ROYAL ACADEMY OF ENGINEERING

FAEO
Committee for Women in Engineering

AFBE-UK
Inspiring People Of BME Origin In Engineering

APWEN

SciEtech
Science, Engineering & Technology Development Network

African Catalyst Project

Statistical data for women in science and engineering.

A Pilot Project of Nigeria, Rwanda and Malawi

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FOREWARD

The underrepresentation of women across the globe in science, engineering and technology (SET) has attracted concerted efforts by different organizations. In their support for the girl-child education and increasing the number of women in SET for improved socio-economic and technological growth, various countries have, put in place legal frameworks or policies to achieve desired targets. In Africa, the situation is not different, however what is of major concern is that with the exception of South Africa there is no empirical data for the participation of women in SET.

As the Chair of the Committee for Women in Engineering, this is of great concern because the impact of our activities and the collective activities of member countries could not be quantified. In view of this the African catalyst project executed and funded through the Royal Academy of Engineering, United Kingdom (UK) was of great interest and a welcomed initiative. The Committee with our UK partner Association of Black and minority engineers(AfBE) in collaboration with SciEtech and APWEN have carried out this survey towards developing a baseline data for w omen in science,

engineering and Technology. The survey was executed in three countries Malawi, Nigeria and Rwanda with a coordinating team in Nigeria with the Institution of Engineers, Rwanda(IER) and the South African Federation of Engineering organizations (SAFEO) executing in Rwanda and Malawi respectively.

The survey identified significant similarities across the three countries with slight variations such as the Gender Parity Index (GPI) at university level was an average of 0.1 in favour of male students and 0.8 in polytechnics.

The survey identified a key element of the disparity which is that female students were found to lose interest in Mathematics in the senior secondary schools in comparison to their level of interest in the junior secondary. Across the three countries it appeared that female students were more comfortable studying life science subjects than the physical sciences which may explain the lower number of females in engineering schools.

Gender Parity Index (GPI) is a socioeconomic index usually designed to measure the relative access to education of males and females

It is worthy of note that that female role models were not an influencing factor in career choice amongst female engineering students This is quite a concern for the Committee for Women in Engineering as role models have been shown across other parts of the world to be a key influencer for women in SET. There is therefore a need for more visibility of women in SET. The teaching methods also have an impact on attracting male and female students

towards SET careers as an example Malawi and Rwandan students appeared to perform well in science subjects without support from private tutors. We believe policies which influence good proven teaching methods for SET subjects could be an advantage for all students and in particular may ensure females are not easily put off from SET subjects. There is therefore an urgent need to review teaching methods with a view to standardizing it across Africa with the collaboration of the scientific department of the African Union.

The committee has highlighted the findings in this report and will work with all stakeholders to achieve the desired goals for the outcome of this report.

I would like to thank all those involved in making this report completed –Dr Nike Folayan of AfBE and Dr Ina Colombo of IIR, , the coordinator and our Consultant Statisticians and all members of the project team. The coordinating support of the FAEO and the Nigerian Society of Engineers is appreciated. Louise Olofsson has been wonderful in her support and of course the Royal Academy of Engineering African Catalyst Project Team. Thank you all for this opportunity. It was larger than we thought at conception but you all made it possible to pull and deliver the report.

Engr Valerie Agberagba FNSE
Chair, Committee for Women in Engineering
Federation of African Engineering Organizations (FAEO)

Women remain underrepresented in SET globally. Available Data shows that women occupied 11.2% of technology leadership roles in Europe, the Middle East and Africa compared with 18.1% in North America, 13.4% in Latin America and 11.5% in Asia. In the UK the situation is just as dire as women represent only 9% of the engineering workforce although 50% of the UK population are women.

Unfortunately similar statistics are not available for the numbers of women in engineering across Africa (with the exception of South Africa). It is with this in mind that the Committee for Women in Engineering, Federation of African Engineering Organizations (FAEO) sought to gather data which will form the basis of a database to assess the percentage of women in engineering, develop /track progress of initiatives to increase participation and in the long term influence government policies for women in SET. AFBE-UK's involvement is driven by our objective to champion knowledge transfer between in The UK and Africa as well as to function as a representative body on developments that affect the careers of BME communities in the UK and abroad. We applaud the FAEO, the enthusiastic survey teams

https://www.theguardian.com/technology/2014/may/14/women-technology-inequality-10-years-female

http://www.wes.org.uk/sites/default/files/Women%20in%20Engineering%20Statistics%20March2016.pdf

and in particular Engr Valerie Agberagba for her tireless work and effort to make this project a success. It is hoped that the challenges and learnings gained from this project will be used to develop policies, programmes and initiatives which will have lasting impact on the countries involved and for the continent of Africa

Nike Folayan (PhD. CEng.MIET
Chairperson, AFBE-UK

CHAPTER ONE

Needs and Numbers

1.1 Introduction of Project

The African Catalyst Project is a United Kingdom (UK) funded project through the Royal Academy of Engineering, RAEng. The project which was an initiative of the World Federation of Engineering Organizations, has been executed and funded through the Royal academy of Engineering. The purpose of the project is to build capacity and capability in engineering communities across Africa.

