UNILAG Journal of Humanities (UJH) Vol. 7, No 1, 2019

Examining the Gender Differentials in the Application for STEM Fields: Findings from the University of Lagos

Franca Attoh, Yemisi Obashoro-John, Maryam Quadri, Femi Olowu & Abimbola Durojaiye

Department of Sociology, Department of Adult Education, Department of Political Science, Department of Social Work, & Admissions Office, University of Lagos, Akoka

Abstract

Building on secondary data, this paper seeks to make two contributions to literature. First, to present a description of the sex differentials in course applications into Nigerian universities, using the University of Lagos as a sample and second, to describe the variation in the selection of courses in the fields of Science, Technology, Engineering and Mathematics (STEM) by prospective students that are females. Findings showed that female applications for degree programmes were higher than male applications in most fields, including some core science fields which involve human-oriented professions like pharmacology and medicine. Nevertheless, the overall statistics revealed that the proportion of male applicants were fractionally higher during the four sessions under review. The sex differentials were highest in engineering and environmental sciences fields where male applications outnumbered female applications by a ratio of about three to one. Furthermore, female applicants were more likely to choose biological, people-oriented and care-centred fields, leading to female apathy towards engineering and other technical programmes, especially those with mathematics, physics and geography as core subjects. We, therefore, recommend the development of nationwide programmes aimed at dispelling gendered misconceptions about certain fields, especially STEM fields. This is very essential in a world where science and technology define national economies. Nigeria cannot afford to leave half her population behind.

Keywords: Gender differentials, STEM, STEM fields applications, University of Lagos.

Introduction

Gender dynamics of participation in higher education has been the subject of extensive research over recent decades (Diekman *et al.*, 2010; Parson, 2016; Ndirika & Agommuoh, 2017). National and global statistics have shown that female participation has increased over time, and has surpassed male participation in several countries (UNESCO, 2010; NSF, 2013; OECD, 2017; UIS, 2019). Nonetheless, participation in Science, Technology, Engineering and Mathematics (STEM) has been reported as low and not responsive to change, although the

 UJH is published under the Creative Commons License of Attribution & Noncommercial ***(CC BY-NC)***

same reports show greater female participation in health and medical sciences fields (Hango, 2013; McMaster, 2017; Perry, 2018). Literature and reports consistently show that the phenomenon of gender-disparity in career paths occur in both developed and developing countries, in spite of the axiomatic 'gender-equity' contexts or status of countries (Steot, *et al.*, 2016; Steot and Geary, 2018; MATRIX, 2018; Perry, 2018; UIS, 2019).

In Nigeria, national databases have failed to capture the sex–STEM dynamics. The most recent data from the National Bureau of Statistics showed that female enrolment in Nigerian Universities was 38.36% in 2012/2013 while the percentage of male enrolmentwas61.64% (NBS, 2018). However, the assumptions are that the patterns have changed over the last five years. Besides, considering participation in the National Youth Service Corps (NYSC) as a means of measuring participation in higher education, data shows that female participation ranged from 45 to 48% between 2014 and 2016. It is thus assumed that female participation in higher education has increased across the country (NBS, 2018).

In much of the writings on gender disparity in higher education in Nigeria especially those that emphasize the participation of girls and women in the STEM fields, discussions tend to focus on the correlates of gender–STEM inequality derived from western data and research, without examining the fulcrum – statistical evidence of its prevalence in Nigeria. At this juncture, it should be noted that it is not enough to simply theorise correlates, without substantiating statistics to backup claims of gender disparity, and the fact of the validity of sex differentials in interest and enrolments for the diverse fields of higher education in Nigeria. Thus, there appear to be an apparent literature gap, and primarily a need to analyse data in order to have empirical statistics from which valid inferences can be drawn for policy interventions. Such statistics can then serve to mitigate whatever gender–gap that exists and ensure sustainable participatory trends for socio-economic development across genders. This is important especially in the contemporary STEM-dependent post-industrial age we live in. This paper, therefore answers two questions: what is the sex ratio of Post-UTME applicants to the University of Lagos from 2015/2016 to 2018/2019 sessions and what are the trends of female application in STEM courses over the same period?

