with the primary focus on giving mature women a second chance to acquire higher education qualifications to empower them to fulfil socio-economic, political and leadership roles. According to the WUA founders, the empowerment of women is of absolute and importance for the achievement of sustainable economic growth (Nherera, 2015). WUA's enabling legal document (Charter) allows it to recruit students and staff in the ratio of 17:3 women to men, respectively. WUA opened its doors to 145 students in 2002, and the number has grown to the current 5158. To

date a total of 9128 graduates have successfully entered the labour market, 77 percent of which are female.

WUA is headquartered in Harare and has satellite campuses in Zimbabwe (Bulawayo, Mutare, Marondera and Kadoma), Zambia and Malawi. The university offers innovative programmes in humanities and natural sciences designed to address the rising demand for high end training in line with the national and international development needs. WUA has embarked on offering tailor-made programmes and outreach programmes aimed at "taking the university to the people" (ibid).

World-over, especially in countries where they exist, pro-women institutions have contributed immensely in providing access to women who were previously excluded from the higher education as well as addressing issues of equity (Rudolph, 1962). Literature reveals the importance of female-centred institutions in creating a conducive academic environment for 'healing' women with prior negative societal experiences through positive and targeted educational experiences that have created a new generation of women leaders well-motivated to persist and achieve in non-traditional fields (Sadker & Sadker, 1994; Sebrechts, 1999). According to Astin (1977 p. 323):

> *Students at single sex colleges are more satisfied with virtually all aspects of college life: student-faculty relationships, quality of instruction, curricular variety, student friendship, and the quality of the science program; and that women are more likely to attain positions of leadership and to become involved in the student government, to develop high aspirations, and to persist to graduation if they attended a women's college.*

Methodology

The case study approach was used in this research wherein the Women's University in Africa (WUA) was used to interrogate and investigate practice that can be used in similar contexts. The choice of WUA was motivated by the fact that it is the only registered university which is allowed to legally focus on women and gender issues. In addition, WUA is the only University in Zimbabwe with a female Chancellor, Board Chair, Council Chair, Vice Chancellor and Pro-Vice Chancellor.

Periera and Valance (2006) advance the case study as the major methodological approach in educational research due to its ability to aptly represent complex practices. It involves transforming the actual or "really real" places, situations, activities and practices in a setting to become a representation that is immutable and mobile (Anderson and Harrison, 2010). Often criticised for lack of generalisability (Stark and Torrance, 2005), the case study approach was found to be appropriate in this study based on its ability to leverage a context-

based investigation of practice to develop understanding and extend experience based on what is already known (Flyvbjerg, 2006).

The study used both secondary and primary data to respond to the three research questions listed above. Secondary data involved documentary analysis of the legal documents, regulations, strategic plans, student enrolment data, gender profiles, annual reports and other documents and information on the website. Relevant documents were also collected from the quality assurance body - the Zimbabwe Council for Higher Education and the parent ministry.

The primary data was collected through a combination of questionnaires and interviews for the sampled students and alumni. Undergraduate students and alumni where given questionnaires whilst postgraduate students were interviewed using semi-structured interview schedules. The study population consisted of 5158 diploma, undergraduate and postgraduate students as well as 9128 alumni. The purposeful sample included 20 (15 female, 4 male) semi-structured interviews with the founders (1), management (4), the inaugural academics (4), current academics (4), staff that have been there since inception (2) and alumni (5). To complement this, two focus group discussions with a group of 15 (10 female, 5 male) current undergraduate students and 10 (7 female 3 male) current postgraduate students over a period of one year.

Questionnaires were send to undergraduate students who willingly provided their emails to the researchers on request through their student representatives. Alumni were identified through the alumni office and through personal contacts whilst postgraduate students were approached personally for from December 2018 to July 2019. The interviews helped the researchers to explore and obtain in-depth understanding of issues under study.

Narrative data was analysed using the thematic approach to the topics generated by the interviews and questionnaires. The limitation of the study relates to the need to make generalizations of findings and recommendations to the wider academic community based on a case study approach.

Results and Discussion

The findings and discussions are arranged according to the themes that emerged for each of the research question namely: Barriers to female participation in higher education; Transformational Experiences - What helped women to enrol and persist in studies? and What lessons can be adopted as best practice to inform policy and practice to address gender disparity in STEM, particularly in Africa?