The project focuses on six areas, and one of these areas is Needs and Numbers. The committee for women in engineering of the federation of African Engineering Organizations with its concerns on the availability of accurate data to work with advised a project on Needs and Numbers. The research project aims to examine the current engineering landscape as it relates to people engaged in studying and working in engineering across Africa. The objective is to determine what is required to improve or enhance the participation.

The underrepresentation of women in Science, Technology, Engineering and Mathematics (STEM), particularly in Engineering is a source of concern globally. You can give some more worldwide figures from the attached academic paper (if you want).

According to a report by UNESCO on closing the gender gap (2016), only 10% and 8% of the female graduates work as graduate engineers in the workforce in South Africa and Kenya respectively.

Nevertheless, there still appears to be very limited information available on the numbers studying and working in engineering across Africa. There is also a continuous dearth on reliable and systematic information on women across all sectors especially the engineering and technology environment.

Organisations across Africa including the Committee for Women in Engineering of the Federation of African Engineering Organizations, the association of Professional Women Engineers of Nigeria, the women Session of the Institution of electrical and electronics engineers, to name a few, have started to develop initiatives and programmes to attract girls to study engineering and retain them in the profession. These initiatives include practical/hands-on activities, career fairs held to engage girls. However there are no measureable or impact assessments conducted to measure the impact of these engagement activities taking places

Therefore, this outcome of this project is needed in order to map out the engineering landscape using sample data to develop a database which can be used to develop a strategic approach to engineering engagement activities and policies by Professional Engineering Institutions' (PEIs), governments and the international community in relation to Africa.

The project is conducted in three countries Nigeria, Rwanda and Malawi.

1.2 Current Status

A UNESCO report on women in Africa and the Arab states (2015) as released by the institute of statistics, women across the globe pursuing careers in science are only 28%, and just 30% of professionals in the sciences in Sub-Saharan Africa are women (Awei

Ismail, 2016). In Sub Saharan African countries the average female engineering students' population is only 7-12 % of the entire student population. (UNESCO, 2015). Although some universities in Africa record enrolment of female students in engineering as high as 20% such as Makerere, Uganda in 2009 and in Rwanda, 19% female engineering students in two sessions between 2013- 2015 There is no consistent measure of female participation in engineering across the continent.

Across Africa, the republic of South Africa is the only nation with some data on the participation of women in Engineering and Technology from education to involvement of women in engineering related workforce.

1.2.1 Nigeria

The National Development Plans set up by the Federal Government of Nigeria in 1962 had intentions to increase training in engineering and thereby the engineering manpower in Nigeria. However these plans had no specific emphasis on increasing the gender diversity in engineering. In fact, the first four National Development Plans did not project the required number of engineers to be trained or even the numbers required for national development.

The first major plan for women in engineering was formulated after a meeting of experts in Paris in 1986 for the Consultative Meeting on Women in Engineering and Technological Education and Training. At this meeting it was emphasised that for most countries, Nigeria inclusive, the percentage of women in engineering and technological occupations was significantly low. They identified, among many other challenges, the lack of statistics and research work on women in

engineering and had amongst their recommendation, that studies should be carried out at the national level on the participation of women in engineering, the role of engineering educators and on reasons for the differences between male and female participation in the engineering (Badekele).

In the recent past, efforts towards rectification of this imbalance have been preliminary and limited mostly to engineering institutions.

It is noteworthy that none of the national development plans nor the activities for the Science and Technology Development plans from the Ministry of Science and Technology have had emphasis on any activity to ensure the participation of women in the fields.

There is now the need for concerted efforts to put in place programmes and policies by government on how to reduce the gender gap. This will assist in significantly improving the economic and technological growth of the economy in Nigeria while improving the standard of living for women and girls.

Available statistics indicate that the percentage females' enrolled to study engineering in most Nigerian Universities is between 5-12 %.(reference). This research aims to confirm these figures using sample secondary data from 18 states within Nigeria.

1.2.2 Rwanda

The country Rwanda, after the recent genocide experience is on the path of massive restructuring towards strong economic growth. The enrolment of females to engineering schools is on average between 15 -22 % (references). Rwanda has, indisputably, demonstrated tangible results in the promotion of gender equality with strong institutional, policy and

legal frameworks that enable the implementation of gender commitments. The government on Rwanda has put in place a deliberate policy to have 30% gender representation in almost every sector of the country's economy. It was ranked as 7th, 6th and 5th in 2014, 2015, and 2016 respectively in closing the gender gap by the Global Gender Gap Report (GGGR) index that benchmarks national gender gaps on economic, education, health and political criteria.

Though there have been tremendous efforts and achievements in the gender equality in Rwanda as shown in the above examples, there are many reasons to be concerned about the apparent or existing gender inequalities in Science, Engineering and Technology (STEM) when the Rwanda education system and statistics are analysed.

The study will measure the impact of this policy and where the learnings form these approach are making a significant difference to the number of women in engineering.