Literature and Theoretical Review

In an attempt to diagnose the cause of this phenomenon of girls' and women's under representation in STEM, researchers have severally theorised that biological and/or socio-cultural factors serve to inhibit enrolment in certain academic or

 UJH is published under the Creative Commons License of Attribution & Noncommercial ***(CC BY-NC)***

occupational fields based on physiological sex and gender-based socialisation (Ceci, Williams & Barnett, 2009; Diekman *et al.*, 2010; McDaniel, 2015). These constellations of biological and social roles differentiations are believed to have instigated as well as perpetuated the perception that particular academic fields are masculine or feminine (Su, Rounds & Armstrong, 2009; Reinking & Martin, 2018).One of such theories rests on the proposition that this dichotomy exists because career choice of girls and women are impacted by their biological makeup which dictates their capacity to carryout physical and intellectually demanding work activities. According to this theoretical standpoint, the genetic and physical compositions of the female body as well as the physiological demands of reproduction and societal expectations regarding child rearing render women incapable of sufficiently participating in certain physical and mentally tasking work activities (Wood & Eagly, 2012).

Furthermore, biosocial theorists hypothesized that the presence of high levels of testosterone and dominant left-brain activities in men make them to be more aggressive, assertive and rational compared to their female counterparts who are perceived to be passive and emotional (Baron-Cohen, 2003). Hence, dominant and analytical reasoning is attributed to men while passivity is related to women (Keller, 1995). The conclusion that could be drawn from this perspective is that the female physiology and mental state limit their capacities to engage in the rigours of technical, science and engineering courses. This is because it is believed that females, by the nature of their biology, have low interest in fields considered to be associated with those occupations or professions that are physically and mentally demanding (Brotman & Moore, 2008; Ceci & Williams, 2010). Conversely, across-national survey using the Programme for International Students Assessment (PISA) 2015 data from 71 countries showed that girls performed comparatively better than boys in science in two of every three countries, and in nearly all countries, more girls appeared capable of performing well in college-level STEM study they enrolled for (Stoet & Geary, 2018).Thus, the critical summation in contemporary studies that examined cognitive variations in mathematics and sciences performance is: there is no significant biological difference in men's and women's performance in STEM courses (Ceci & Williams, 2010; Goetz, *et al.*, 2013; Wang, Eccles & Kenny, 2013).

Another theoretical standpoint that attempts to explain the sex difference in academic interests is the social roles or gender scripts propositions. The assumptions are that social-cultural norms and gender stereotypes inhibit girls and women participation in STEM. Wood and Eagly (2012) maintained that rather

 UJH is published under the Creative Commons License of Attribution & Noncommercial ***(CC BY-NC)***

than biological or physiological parameters, social construction of gender roles create differences in behaviour between the sexes as people react to others' expectations and act on their own gender identities based on socially defined scripts of femininity and masculinity. Also, individuals contend with social and personal pressures to conform to socio-cultural gender stereotypes they were socialised into from infancy. These determine their positions in society along female or male dichotomy (Wood & Eagly, 2012). The point here is, whether male or female, individual behaviour patterns are influenced by experiential and vicarious social and psychological processes conceived as biological facts. These subsequently shape the understanding of what is appropriate or expected of a person based on his or her gender.

Since girls and women have been ascribed the general social role of care-givers and socialised from childhood to carry out activities related to care-giving roles, they have been psychologically conditioned to gravitate towards activities, whether academic or occupational, that meet these stereotypes (Weber, 2012). While Ceci and Williams (2010); Wang, Eccles, and Kenny (2013) conclude from their studies that women place more importance on working with and for people, and see STEM fields such as Engineering as incongruent with gender typified roles, Wang et al (2013) reiterated that women are more concerned with achieving the communal goal of helping others, while men tend to value money and status, which is often associated with masculinity, as their primary motive.

