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The Call For Gender Balance, Levelling The Engineering Gradient For More Female Students: The Case Of Gweru Polytechnic College.

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ABSTRACT: *Women are important partners in economic development but their underrepresentation in engineering courses is a cause for concern in Zimbabwe polytechnics. The study's purpose is to unravel reasons for this anomaly. Purposive and random sampling was used to select participants made up of 10 lecturers, 5 parents and 40 students from engineering division. The research employed a case study approach where data was collected through focus groups, face to face interviews, questionnaires and document analysis. Results of the study were thematically analysed in line with qualitative and quantitative approaches. The study's findings highlighted that little knowledge, unfavourable working conditions, lack of funds to pursue Engineering career trade, challenging and demanding courses for females, low entry qualifications and discrimination against females by society were noted. This study recommends that technical engineering courses be introduced early at primary and secondary schools. There is need of career guidance and extensive marketing of engineering programmes. Repeat of the study on a national level will help to verify this problem for policy implications.*
Keywords: *gender imbalance, marginalisation, under representation, TVET, engineering.*

I. BACKGROUND TO THE STUDY

Affirmative action intervention strategies adopted in Zimbabwe in 1995 appear to be effective though confined to universities only. However, this has achieved at least 33% female enrolment in universities. In 1995, institutions such as the University of Zimbabwe adopted an affirmative action policy which admits into university aspiring female students who may have lower entry points than males in order to increase their participation in education. Special attention has been paid to achieve equal access of girls and women to academic education but little has been done to promote gender main streaming in scientific, technical and vocational education and training. The support for women education has been promoted by UNESCO policy initiative. To this effect the Convention on Technical and Vocational Education, and the Project 2000+ declaration was recommended. In Zimbabwe a special project on "Women and Science and Technology" was also launched by the Science Sector to promote women's participation in science and technology education and related careers at a global level.

Recent history has demonstrated the potential of science and technology (S&T) for improving the quality of people's lives. Hitherto it has been realised that S&T has profound effect on the quality of life across the human species. As a result, it is now widely accepted that socio-economic and indeed cultural development, is largely dependent on the harnessing and application of S&T achievements. Many countries of the world have adopted and are signatory to the Beijing Declaration and Platform for Action (1995) whose main agenda was to achieve equality and empowerment of females. Currently, the gender disparities are unacceptably high and in most cases women are on the loosing end. Taeuber (1991) posited that sixty percent of all working women hold clerical, service, or professional positions; however, more than sixty percent of the women holding professional positions are concentrated in female-intensive fields such as school teaching and nursing. Studies indicate that women are still generally underrepresented in higher institution in the field of science, engineering and technology (Ceci & Williams, 2011). A study of women scientists in the United Kingdom (UK) reveal that women are still underrepresented in the higher echelons of science, engineering and technology (Van Langena et al., 2006). In Zimbabwe women are 52% and males are 48% but the distribution of resources and services are slope-sided and in favour of males. In 1992, Eileen Byrne arguing for equal participation of women in education and labour force stated: "God put 51 per cent of the brains of the world into female skulls, and to be used" (Farago 1992:14). This perception merits consideration taking cognisance of the fact that female students are to date recording low enrolment levels in the Engineering courses in Zimbabwe polytechnic education. Yet education is viewed as an instrument for preparing the community for life. (Nyerere, 1968: 274) affirms that "Education … must impart knowledge and skills needed for family life and for participation in the development and maintenance of the community." This articulation seems to spell that those who are not accessing education may be left out in the development and maintenance of the community. It is therefore imperative for this

research to unearth underlying factors which explain the reasons why female engineering students are under represented as compared to their male counter parts. If this statement is to hold water then the culture of marginalisation and discrimination of the women particularly in education and development remains a perpetually an unfair fair deal.

1.1 Purpose of the study

The purpose of the study was to establish the reasons that contribute to the low female students' enrolment in engineering courses, and to proffer solutions that mitigate underrepresentation of females in engineering programmes.