1.2.3 Malawi

Malawi as a country has a low number of engineers. The engineer to people ratio is 1 to 14,000 compared to what exist in the sub Saharan Africa of about 1 to 7000 (Mkandawire, T, 2016). Malawi has had challenges in its education sector and has developed strategies to achieve the universal primary education while reducing the number of dropouts from school.

Gender equality is achieved when women and men enjoy the same rights and opportunities across all sectors of society, including economic participation and decision-making, and when the different behaviors, aspirations and needs of women and men are equally valued and favored

The Ministry of Education, Science and Technology (MoEST) in collaboration with international development partners and other stakeholders formulated the National Education Sector Plan (NESP 2008-2017), which was designed towards achieving quality education.

In 1993, the MoEST had a major policy shift to enhance girls' education through the removal of subject restriction that barred female students from taking certain subjects particularly sciences at the primary and secondary schools. However, there is the challenge to put the gender sensitive policies into practice in the school management, learning environment and implementation of the curriculum.

The government of Malawi has also put in place policies and strategies to improve the quality of education up to the tertiary level.

CHAPTER TWO

Profile Of Respondents

2.0 Survey Objectives

The primary objective of the survey was to develop baseline data for women in Science, Engineering & Technology (SET) in Secondary and Tertiary Institutions (Universities and Polytechnics) for the three African countries Malawi, Rwanda and Nigeria as well as for women in the workforce and ICT from Malawi and Rwanda.

The key deliverables of this objective will:

- Confirm the approximate number of women in SET in secondary and tertiary institutions in Malawi, Nigeria and Rwanda
- Establish a basis for assessing the needs of women in set in secondary and tertiary institutions in these three countries.
- Provide data on women in workforce in Malawi and Rwanda.

2.1 Survey Methodology.

The data collection involved using the primary and secondary sources. The primary data was sourced through surveys conducted in selected regions, and states. The demography of survey respondents were:

- Students in Junior Secondary Schools.
- Students in Senior Secondary Schools (science and non-science).
- Students from Universities studying Science, Engineering & Technology courses/subjects.

  Students from Polytechnics studying Science, Engineering &

Technology courses/subjects.

The secondary data was collected from all selected schools and institutions and supported with data provided by some government organizations focusing on Education, Gender and Science, Engineering and Technology.

The collected data was limited to the period from 2011- 2015. The information expected included:

- Total number of Science and Non Science students in the selected senior secondary schools.
- Total number of male and female students in each selected junior secondary school.
- Total number and gender make up of students offered an undergraduate course for each engineering department within a faculty from the Universities selected and from national university commissions (public and private)
- Total number of students offered an undergraduate course into Engineering in the different departments in the college of engineering from the selected Polytechnics and from polytechnic commissions (public and private).

Questionnaires were used to elicit information from the respondents. These questionnaires were tailored to each respondent group to ensure that comprehensive and relevant responses were obtained. There were four different questionnaires for the primary data for Junior Secondary School Students, Senior Secondary School Students, University Undergraduates and Polytechnic undergraduates. These can be found in Appendix I.

2.1.1 Survey Scope

Questionnaires were administered in only co-educational secondary schools with three schools for the category. Other criteria included selecting one – three universities including the oldest university in the region and the oldest polytechnic in the region. However it is important to note that the selection criteria were specific to each country.

The total number of questionnaires administered in Malawi was not specified in the report both secondary and the tertiary institutions.

In Nigeria, a total of 13787 questionnaires were issued for secondary schools, 6160 for universities and 4400 for polytechnics with average return rate of over 90%.
While Rwanda had 2303 for secondary schools, 101 for university and 386 for polytechnics. The details of these can be found in the reports from Malawi, Nigeria and Rwanda (appendixes 11-1V).

2.2 Survey Constraints

There were several constraints across the three countries; however some of these constraints were common across the three countries;

1. Access and Approval: Obtaining access and approval to administer questionnaires within secondary schools and universities was a challenge which had an impact on the survey timeline and project programme. This was due in some instances to lack of delegation of authority by some institutions' leadership. This caused significant delay with an average of a three day time delay and in some cases up to a month and half. This was particularly evident in some states within Nigeria. The effect of these constraints h as prolonged the programme and timeline from of the estimated survey period of fourteen days to over thirty days. Consequently this affected the overall project programme, execution and final delivery.
2. Record Keeping and availability of secondary data: A significant numbers of schools did not have records for the secondary data hence some secondary data could not be obtained. In particular, the lack of available secondary data from institutions, organizations and specific government agencies had a significant impact on the execution of the project. Some organizations requested payments of very exorbitant sum.

3. Skills, Training and Expertise: All enumerators were provided with training on how to administer questionnaires and given training manuals. However a few enumerators appeared to have misunderstood some of the expected processes. This was apparent in some returned questionnaires as their responses indicated lack of guidance during the filling of the questionnaire. Hence, the respondents' understanding of how to complete some part of the questionnaires was impacted. This was apparent in the responses to selected worst subjects as compared to the best from some junior secondary response. This was as a result of insufficient manpower for the enumeration as there were several classes to be manned simultaneously.