Researchers have affirmed the central proposition of this perspective and have shown that differences in gender-based attitudes are somewhat related to why more males than females apply for STEM courses (Eagly & Wood, 2011; Diekman *et al.*, 2017). Since communal goals that involve people-oriented and nurturing services are central to feminine roles, they may influence male reasoning and dissuade them from considering people-oriented fields or professions (Deikman, Weisgram & Belanger, 2015; Weisgram & Deikman, 2015). In addition, since more females are likely to pursue communal goals, this may provide an explanation why more males than females are represented in STEM courses (Diekman et al, 2010; Eagly & Wood, 2011; Diekman *et al.*, 2017). In other words, more males are likely to shy away from courses that involve working with and for people, and opt for financially stable STEM courses. Therefore, the arguments have sufficed that through socialisation that emphasised gender discrepancies, both male and female have been inculcated with stereotypes that disfavour some academic career path for either male or female.

 UJH is published under the Creative Commons License of Attribution & Noncommercial ***(CC BY-NC)***

Scholars have also maintained that girls and women have lower levels of analytical abilities, in mathematics and science subjects, compared to boys and men. Rather, they have a physiological state that leads to devalued self-efficacy in girls and results in decreased interest in STEM courses (Spencer, Steele & Quinn, 1999; Feist, 2012; Ganley, George, Cimpian & Makowski. 2017; Lippa, 2010; Good, Rattan & Dweck, 2012; Reuben, Sapienza & Zingales, 2014). These gender stereotypes shape girls' attitude toward mathematics and physics and ultimately diminish their self-efficacy and interest in STEM disciplines which they consider heavily driven by these two subjects. This further undermines girls and women's self-efficacy in science and mathematics, thereby lowering their motivation for STEM disciplines as compared with their male counterparts (Kolmos, *et al.*, 2013).

Methodology

A descriptive survey design that involved quantitative analyses of secondary data was employed. Data were obtained from the Admissions Unit of the University of Lagos. This research design was chosen because the goal was essentially to describe the sex differentials in the applications for courses by prospective students of the University of Lagos. Data contained information of applicants who had successfully met the UTME basic requirements for admission into the University of Lagos. The data spanned a period of four academic sessions of the various courses applied for with the aim of ascertaining the gender dynamics for STEM.

Findings

The population for the study was applicants for the University of Lagos Post-UTME (referred to as applicants henceforth) over the four sessions from 2015 to 2018. Participation meant that the applicants had selected the University of Lagos as their institution of first choice in their respective JAMB-UTME entrance examination registrations and had scored the average grade of 200 and above in their JAMB-UTME qualifying examination. All charts presented in the findings show percentages of female applicants, unless otherwise indicated.

 UJH is published under the Creative Commons License of Attribution & Noncommercial ***(CC BY-NC)***

Table 1: Sex Distribution of Applicants by Academic Session

Sex	2015/2016	2016/2017	2017/2018	2018/2019	Total
Female	13,054 50.1	7,515 50.9	14,415 49.3	11,810 49.7	46,794 49.9
Male	12,976 49.9	7,238 49.1	14,825 50.7	11,962 50.3	47,001 50.1
Total	26,030 27.8	14753 15.7	29,240 31.2	23,772 25.3	93,795 100

Data on Table 1 show the gender distribution according to the admission sessions. The population of applicants over the four sessions was 93,795. The 2016/2017 session had the lowest proportion with only 15.7% of the total population, while 2017/2018 had the most, contributing 31.2% of the total population. For both 2015/2016 and 2016/2017 sessions, the population of female applicants were marginally higher than male applicants, while for the two remaining sessions, the reverse was the case, with male applicants marginally edging their female cohort. Over the four sessions, the proportion of male applicants was 0.2 % higher than that of their female counterpart.