1.2 Statement of the problem

Globally many countries accept the fact that the field of technical and vocational education is a key factor to develop the country's economic growth, quality of life and job creation and women can play a key role in development. The Zimbabwe government has been making significant efforts to harness effective participation of women in many sectors of the economy through education to enable create employment opportunities. However, opportunities for female students in engineering fields have remained relatively low leaving women grossly underrepresented and marginalised. Why there are so few female students pursuing the engineering courses remain a cause for concern in polytechnics in Zimbabwe. The perspectives of students in the Engineering department remain basic for the adoption, implementation of strategies to promote for more female participation in engineering courses.

It is imperative therefore for this research to investigate the reasons why female students remain poorly represented despite efforts being made to break glass ceiling.

1.3 Research Objectives

- To establish the reasons for very low female students enrolments in engineering courses at Gweru Polytechnic.
- To proffer some intervention strategies on how to effectively reduce barriers and encourage more female students persue Engineering courses at polytechnics.

1.4 Research Questions

- What are the reasons for very low female students' enrolments in engineering courses at Gweru Polytechnic?
- What intervention strategies can be put in place to encourage more female students persue Engineering courses in polytechnics

1.5 Significance of the study

This study is significant in that it will contribute meaningfully to the growing literature on gender studies and women empowerment. Also the study will equally be of use to the polytechnic management in promoting equal opportunities to Technical Vocational Education Training (TVET) on an equal footing without women being discriminated against on the basis of gender. The researcher would also contribute to the existing body of knowledge that women must be treated on equal basis with their male counterparts a justification that calls for women empowerment from all walks of life.

II. RELATED LITERATURE REVIEW

At the eve of independence Zimbabwean government made several policy changes in a bid to address gender imbalance. Most efforts are dedicated to increasing the number of women in decision-making positions on the political front and increasing girls' access to primary and lower secondary education (UNESCO 1995). While it is true that females are generally over-enrolled in Zimbabwe's formal school system, the problem is more pronounced when it comes to technical training. Here, females are not only extremely under-represented, but the few who are admitted tend to be offered a narrow curriculum focusing on the traditional *feminine* courses such as Home Economics, Typing, Food Processing and Tailoring rather than the pure science and technology courses leading to engineering courses and modern technological occupations. Because of their under-representation in science and technology-based subjects, females are likely to become increasingly marginalized and possibly excluded from the mainstream of national development.

According to Ismail (2003), people in Malaysia still perceive engineering as a male-dominated profession and women are stereotyped as unskilled and incompetent as engineers.

This perception is likely to haunt females when it comes to selection of their career choices.

Female participation is emphasized as part of the national agenda providing opportunities for women to increase their positions. The situation still remains worrisome because female students' enrolment is very low in engineering courses in Zimbabwe polytechnic institutions. According to the research conducted by Fabert et al (2011) on ten engineering female students, he found out that women experienced "disparaging comments, an unpleasant competitive atmosphere, and generally were aware of feeling 'different." This perception among female students tended to increase the gender imbalance and would have negative consequences on employment opportunities. A research conducted in Nigeria has elicited that the Nigerian polytechnic education has always favoured men. The reasons that were highlighted were that most females do not get higher education due to their uneducated parents, poor career guidance, early marriage and child bearing, ignorance, poverty and sex discrimination among others. This situation is not new to Zimbabwe as most of the African countries have complex cultures that mainly impact negatively on girl child's education (World Bank 2012). According to Mordi et al (2010), the girl child is culturally expected to be on the home front, while the boy child is trained to work. This would in turn create unequal opportunities with their male counter parts especially when it comes to job opportunities. Previous research has shown that because of perceptions and attitudes formed from early ages, by the time they turn 14 many girls have ruled themselves out of a career in engineering (Kiwana at al 2011). It may be possible to date that many female students still believe that most science-related careers are masculine or reserved for the brainy few. Likely influencers such as teachers and families believe that a career in engineering is for men. This will dampen the spirit of females to make engineering courses a priority major. Although female students' academic achievement in engineering is better compared to male students, active participation continues to be a concern as female students claim that teachers pay more attention to opposite gender (She, 2000).