CHAPTER THREE

Survey Findings

3.0 The survey covered five major areas including;

- Demography- (Gender and Social)
- Preference for SET
- Factors influencing students choices
- Students' attitude and perception of SET
- Students' future career aspirations.

This chapter discusses the key findings in each country

3.1 Gender demographics show lower participation of females in the survey.

3.1.1 Junior Secondary Schools

- Junior secondary school respondents in Nigeria had an average age of 13years. 48.6% of females participated in completing the survey.
- In Rwanda percent representation for female respondents was 45%.
- Malawi using the initial selection criteria, had only girls' schools for the administration of the questionnaires.

3.1.2 Senior Secondary Schools

- In Nigeria most senior secondary school respondents reside in the urban areas. The average age respondents were 15.69 with 48.6 % representation of female students.
- The percentage female respondents of 48% was slightly higher than the percent participation at the junior level. This indicates that there was better female participation amongst the female senior secondary School students.
- Malawi using the initial selection criteria, had only girls' schools for the administration of the questionnaires.

3.1.3 Polytechnics

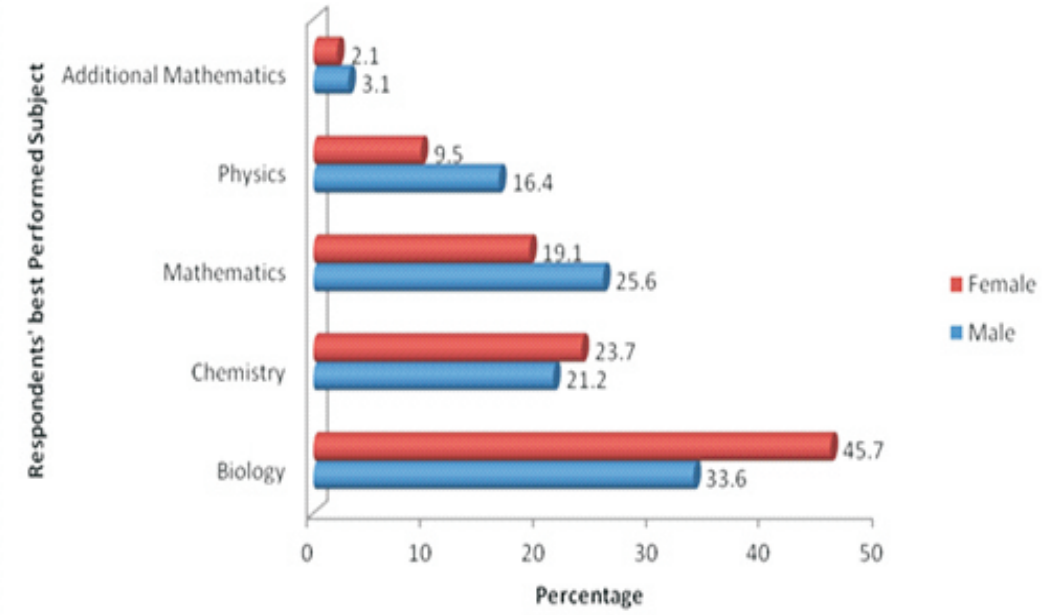
- 55.5% of the Polytechnic students in Nigeria are between the age of 20 and 24. Male students account for 67.6% of the student respondents while female students are only 32.4%.
- The female composition for the survey in the polytechnic for Rwanda was only 36% out of a total of 1268 students from three (3) polytechnics.
- Malawi polytechnic had 18% female participation rate.

3.1.4 Universities.

- In Nigeria, similar to polytechnics, the participation of female undergraduates in the survey was 36 %.
- However in Rwanda and in spite of the government initiative to encourage more female participation in every sector, only 19% of the one hundred and one (101) university students from the only accredited public university were studying towards an engineering undergraduate degree.
- The universities in Malawi had 24% female respondents in the survey.

3.2 Female preference for SET

- Survey findings showed that female preference for SET subjects was similar for students in junior secondary schools across Nigeria. As an example41.1% of males had a preference for mathematics as against 40.6% of females. In Nigeria, female students in the senior secondary had a lower preference for SET subjects than their male colleagues For example in subjects like Mathematics, Physics and Additional Mathematics, the females preferences were 21.3%, 10.4% and 1.6% while the males preferences were 26%, 18.6% and 2.8%. Preference for Chemistry appeared to be similar for males and females 21% and 20% respectively but biology was 45.7% females to 32.7% male.



Distribution of subject preference in Senior Secondary (Nigeria)
Figure 3.1

- In Rwanda, senior secondary and the junior secondary schools data confirmed that there was more preference by the males for SET subjects.
- The survey showed that male students had a higher preference for SET subjects (23.7%- Physics, 30.3%- Mathematics and 15.8% - Biology) in comparison to female students (10.3%- Physics, 26.7%- Mathematics and 19.6% - Biology.
- The schools in Malawi were all girls' schools and there was 47.1% preference for Basis Science and 29.4 for mathematics in junior secondary. The senior secondary had 28.3% for mathematics, 19.9% for physics and 2.3% for additional mathematics.