Table 2: Sex Distribution of Applicants by Faculty

Faculty	Female %	Male %	Difference %
Pharmacy	60.7	39.3	21.4
Law	59.6	40.4	19.2
Clinical Sciences	59.5	40.5	19
Education	58.4	41.6	16.8
Arts/Humanities	57.8	44.2	13.6
Dentistry	56.7	43.3	13.4
Basic Medical Sciences	55.1	44.9	10.2
Social Sciences	53.7	46.3	7.4
Business Administration	51.9	48.1	3.8
Science	41.7	58.3	16.6*
Environmental Sciences	29.6	70.4	40.8*
Engineering	22.4	77.6	55.2*

*represents higher male proportion

UJH is published under the Creative Commons License of Attribution & Noncommercial ***(CC BY-NC)***

Using the data of the 93,795 applicants across the four admission sessions, Table 2 shows that female applicants were significantly more than the male applicants in 9 of the 12 faculties of the University. The two largest sex differentials were among the faculties where male applicants were the majority. For instance, seven in nine applicants for Engineering were male, and 7 in 10 for Environmental Sciences were male. The only other faculty where male applicants constituted the majority was the Faculty of Science with a percentage difference of 16.6%. As reported in the literature and national data, females had considerably higher proportions of representation in the Health and Medical Sciences branch of STEM with females constituting 60.7% of pharmacy applicants; 59.9%, 56.7% and 55.1% of applicants for Clinical Sciences, Dentistry and Basic Medical Sciences respectively. Furthermore, all the Non-STEM fields had higher proportions of female applicants in comparison to male counterparts with percentage differences as high as 19.2% for Law, 16.8% for Education, while the lowest differences were 7.4% and 3.8% for the Social Sciences and Business Administration respectively.

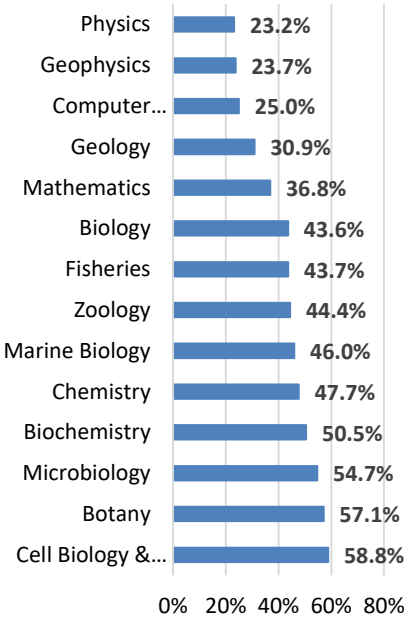


Figure 1: Science Programmes

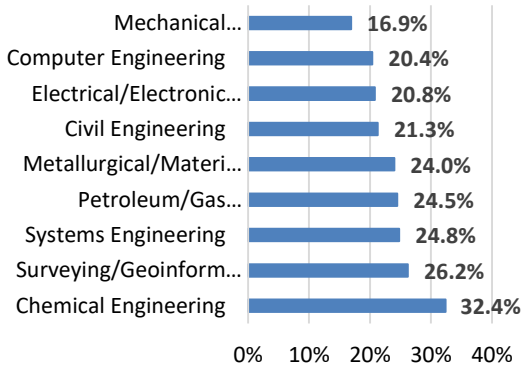


Figure 2: Engineering Programmes

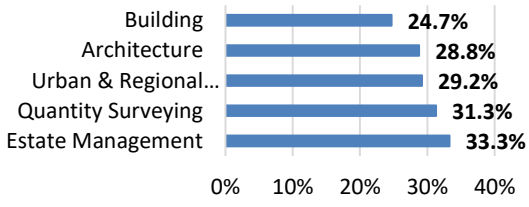


Figure 3: Environmental Sciences Programmes

UJH is published under the Creative Commons License of Attribution & Noncommercial ***(CC BY-NC)***