Barriers to female participation in higher education

Participants' responses to the question regarding their reasons for previously failing to fit into the higher education arena included a complexity of issues relating to the following themes: personal considerations, social identity and higher education environment. The themes are discussed in detail.

Personal factors

Participants reported that the four to five years required to go through a Bachelor degree demotivated them, their parents/guardians or their prospective spouses since it delayed their opportunity to quickly get married and start a family. Given a choice between pursuing higher education and getting married, most girls and women preferred the latter. One participant expressed why she had not initially enrolled for a degree programme:

> *I carefully reflected on my options and decided that marriage should get the upper hand. I consulted my friends and close family members and they agreed with me. They even informed me that I could always proceed with my studies after settling down and having a family whereas if I prioritised studies I would grow too old and too bossy to be able to attract serious suitors.*

Sadly as the participants revealed, those women who opted or were forced into marriage before they could pursue higher education, latter had to content with the rigours of looking after a family and the preference of recent high school leavers by most universities over mature women restricted them from pursuing studies post marriage. This was considered to be the critical void that the WUA managed to address - that of giving a second chance for mature women to advance themselves academically without having to compete with men or youth for university places. As emotionally put forward by one participant: *"If WUA was human and ever needed a donor for a lung or kidney, I would gladly offer them mine. The inspiration, motivation and hope they gave me was all I needed to find myself."*

Some participants underestimated their own academic abilities to the extent that they were not confident enough to enter university. As observed in literature, this is a common stereotype threat that is often associated with stress for and anxiety in current and prospective female students respectively (Cheryan et al. 2017; Nguyen 2016). On hindsight, one participant averred: *"Women fail to enrol for university studies not because they are dull but because they are made to believe that they cannot do it either because they are made to feel so special or so hopeless."* Some participants also confessed having been uninspired by some educated women they had interacted with as girls and who had appeared as being so arrogant to the extent that they had given an image that higher education for women was a bad idea. Our findings in this respect support those by Tanye (2008) who found women to

shun higher education studies for fear of being considered unsuitable for marriage since they become and unable to listen to their husbands or do domestic work.

Some participants cited poverty and economic status as important personal circumstances that had previously affected their desire to advance themselves academically. This was so due to the fact that many resource poor families preferred educating boys ahead of girls as they perceive investing money in girls' education to be a waste of limited resources considering that when they get married, women help to support their newfound homes and cease to provide for their parents. Some of these families also tend to be under pressure to marry off their girl children for financial gain. As one participant reflected, *"I failed to complete even my Advanced level studies after my father married me off at the age of 18 to raise money to pay fees for my two younger brothers' education."* Even more profound, one participant shed tears whilst explaining how, hailing from a single-parent household, her mother would drag her into illicit and transactional affairs with men, as a financial-coping means of raising funds for house rentals and food, whilst being denied of a chance to improve their lives through academic empowerment.

These findings were consistent with those from literature were girls and women from financially resources families are the more likely to progress into higher education (Mangheni, et al. 2010; UNESCO 2010). The impact of women's economic standing on higher education participation is also evident in developed countries as evidenced by the results of a survey from Dublin, Ireland which revealed that in general, students from the affluent families were 14 times more likely to progress to university than those from disadvantaged areas, and specifically, non-fee-paying all-girls schools recorded 100% progression rates (O'Brien, et al. 2018).

Socialization

The different socialisation girls had compared with their male counterparts since birth were considered by the participants to have a powerful influence on their subsequent attitude, behaviour, personality and perceived abilities as reflected by the women's low self-esteem and lack of confidence that had prevented them from participating in higher education before joining WUA. The findings revealed the complex domestic and societal expectations, responsibilities and chores girls and women shoulder that limit their educational advancement opportunities and overall achievement. Because women are considered to be academically inept but are valued for their beauty, supportive and reproductive roles as wives and mothers, their educational pursuits are not supported and perceived to be a 'loss' for the family and society. Consistent with existing literature, participants highlighted issues regarding the perception that women lag behind their male counterparts in terms of intelligence and academic potential but perform well as mothers and family carers, hence

some parents, even when finances are available, do not educate their women folk to university level (Kayobyo et al. 2010).