In general and in all countries, the students were observed to perform best in their preferred subjects.

3.3 Key Influencers with regards to interest in STEM/Engineering

- The survey determined that parental influence is a key factor in career choices across Nigeria. Another significant factor is the socio-economic factor. In junior secondary schools the importance of role models was also highlighted as a key determinant of career choices. Teachers influence however appeared to be the least significant factor in influencing career choices.
- Although the key influencers listed above applied to both male and female respondents, to determine if there was any disparity between male and female views on influence, the survey was analysed by gender. The results showed that male engineering role models are more visible and available to male undergraduates in universities in Nigeria and are a main factor for influencing career choice and desire to build a lasting career in engineering amongst male students. In addition male undergraduate students had teacher/lecturer influence as a key determinant factor.
- The survey in Rwanda presented a different outcome from Nigeria with the Socio-economic factor having the greater influence on career choices followed by parental influence. Similarly to Nigeria, teachers appeared to have little to no influence on career choices with only 4.3% and 1% of junior and senior secondary respondents respectively stating that teachers have any influence on their career choices. Another important factor is career guidance, 42% of students in Rwanda have never participated in career guidance and counselling programmes towards taking courses in STEM.
- In Nigeria, 66% of females have never participated in career guidance and counselling programme and have never heard of scholarship opportunities.

  Overall the effect of role model influence on career choice was seemingly low in Rwanda and Nigeria and in some instances had

respondents claiming parents/family as role models.

However, the survey in Malawi presented an outcome of role model as key influencers to both male and female students followed by parental influence. On career guidance, 63% and 40% of students in the senior secondary and junior secondary have participated in career and guidance counselling. In the University, 66.7 female against 50.9% of males have never heard of scholarship.