Focusing on the fields with relatively higher male applicants – Science, Engineering, and Environmental Sciences, Figure 1 indicates that female interests were relatively lower across courses in Science, with the exception of some biology intensive courses - Cell biology and Genetics, Botany, Microbiology and Biochemistry. Interests for biology-centred courses could also be deduced from female preferences for health and medical sciences fields. On the other hand, low female interests were pronounced in Physics, Geography and mathematics intensive programmes, with greater apathy towards physics intensive courses - Physics23.3% and geophysics 23.7%.Female applicants constituted less than a quarter of the population of applicants in the core physics intensive programmes in the natural sciences.

In terms of applications for engineering fields, Figure 2 indicates that female applicants substantially under applied compared to male applicants. Female applicants were less than a third of applicants across the programmes in the field. For instance, Chemical Engineering had the highest proportion of female applicants as it had 32.4% of applicants for the programme in the sessions under review, while less than 17 % of applicants for Mechanical Engineering were female. Figure 3 shows that there were relatively lower applications by female applicants for programmes in the Environmental Sciences. Female applicants were also less than a third across all fields in Environmental Sciences programmes with the highest proportion of female applicants being the 33.3% who applied for Estate Management.

 UJH is published under the Creative Commons License of Attribution & Noncommercial ***(CC BY-NC)***

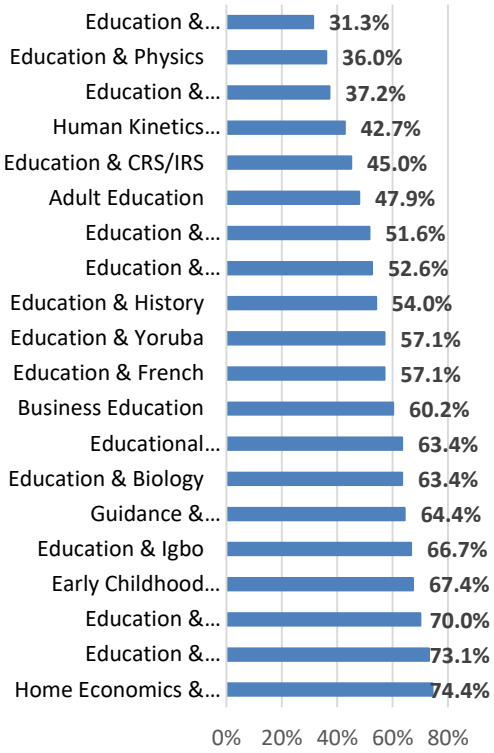


Figure 4: Education Programmes

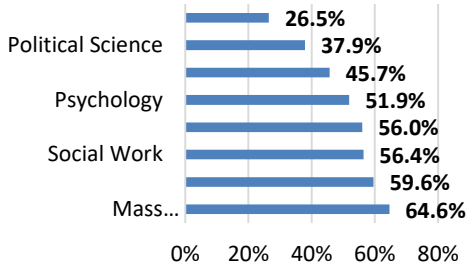


Figure 5: Social Sciences & Law Programmes

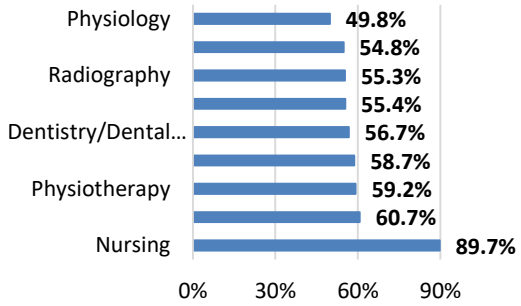


Figure 6 indicates that female applicants were significantly more in all health and medical sciences programmes, with the exception of Physiology that has 49.8%. A closer examination shows that the proportion of female applicants across the Health and Medical Sciences programmes ranged from around 55 to 61% with average percentage differences between 10 and 20 per cent. Nursing had the largest sex differential of all the programmes applied for across both sexes. Female applicants constituted almost 90% of Nursing applicants.