However, statistics generally confirm that, engineering is predominantly a male occupation, and women, who are in the minority, will always therefore have difficulties fitting into the male-dominated and oriented structure. It has been observed that often women do not feel a sense of belonging, or have not developed the confidence to work, in such a male-orientated environment. Commission on Engineering and Technical Systems (1985) research opined that many females find engineering schools to be stressful environments in which they experience a sense of isolation and a lack of acceptance on the part of the faculty by staff and the male students. The design of the engineering curricula has been observed as a critical factor that may discourage and disadvantage female students. Such curricula meet the needs of male students grossly neglecting the female learners. For instance, in India, girls undertaking engineering disciplines admitted that they were slightly handicapped due to less physical strength when working in some of the laboratories and workshops (Onokala & Onah 1998). In a research conducted by Lewis (1991) it obtained that girls are usually expected to be more accomplished in linguistic and social skills, and boys are supposed to be better at mathematical, mechanical and other problem-solving tasks. On a general note the perception would be that generally women are thought to be non-technical and men more technically focused.

A national survey by the Cooper Union of women studying engineering as well as those in engineering practice revealed that 75 percent of those women had fathers or brothers who were engineers (Hamlin, 1995). The father often provides an engineering or technical role model, thus offering his daughter learning experiences, opportunities, and encouragement to pursue engineering as a profession. Technically, role models plays an important role in encouraging female students develop an interest in pursuing engineering courses. According to Keino (1985) he argues that female trainees may be presumed unprepared to cope with science and technical subjects or lack confidence in pursuing *masculine* courses. It is also noted that in some institutions prevailing attitude is not supportive of females taking high-tech subjects. Besides there are no or few female teachers to act as role models in the fields of high-tech training such as mechanical engineering, electrical engineering, building construction, wood and metal technology, motor mechanics and plumbing, may discourage the few who have the interest and aptitude to venture into any of them. Fourthly, due to the fact that there are very few women in technical training institutions, those who wish to venture into the male-dominated courses may become discouraged when they find they are the only one or two female(s) in the course. Kithyo & Petrina (2002) studies found that people belief about technical and vocational education courses like engineering, architecture etc. are for men and that women have accepted these stereotyping expectations from the society. Several of the women in this study felt that TVE was male-dominated field and barrier for Nigerian women in higher education. Women perception about science and technology (ST) has been socialized to see (ST) as a field that is difficult and suited to male brains only (Nsofor, 2001).

According to Ismail (2003), people in Malaysia still perceive engineering as a male-dominated profession and women are stereotyped as unskilled and incompetent as engineers. She stated that "Malaysian female engineers accounted for less than 10 percent of the total professional workforce despite the encouraging number of Malaysian females enrolling in the field of engineering, locally and abroad". Contrary to this finding a research in Nigeria by Ellis 1997 (in Ayang & Edu, 2012) asserts that there are many Nigerian women who are highly intelligent, but are not encouraged especially in the science-related and technical professions and thus

not contribute to nation building. Given these scenarios it is high time to level off barriers to allow more women into engineering courses for economic innovation and development in Zimbabwe. Women's underrepresentation, or failure to choose, and attrition rate, or failure to persist, in engineering and other non-traditional curricula, results in their continuing plight with occupational segregation and wage discrimination.

Globally many countries accept the fact that the field of technical and vocational education is a key factor to develop the country's economic growth, quality of life and job creation and women can play key roles to development. The government of Nigeria has been making efforts to increase the number of women in technical and vocational education in institution of higher learning to enable her creates employment opportunities for her citizenry. However, women are not embracing this opportunity by enrolling in technical and vocational education programmes that will equip them with skills for self-reliant and contribute to national development. Opportunities for women in technical and vocational education field have remained relatively unexplored in Zimbabwe. The research of low female enrolment has remained a neglected area in Zimbabwe hence the critical moment has come to unravel the problems that block women development in the twenty first century.