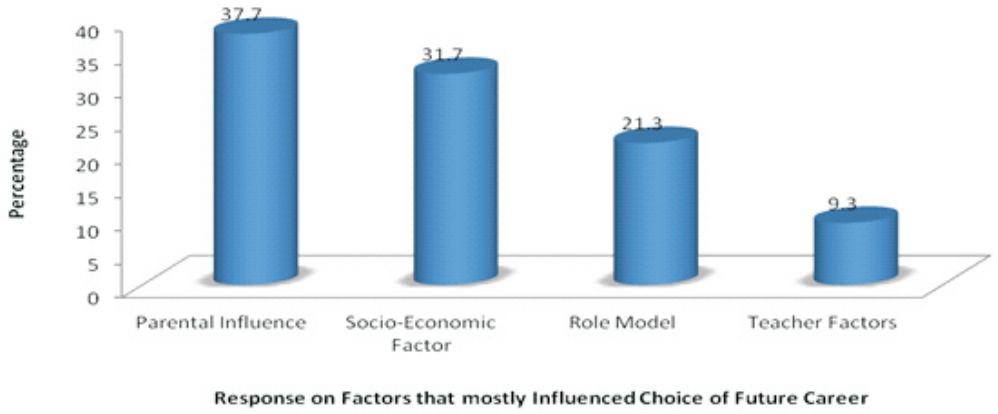


Figure 3.2 from polytechnic, Nigeria: Factors that influence career choice

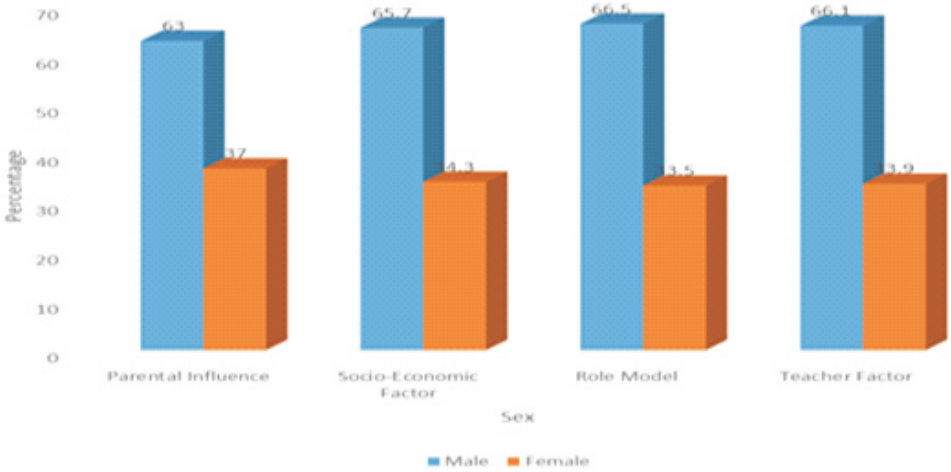


Figure 3.3 University, Nigeria: Factors that influence career choice most

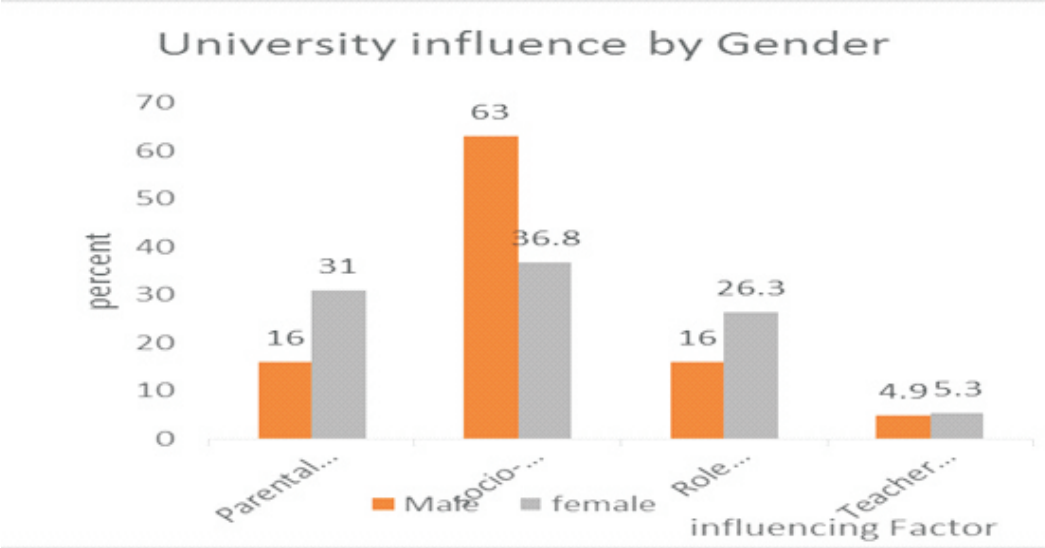


Figure 3.4 University, Rwanda: Factors that influence career choice most

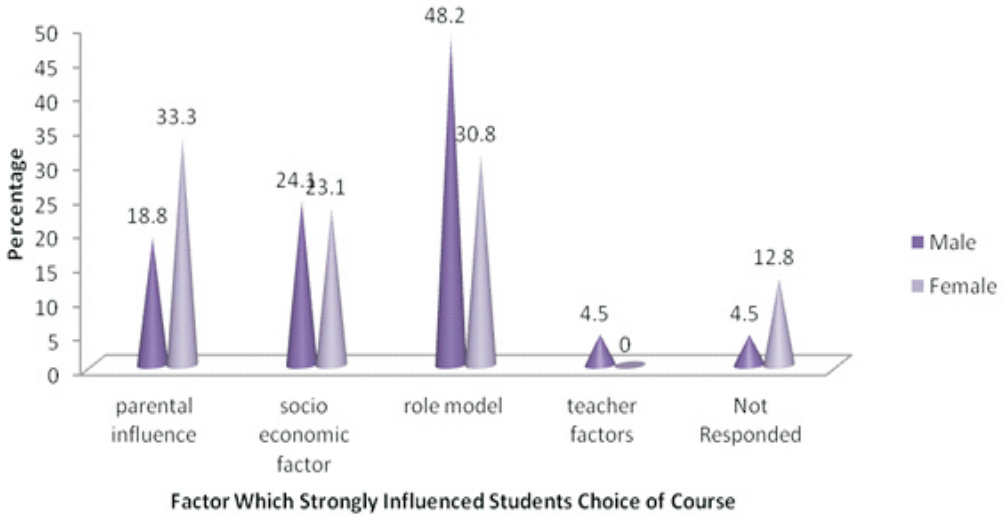


Figure 3.5 University, Malawi: Factors that influence career choice most

3.4 Gender disparity in students' attitude and perception

- The students in junior secondary in across the countries seemed to have confidence in their abilities to do well in SET subjects. They also appeared to understand the importance of science to their future

career. It was noted that their perception of science was influenced by their parents.

- At senior secondary school level, having chosen to study science subjects, the students appeared to be confident in their abilities to excel in science with about 90% from Nigeria and Rwanda and about 80% from Malawi affirming the importance of science to their desired future career.
- Good performance in science subjects in secondary school and in engineering and polytechnic from the three countries was attributed by the students to be both teacher and parental influence and support.
- In Rwanda and Nigeria, 57.9% and 70.1% respectively of the female science students from the senior secondary had ambitions to study courses in engineering at higher education levels.
- In Nigeria, both male and female respondents' appeared confident in their ability to study and "do well" in Engineering and science. A majority of both male and female (53.0% and 45.4% respectively) affirmed that they were confident with their abilities to study engineering. while it appeared that more females 44.3% were more confident to study life science (e.g. Biology and Chemistry etc) at university than males at 37.6%
- The result from Nigeria is similar to that obtained in Rwanda, where most male and female university students (90.1%) appeared to be fully confident of their ability to excel in engineering careers. A significant finding showed that 94.8% of female engineering students had a passion and ambition for future careers in engineering .

3.5 Gender and Engineering Careers

- The survey highlighted that students from the polytechnics in Nigeria have a strong desire for a long lasting career in engineering with females showing slightly lower percentage (2.9%) ambition for long

term engineering careers in comparison to their male counterparts.