UJH is published under the Creative Commons License of Attribution & Noncommercial ***(CC BY-NC)***

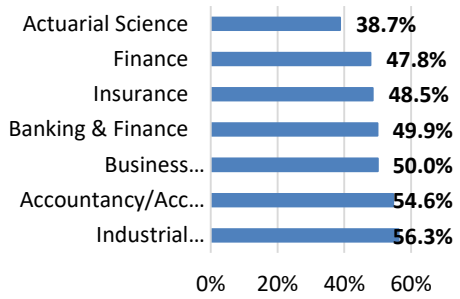


Figure 7: Business Administration Programmes

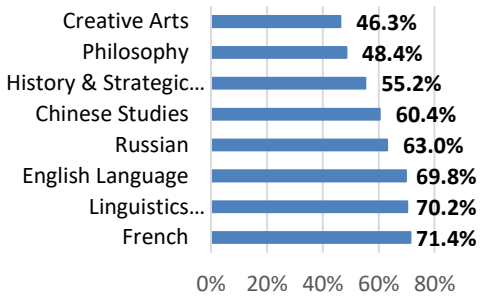


Figure 8: Arts/Humanities Programmes

The charts above show the proportions of female applicants for Arts/Humanities and Business Administration fields. Figure 7 reveals that Actuarial Science had the least percentage of female applicants in business administration programmes. This is perhaps because it is the most mathematics intensive programme in Business Administration. However, Accounting/Accountancy which is also mathematics intensive had the second highest proportion of female applicants, second only to the most people-oriented programme - Industrial Relations and Personnel Management - in Business Administration. Figure 8 indicates that more female applicants applied for Language and Linguistics related programmes than male applicants.

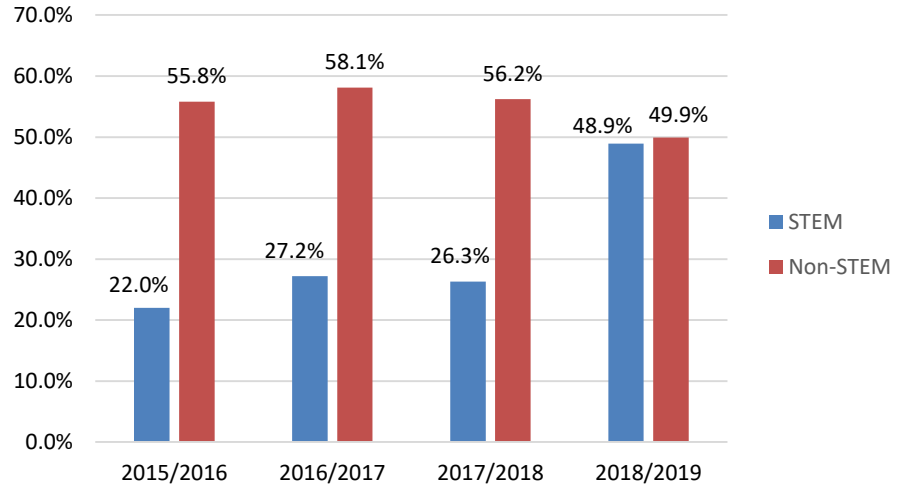
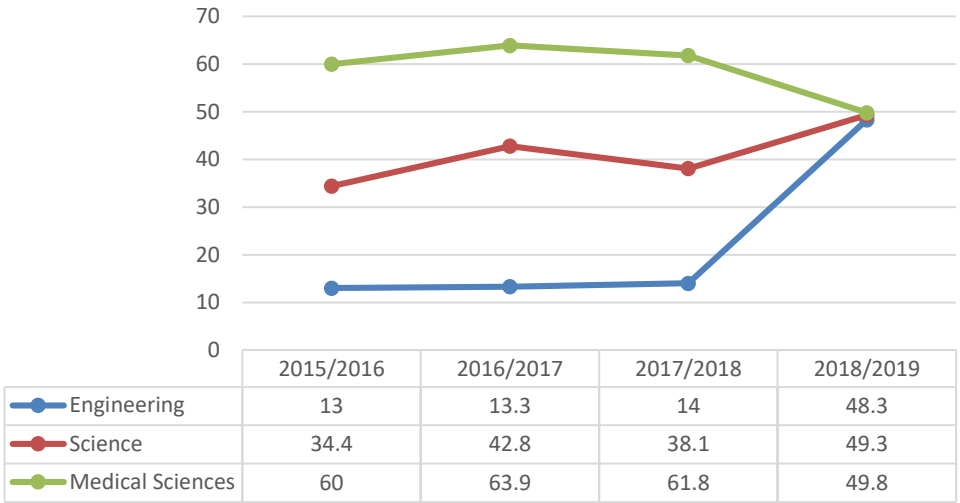