III. Methodology

The research adopted the quantitative and qualitative interpretive approach. A case study design was employed in this study. The qualitative approach was preferred because it allows the researcher to gain understanding of this social phenomenon from participants' perspectives in their natural settings, (McMillan and Schumacher, 2010). The researcher used open ended questionnaires, focus groups and interviews and document analysis as main data collection methods. Purposive and random samplings were used to select participants for the study who were made up of 40 students and 10 lecturers in the engineering department and 5 purposively selected parents. Three focus groups of eight students each were conducted comprised of students from Mechanical, Automotive and Electrical Engineering departments. The results of the study were thematically analysed. Purposive sampling seeks individuals and sites that can best supply relevant information needed to answer the research questions raised (Creswel, 2008: 214). The researcher analysed narrative data from interviews and focus groups using predetermined thematic categories and statistics presentations.

IV. IV. Findings and Discussions

In Zimbabwe prejudice continues to exist as does the glass ceiling that limits women from enjoying truly equal opportunities in education. Adeleke (2003) has observed that there is high inequality between men and women, thus creating a wide gap between them, both in political, economic, social and cultural sphere. The most notable and obvious situation is the under representation of female students in Engineering courses in polytechnics. Simple survey of statistical distribution of students' enrolment in engineering courses shows a strong bias towards male students.

Table I. Engineering Courses Enrolment by Department (N=55)

DEPARTMENTS	CLASSES	M	F	Total
Electrical Engineering	Electrical power NC1	59	16	75
	ElectricalpowerNC3	24	4	28
	Instrumentation NC1	14	4	18
	Instrumentation NC3	9	4	13
	Communication SystemsNC3	5	4	9
Mechanical Engineering	Fabrication NC1	25	5	30
	Refrigeration NC1	9	6	15
	Machine Shop NC1	18	2	20
Automotive Engineering	Auto-electrics NC1	15	8	23
	Auto-electrics NC3	13	3	16
	Motor Mechanics NC1	20	1	21
	Motor Mechanics NC3	16	0	16
	Diesel Plant Fitting NC1	27	6	33
	Diesel Plant Fitting NC3	40	1	41
TOTAL	**14**	**294**	**64**	**358**

Source: Gweru poly

Gweru Polytechnic Engineering female students account for 17.87% of the total students despite efforts being made to encourage more students to take up engineering courses during symposium campaign programmes. Even though the women lag in numbers when considering the total number of people employed in the engineering arena, and such issues come under debate in the area of gender equality (Rodgers & Boyer, 2006). The modalities in which female students are to gain confidence in taking engineering courses remain a bone of contention. It emerged that there are an array of problems that confront females in their attempt to acquire education at each level up to higher institutions. The domain of male domination will grow and spread in employment circles to leadership positions. For instance, at Polytechnics, where technical and vocational subjects are being offered, male students dominate the population student in college with 82.13%.

From the open ended survey of questionnaires and interviews, various reasons and factors were indicated that contributed and influenced gender differences in students pursuing Engineering courses. Table 2 Shows reasons on why fewer female students have low aspirations of taking vocational training in engineering courses.

Table II: Reasons of female students reluctantly taking Engineering courses (N=55)

1.Low educational requirements such as a pass in Mathematics and Science
2.Females think the Engineering courses are difficulty
3.Engineering employment is more risk payslips reflect danger allowances
4.There is lot of manual tasks which are too demanding for women
5.After college conditions in Engineering employment are not favourable for women
6.Costly when students are supposed to buy own tools eg tools box and safety shoes

Source: Survey

Academic performance differs between male and female students. Different characteristics become the determinant factors that affect the educational attainment. Among the important characters found in this study is that females are more worried about their work environment, they are more choosy in terms of job choices, they are not risk takers hence may become less adventurous, also women choose professions that are smart for them and not physically challenging or demanding in terms of manual work. This scenario creates an unhealthy situation where females are lagging behind in many social and economic developments circles. It was ideally important in this study to capture the perception of the female students on why they prefer other choice careers than engineering. One student lamented that;