In the Zimbabwean context, as revealed by participants and indeed in most African contexts, girls and women are dependent on men (fathers, brothers or husbands) to make decisions for pursuing studies especially if it involves staying away from home or frequent travel. It also surfaced in the focus group discussions with postgraduate students that some participants had previously secured places for higher education but were forced to turn them down by their husbands or in-laws whom they necessarily had to consult before accepting the offer. For example, one participant said that:

> *I consulted my husband with the good news that I had been offered a place to study law at university but he did not think that it was a good idea so I declined the offer. When I eventually got an offer and a scholarship from the Women's University in Africa, I felt empowered enough to just inform him since I did not need his money. Strangely, he congratulated me and joked that he felt that I was safe – studying with other women!*

This finding is consistent with those found in literature wherein educational decisions tend to be made at family and not individual level. This is largely because education for girls is considered resource-intensive but with limited family returns compared to the status and benefits arising from the girls' marriage (Gupta, 2019).

Institutional environment

The participants explained that the environment at most higher education institutions was unfavourable for girls and women in that it reflects exclusionary intentions toward women. Fears of what they heard about or read regarding negative experiences where male students get preferential treatment whilst female students are treated as weaklings, intellectually deficient, inferior and vulnerable. This was reflected in the policies, infrastructure, teaching and learning methods, as well as the attitudes and behaviour of staff and male students. In addition, some of these institutions reportedly lacked mechanisms for enabling women to balance their academic and family responsibilities. These findings are similar to those by other African researchers who reported the existence of 'persistent institutional inequalities' at higher education institutions, wherein female students are treated without any dignity or respect and male sexual aggression was institutionalized and considered as normal (Itegi & Njuguna, 2013; Loots and Walker, 2015; Mama & Barnes 2007).

The presence of predominantly male Vice Chancellors in most Zimbabwean universities was considered as a deterrent to female participation in higher education. The presence of successful female leaders at WUA was presented as one of the greatest factors that

attracted female students to WUA buttressing the importance of role models as presented in literature. It immediately gave prospective students confidence that the leadership would understand the effects, needs and support needed by pregnant, nursing and students with sick relatives.

Transformational Experiences - What helped women to enrol and persist in studies?

Impacts of Institutional Policies, Structures and Cultures

The power of policy in determining women's participation in higher education was evident in WUA's Charter, a legal document that gave it the power and mandate to address gender imbalances by maintaining a student and staff ratio of 17:3 women to men, respectively. This legal instrument has empowered WUA to churn out a total of 9128 graduates with high end skills into the labour and productive market, 77 percent of which are female, a feat that even the oldest institutions hold in awe. Literature highlights the importance of gender-equality policies in improving access and success of women and girls both as students or staff (Gaidzanwa, 2007; Unterhalter; 2014). In addition to its Charter, WUA's institutional policies create a gender-friendly atmosphere which encourages students to learn and achieve lifelong success. Participants cherished the complete absence of unfavourable and overtly gender-based hostile campus atmosphere reported in some universities in Zimbabwe and other African countries (e.g. Gaidzanwa, 2007; Mlama 1998) characterized by negative 'masculine' tendencies of sexual harassment, belittling and verbal abuse of women.

The university, in a bid to increase access to women and promote academic excellence engaged industry, philanthropists and development agencies to fund scholarships and prizes to deserving financially disadvantaged and high achievers. In addition to the Charter, the university has a robust strategic plan with detailed strategies for integrating gender issues into the university. These include strategies and programmes for:

- introducing more female demand driven programmes and thus improve access and relevance,
- improving academic outcomes,
- gender awareness
- eliminating gender discrimination and
- increasing women's participation in development.

Targeted and Flexible Recruitment and Retention Approaches

The WUA was able to recruit mature women through advertising extensively on radio and TV as well as through outreach programmes. The concept of "taking the university to the people" was well received by prospective students. Lecturers visit and perform lectures to students who work at institutions at agreed times upon prior arrangement. The programmes were targeted for the needs of women and the programme offerings were flexible enough to

allow women to study as and when they find time. As such, they offer programmes during the day, evenings, weekends or during school holidays for teachers.

Participants spoke positively about the importance of university (female) leadership in achieving high levels of participation by women. The student body reflected a diversity and inclusivity in terms of age, disability, economic and social standing, gender, employment status and nationality. The interview with the university leadership revealed that the high participation of women at WUA in itself is causing the attraction of even more women to the university.