Figure 9: Percentage Distribution by STEM and Non-STEM fields

UJH is published under the Creative Commons License of Attribution & Noncommercial ***(CC BY-NC)***

Using only programmes in the Faculty of Science and Engineering as the STEM fields, data show that female applicants constituted the majority of applicants for the Non-STEM fields ranging from 55.8% in 2015, 58.1% in 2016 to 56.2% in 2017. Although in 2018, female applications dropped slightly below average to 49.9%,one will notice that there have been significantly more male applications for STEM fields, with female applications constituting less than a third of the total applications made over the four years under review. In 2015, female applicants constituted only 22% for STEM programmes. However, the proportion of female applications spiked to 48.9% in 2018 against 26.3% in the previous year.



	2015/2016	2016/2017	2017/2018	2018/2019
Engineering	13	13.3	14	48.3
Science	34.4	42.8	38.1	49.3
Medical Sciences	60	63.9	61.8	49.8

Figure 10: Percentages of Sessional Applications for STEM fields

The data on Figure 10 indicate that there were positive shifts in female applications for engineering fields for each admission session, slowly rising from 13% in 2015 to 14% in 2017. However, there was a drastic pike from 14% in 2017 to 48.3% in 2018. In fact, the 2018 data were quite irregular as the figures contrasted with the data from the three previous years under review. For Science fields, the proportion of female applications shifted upward from 34.4% in 2015 to 42.8% in 2016, then dropped the following year to 38.1% and rose again to 49.3% in 2018.

Discussions

Findings from the data showed that fewer females opt for engineering, physical sciences and other technical courses like Architecture and allied programmes, while male applicants were also not likely to offer programmes at extremities of people-oriented or care-giving services (UIS, 2019;Su, Rounds & Armstrong,

 UJH is published under the Creative Commons License of Attribution & Noncommercial ***(CC BY-NC)***

2009).These findings support the assumption that female applicants were more likely to demonstrate apathy toward career paths that are centred on mathematics, physics, or geography. These subjects are often misconstrued with masculinity (Weber, 2012; Parsons, 2016; Reinking & Martin, 2018). The masculinity assumption attached to these STEM subjects performs two functions. One, it undermines female participation in Engineering, Technology and other allied fields where these subjects are core and particularly diminishes girls and women self-confidence in participating in these core subjects thereby creating a vicious-cycle that lowers their motivation for STEM fields they consider heavily reliant on advanced levels of Mathematics and Physics. Two, it serves to create some form of group identity for male prospective students and provides psychosocial incentives for more male to participate in STEM (Spencer, Steele & Quinn, 1999; Reuben, Sapienza & Zingales, 2014).