"I would not like to cheat my self to peruse my studies the engineering way. There are so many short comings in these courses. Sir, it is too dirty, too greasy oils all over my body. I think there are other better smart courses. In fact Iam not a man I need to do my hair and wear my smart shoes not to be found dragging the heavy safety shoe all the times oooh sorry"

The lecturers who were interviewed echoed that engineering and Sciences are male-dominated disciplines and this has been like that from the past. To date female students have that strong traditional notion hence just a few would want to study a course in he engineering. Using some materials or machines or

equipments requires a double portion of strength and in many cases females would shy this type of work environment. The comments from one lecturer indicated that it becomes difficulty especially for a young girl coming from secondary school and cope with Diesel Plant Fitting or Machine Shop course demands. The work is found to be tough.

Some views from the focus group of students discredited the fact that it is Mathematics that shy away students in the engineering courses. There were disparaging arguments and comments from the students. 85% argued against Mathematics as a barrier while 15% hold that many may not have Mathematics. One student lamented that *"There are so many females in Information Technology and Accountancy who have passes in Mathematics so the issue of Mathematics falls out. Society's treatment is always in favour of boys. So I go where I am needed. Employment conditions after college life favour boys especially in this field. Spouses would fail to take it when the wife is called for night duty or you are always on standby. I have taken this course to challenge men status in this trade."*

The above comments are too suggestive that the issue of gender roles is still with the society despite initiatives being taken to call for equal treatment of men and women. So females are suppressed right as early as at kindergarten age up to institutions of higher learning. Again Ayang & Edu (2012) holds that all along opportunities in technical and vocational education has been for men alone, thus creating an imbalance and inferiority complex among women. Moreover, stereotypes continue to manifest themselves. For example, nursing and social work programmes tend to have large proportions of women, even up to 95% while physics, mathematics and engineering programmes have low proportions of women, below 17%.

Findings of this study reveal that the atmosphere in technical and vocational education environment in some engineering classes is full with comments that are sexist in nature. Some male students echoed that "the *language in the engineering section does not make women comfortable; it is an industry language which is not professional or respectful. Some of the females are not used to that.*" A female student in this class mentioned that male students must be educated for them to accommodate female counterparts and issues of bullying must be guarded against. Focus group participants revealed that intimidation by male colleagues created problem that affects their confidence and moral in the programme. Study by Rose (2007) found that females that were intimidated by males in male-dominated work environment made the women feel like outsider and hindered their career development.

4.2Parental attitude in choice of subjects

The study found out that parental attitude still dominates when it comes to the child's choice of course to take especially with technical vocational courses. Ayang & Edu, 2012) asserts that there are many women who are highly intelligent, but are not encouraged especially in the science-related and technical professions and thus not contribute to nation building. The parents who participated in this research concurred that it is the parent's responsibility to advise a good course for the child. 60% of the parent-participants reckoned that female students must not take engineering when other better courses are still there. According to Mordi et al (2010), the girl child in Nigeria is culturally expected to be on the home front, while the boy child is trained to work. This notion also holds water in Zimbabwe the concept of gender roles still dominates in patriarchal societies. This perception seems to favour the view that women are governed by patriarchal systems of socialization and cultural practices which favour the interests of men above those of women. Contrary to this research study is the view that many female lecturers and male lecturers have positive comments for females to major in engineering courses. 40% of the respondents have felt that views of parents and other sponsors of education are positive while 10% of the respondents remained neutral and the rest 50% do not encourage female students to take up Engineering as their trade careers, the reasons are that there are challenges that go along in the process of acquiring the qualification. One respondent echoed that *"Acquiring the qualification is far too different from getting the job and work as a female engineer"* This comment suggests the challenges that my dog the engineering profession and such comments are prone to discredit engineering female takers.