- Both male and female students equally had strong interests in obtaining higher degrees with or without the provision or availability of scholarship. This was also reflected by University undergraduates who showed strong desires for further studies with or without the provision of scholarships. This indicates that both male and female engineering graduates desire to work and progress in engineering.
- Conversely in Rwanda, the desire for higher studies/degrees from the polytechnic and university students in general was significantly low at 55.2%. However the survey showed that this would significantly increase to 90% and 88.2% respectively if scholarships were made available.
- Majority of university students in Malawi indicated that they would still continue doing a course in engineering with or without a scholarship. 64% of female desire to take higher education courses in engineering against 50.1% of the male.

Respondents' Pursuit of Study in Engineering without Scholarship by Sex

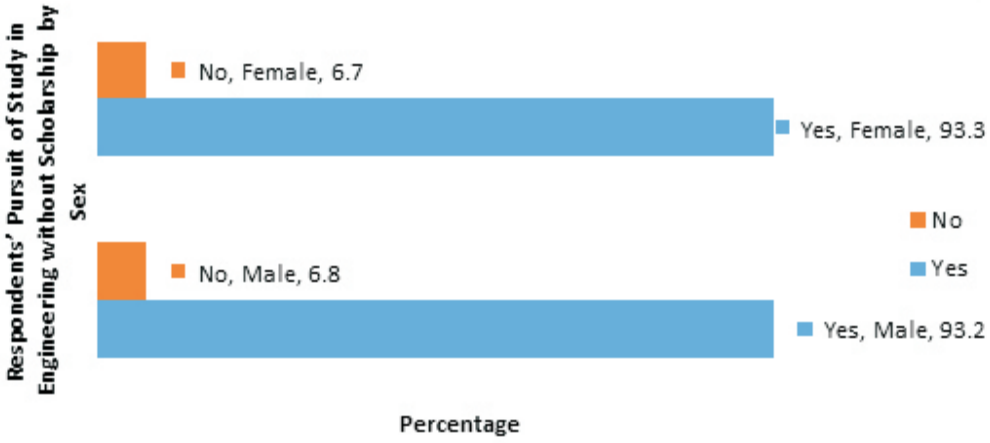


Figure 3.6: Nigeria Students' Pursuit of Study in Engineering without Scholarship by Sex

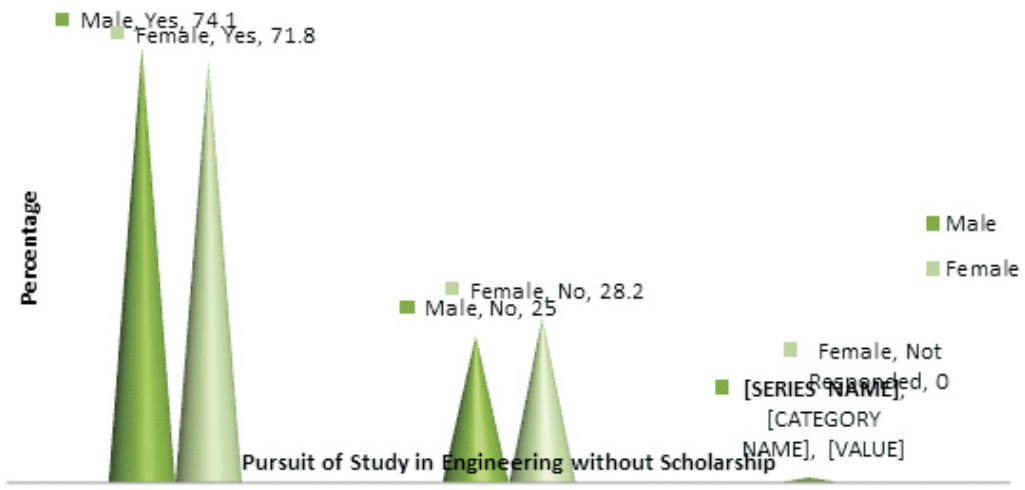


Figure 3.7: Malawi Pursuit of Engineering career without Scholarship by Sex

1.6 Gender and Engineering workforce

· The data for women in engineering workforce and women in ICT was to be part of the Rwanda and Malawi report. However, Rwanda was able to get some scanty report. In the construction sector, only 4.2% of women were found to be in the workforce. There were however more of technicians than engineers. In a survey by Rwanda Development Board, There was 0% female representation.

Due to its time constraint, more data could not be collected and analysed.

CHAPTER FOUR

Summary of Key Findings

The project was conducted to investigate three African countries and to identify differences in approach, influence, perception and numbers of the uptake of SET subjects and careers by female populations. The survey identified significant similarities in the findings Country differences will be highlighted as necessary.

1. More males study engineering at Higher Education level: Across all countries, Gender Parity Index in the faculties of engineering in Universities (average of 0.1) and Polytechnics (average of 0.8) is higher than within secondary schools. This indicates that there are significantly more males studying engineering in tertiary Institutions. From the survey of selected Universities, Gender Parity Index in University's admissions was 0.2 as against 0.1 in a favour of male students. In Rwanda survey results from the only accredited university showed that almost 50% of students were offered places to study towards an engineering degree.