Inspiration, motivation, mentorship and guidance

The participants corroborated the common knowledge that female students often lack confidence and courage air their views in public and to explore and innovate public due to the socialisation effects. The targeted a gender-sensitive approach used by WUA leadership, administration and academic staff in motivating, inspiring, mentoring and providing guidance to female students was hailed by all participants. As one female post graduate student participant reflected:

> *I joined the university as a member of the support staff without a secondary leaving certificate. The environment at WUA and the testimonies I heard from students motivated me to start studying. My husband left me because I had to study during the evening and weekends when I was off duty. The support and mentorship I received from other students and staff helped me to soldier on. I am graduating with a Master's degree this year and guess what? My husband is back and is also studying with WUA.*

Another participant was impressed by the monthly motivational seminars that were organised and delivered by luminaries from various parts of the world. For others it was the combination of the inspiration, motivation, mentorship and guidance by the leadership, fellow students and staff members. This was also reflected in the use of favourable teaching and learning methods inclusive of individual student coaching, group assignments and practical work.

The impact that the WUA institutional environment had on students was reflected by one participant who said "WUA education has helped me to stand on my own feet. They believed in me, they gave me courage and they gave me confidence. That's all I needed to shine."

What lessons can be adopted as best practice to inform policy and practice to address gender disparity in STEM, particularly in Africa?

The findings of the study show that the influence of gender socialisation and unfavourable institutional environment manifested as low self-worth as well as lack of confidence and courage stemming from the belief that the women's role in the family overrides personal and career ambitions. What is clearly evident is that as explained in literature, the confidence gap between males and females is significantly large depending on the environment (Niederle and Vesterlund, 2007; Mobius et al., 2015). When women gain confidence and courage, they are empowered in impactful ways that are beneficial to the whole nation. Lack of confidence affects women's ability to reach their full academic potential and is often triggered by the belief that an individual is not smart enough even if they are. Accordingly, as put forward by Brook, (1997), educating women is a powerful development strategy because of the ripple effect and positive impact it has at the individual, household and societal levels.

The participants revealed that the mentorship and sponsorship they were exposed to at WUA played a key role in boosting their confidence and in building their courage. Whilst the two concepts are largely similar sponsorship takes mentorship to a higher level as shown in Table 1. While both guide academic and professional development, mentors tend to listen to the mentee's problems and give advice sponsors act as advocates, protecting protégé interests and actively propping her up for high-profile projects.

Table 1: Differences between mentorship and sponsorship

	MENTORSHIP	**SPONSORSHIP**
Role	The mentor can be any staff academic member in the university	The sponsor is a senior leader in the university e.g. Dean, Vice Chancellor
Goal	The aim is to give the student guidance and directions about academic and social issues	The aim is to use the Sponsors position and influence to help the student overcome problems and succeed in life
Relationship driver	The mentee drives the relationship through raising areas were they need help from the mentor who is usually responsive to the needs of the "mentee"	The sponsor drives the relationship and literally advocates for, defends and pulls the sponsoree's hand
Actions	The mentee is empowered to make decisions and meet academic goals	The sponsor champions the sponsoree's advancement so that she reaches her potential

Source: Adapted from the Center for Creative leadership - https://www.ccl.org/articles/leading-effectively-articles/why-women-need-a-network-of-champions/

Conclusion

Our findings reveal barriers to the pursuit of higher education by women to be similar to those reported in literature namely lack of self-confidence, socialisation and institutional shortcomings. The success of the Women's University in Africa in mainstreaming gender resulted in an 86.2% female participation rate in programmes (Stem and non-STEM) offered by the university. A raft of mutually-inclusive critical success factors namely, innovative and dedicated *leadership*, targeted *curriculum, flexible* programme offering, *mentorship* and *sponsorship* to instil the courage and confidence so needed by females to succeed. Whilst issues of leadership, curriculum and mentorship have been proposed by other scholars, the role of sponsorship in attracting females to STEM is novel and need to be exploited in disrupting the gendered status quo. The integration of all the five success factors (LCFMS) is critical for success in as far as it empowers the females with confidence. This is in line with the assertion by Murphy and Whitelegg (2006) that self-confidence begets ability. The flipside is true wherein Aspires (2013) found that those who are traditionally under-represented STEM tend to be less confident regardless of their actual abilities and attainment.

The case study revealed successful, potentially replicable strategies for increasing women participation in higher education and STEM. The LCFMS approach is recommended as one that is best suited for adaptation or replication in growing the much needed robust and inclusive STEM talent pool critical for sustainable development and competitiveness of the African region.

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