4.3The perception of lecturers on low female enrolment in Engineering

Of the ten lecturers who participated in this research 60% view engineering as a male-dominated environment and females would always shun it. Students' attitude therefore is playing a role in limiting their entry into engineering courses and vis a vis profession. Further more, responses from the same lecturers purported that some courses like DPF, Machine Shop and Motor Mechanics are demanding and challenging. For instance, handling or coming to terms with manual work requires some extra effort and energy. Proved or unproved research it is believed that in the employment arena, especially in science and technology enterprises, it is widely assumed that women are less capable, less competitive, or less productive than men and that these characteristics account for the scarcity of females in Engineering field. Further comments that emerged from lecturers highlighted many other factors that increase the gradient to limit the intake of females in this career line. One lecturer opined that " *Female students are still haunted by the socio-cultural factors, because in the*

past the courses were purely for men and such parameters have not been reversed, worse off there still exist little knowledge about what happens in this career path, there is also engineering phobia which dispels students' motivation. These factors are still lingering in their lives so in short traditional and institutional barriers are still blocking women in this noble trade." The above statements seem to suggest that a number of factors are playing havoc at the expanse of female students finding it difficult to make a break through into engineering field. However, during the time of this study student enrolment ratios showed that males are 82.13% while females are 17.87%. Against this background, it is obvious that women in our tertiary institutions or engineering fields these days are among the privileged few women who have had access to engineering education. Studies indicate that women are still generally underrepresented in higher institution in the field of science, engineering and technology (Ceci & Williams, 2011).

The study revealed that workshops were constructed on discrimination grounds. For instance, the structures do not have toilets specifically for females and the change rooms are meant for males only. This poses that females are not important and the section areas are for males only hence one feels under-valued and a second class citizen.

4.4 Strategies to encourage female students into engineering courses.

- Introduce affirmative action policy for female students entering engineering career trade.
- Conducting research and policy reviews to eradicate stigmatisation associated with engineering education of females.
- Gender mainstreaming, general policy programmes and practices to support the purposes of gender equality and equity.
- Introduce exclusive scholarship schemes for women pursuing engineering fields.
- Stemtisation programme talked about to have a full quota for females so that many females will afford and also meet the requirements to enrol for the courses.

V. CONCLUSIONS

The purpose of the study was to explore factors that limit female students enrol in engineering their numbers as they do in other disciplines such as Accountancy, Secretarial and Accountancy. Based on the findings the following conclusions were drawn:

- The study concluded that some female students have passion in engineering studies, but there are some problems which make them feel isolated, marginalized or otherwise uncomfortable.
- Some problems enumerated are due to attitude and society's action that women are not equal to men in fields of education and employment.
- Qualifications have been itemised as too high gradient to encourage more participation of women in the engineering courses.
- Among other reasons that evolved from this research include; Engineering phobia, the courses are too difficult, manual tasks are demanding and challenging, high course costs, Engineering employment is risk, employment conditions not favourable for women for instance night calls, standbys and night duty. Besides the trade is associated with dirty, considering the oils and grease in the work environment.

VI. RECOMMENDATIONS

- Through Zimbabwe Development Education Fund (ZIMDEF) female engineering students must be provided with engineering tools for learning such as tools box and safety clothing in line with the policy for addressing equity in education.
- Extensive marketing of TVE programme with an engineering bias will alter the misconceptions about the field of engineering.
- There is need to include TVE principles early in the curriculum that is at primary and secondary education levels so as to expose more of girls to real applications for science, technology, and mathematics.
- The government should set up a balance quota for female students, entering polytechnic education institutions.
- The Ministry of Education should set up motivational programmes to make female students aware of lagging in educational attainment.
- The policy of polytechnic intakes should give priority and flexibility to female students in engineering field.
- Resurface the issue of cadetship to help pay fees for females wanting to take engineering courses.
- Career guidance on importance of engineering is important to remove the stigma.

6.1Further research recommendations

Repeating this study may produce similar results which would strengthen and further validate the study's transferability (Creswell, 2012). It is also the opinion of the author for this research to further study implications in early introduction of technical skills in primary and secondary schools. Preferential bias must be tailored to engineering courses.

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