2. Female students loose interest in Mathematics at Senior Secondary School level: Most of the female students in Junior Secondary Schools expressed interest to read science; with male and female students in Junior Secondary Schools preferring Mathematics to other science related subjects. However at Senior Secondary School level, female students appeared to lose interest in Mathematics. It can be inferred that this may be the point at which more female loose interest in Engineering. Female science students prefer Life Sciences to Physical

Science related subjects: Most of the female science students at secondary school level preferred biology and chemistry in comparison to their male colleagues who appeared to have a preference for physical science subjects such as Mathematics, Physics and Additional Mathematics. This provides an explanation as to why there are more male engineering students at higher education levels than female students. Malawi which was an all girls institution however had a higher percent of female studying sciences than was obtainable for both male or female in the co-educational schools. It could therefore be that there is a possibility of more girls taking science when in an all girls' school.

3. Good teaching methods positively influence female participation in SET subjects .

   In Nigeria, the survey suggests that female science students who achieved outstanding results in mathematics all had private coaching/tutorial support. In addition most students performed best in subjects where they had private coaching. . However in Rwanda, no external/private coaching was required to receive similar outstanding results. This may be an indication of the importance of educational teaching methods in the two countries because the performance of the Rwandan students was directly attributed to teachers' ability and students' capability.

4. No Career Counselling and Guidance for all students: The survey indicates career counseling was non-existent for most students especially those in senior secondary school except for Malawi where the senior secondary indicated a 60% effect of career guidance. In view of this, the influence on career choice could not be determined in Nigeria and Rwanda. In other parts of the world such as the UK as

stressed in the UK parliament report of June, 2017, career guidance is a vital component by government to support career choices and aspirations.

5. **Lack of Visible role Models for females in SET:** The effect of role models on career choices especially for the female students was low across all countries surveyed. In Nigeria, the male students in tertiary institutions seemed to have been influenced by role models. The gender of these role models were unknown but they are likely to be male role models.

   Availability of more scholarship funding has the potential to increase female participation in SET: More female students in tertiary Institutions from Rwanda would further their study in engineering if scholarship opportunities were more readily available. In Nigeria and Malawi, however, female students had an appetite to further their studies whether or not scholarship opportunities were available. Parents are major influencers in Career choices: The results of the study indicate that both male and female students consider their parents' wishes in making choices on subject/disciplines to study in higher education. Parental involvement was rated the highest amongst other influencers on career choices. This is a good indication of the importance of parental involvement in the students' decision making at higher education levels. Both male and female students emphasized their parents' role as facilitators and enablers in making career decisions. Other factors that influence careers choices include teachers .Although not wilding as much influence as parents, the results showed that teachers play an important role at polytechnic and University. Additionally other considerations include social economic factors which also has a significant on students' choices.

6. **Low percentage of female students offered engineering degree courses at University and polytechnics:** Information obtained as part of the study showed that the number of first year university places offered to female students within Nigerian Universities to study courses in Engineering and Technology by the Joint Admission and Matriculation Board (JAMB), which is the body responsible for university application and entry requirements in Nigeria between 2011- 2016 showed an average 14.74%. This significantly low number is consistent for all years with the exception of 2014 where the numbers decreased to 13.6%.Reasons for the decrease were however not stated. Similarly within polytechnics, places offered to female students in engineering by the Polytechnic governing body (National Board of Technical Education) shows an average of 16.54% between 2011 and 2016.

CHAPTER 5

Proposed Next Steps

This project aimed to understand the landscape of female participation in Science, Engineering and Technology (SET) across Africa by obtaining empirical data from three African countries and analysing the data to establish requirements/needs for increasing female participation across Africa.

The purpose of the survey was not to propose solutions but to determine if there is indeed lower participation in SET amongst females in Africa and steps that professional organizations and governments can take to increase female participation.

This pilot survey has provided a clear indication of the levels of female participation in SET education for secondary to tertiary level.

The challenges encountered in gathering the data, developing the sample size, comparative sample sizes and accuracy of results presented have been discussed in Chapter 2 above. Full survey details for each country are within the Appendices. As this is a pilot study with limited sample size, there is a requirement to develop a more robust approach to establishing baseline data for female participation in SET across Africa.

In view of the above, the following recommendations are made: More uniform approach across the three countries could be developed. For example samples from Malawi where only females in secondary schools completed the survey do not match surveys conducted in Nigeria or Rwanda.

- Qualitative surveys using focus groups could provide deeper insights into the needs of females with ambitions to study and work in

engineering, why female may appear more interested in life science subjects, should be determined and addressed

- Professional organizations in engineering across Africa should have greater interest in science and engineering education. Providing more visible role models, especially female role models for outreach programmes.

- African Governments should establish guidance and counselling centres within schools.

- Further study on how SET subjects are taught in Rwanda and teaching style differences and how it affects career choices with a view to training and retraining of better equipped Science teachers should be explored.

- SET Awareness and Engagement initiatives for parents and teachers on their role as key influencers should be developed across the countries.

- SET Career guidance centres either on line or within secondary schools should be considered.

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