Furthermore, available data show that female participants constitute a larger proportion of applicants for Non-STEM, biological and medical sciences fields. This is in consonance with Diekman (2011) which concludes that female participants are more likely than male participants to embrace communal people-oriented goals. Diekman *et al* (2010) premised their conclusions on the assumption that females try to align their career path with their social roles which primarily involves carrying out nurturing and care-giving roles. Career path and professions that fit these stereotypes like health and medical fields and social sciences programmes like psychology and social work which share these characteristics are considered to be naturally feminine, thereby attracting girls and women, while concomitantly deterring males from such academic and professional pursuits (Diekman *et al.*, 2010). Nursing, perhaps more than other fields, has been historically and socially constructed as a people-oriented vis-à-vis a care-giving profession. Consequently, it had the highest sex differential in the University of Lagos in the years under review, with 9 in every 10 applicants being female.

The notion that nursing and other allied health and medical sciences programmes are primarily focused on achieving communal or care-giving goals not only serve to motivate the interests of girls and women to seek the career path, but also prevents male interests and participation, though most health and medical sciences programmes are rooted in STEM. Therefore, the finding which shows that females tend to apply for medical sciences than males is in consonance with the assumptions of Diekman *et al* (2010). It assumes that stereotypes have an influence on decisions regarding academic and/or occupational fields especially

 UJH is published under the Creative Commons License of Attribution & Noncommercial ***(CC BY-NC)***

when such fields are painted communal or social care oriented. Moreover, the arguments have sufficed that females may not necessarily be underrepresented in STEM education and career, because women focus more and enrol in STEM fields that revolve around the medical and biological fields. This offsets women's low interest in engineering and technology fields (Perry, 2018).

Aside from health and medical fields, the case could be made that data support the assumption that women opt for fields that tend towards social interactions and humanitarianism like humanities, social sciences and law. This provides a justification for increased female applications for fields in the health and medical sciences, since they are generally more people-oriented than STEM courses. Considerations for engineering, science and environmental sciences courses as masculine and not directly aligned with communal people-oriented services may have served as a turn off for prospective female undergraduates.

Finally, the assumptions of authors are that these gender belief systems and the subsequent sense of inadequacies they produce are of significant threats and propel lower female participation in STEM programmes. Since these are seen as barriers to their interests, girls and women may not feel that they belong to these fields. This, in turn, leads to the poor interest in such related courses. More so, stereotypes have the power to affect students' attitudes and performances, even if these perceptions are disconnected from reality. Thus, females who fail to perform well in the STEM courses they enrol in tend to reinforce the misconception, even when their proportion is lower than that of their male counterparts.

Conclusion

In this paper, the data for undergraduate studies applications into the University of Lagos showed relatively higher proportion of female applications for non-STEM fields in contrast to STEM fields. While findings show that there was a sex gap in STEM fields, the overall sex gap was negligible, especially considering greater female interests in health and medical sciences. The apparent sex gap in STEM is mitigated by an alternate sex-gap in most of the other fields. Moreover, it was shown that female applicants were more likely to apply for people-oriented and care-giving programmes, like Nursing. Also, findings were in consonance with most researches that show that female applicants were less receptive of physics and mathematics related programmes compared to male applicants. Female applicants for core mathematics programmes like those in the Business Administration fields were more than male applicants. So, it could be inferred that the relatively lower number of female applications for STEM fields might not

 UJH is published under the Creative Commons License of Attribution & Noncommercial ***(CC BY-NC)***

primarily be due to "mathematics-anxiety", when compared to that of physics (science).Similarly, there was noticeable apathy towards geography across all fields. Geography programmes in Education and Social Sciences had the lowest proportion of female applicants. This indicates that female applicants were less likely to apply for any programme with geography as one of its core subjects.

Consequently, we infer that there are possibilities that the form of interactions and socialisations that emerge from socio-cultural stereotypes about the roles of each of the sexes, even if they are not explicit, seemingly have implicit impact on attitudes and indirectly shape academic choices by sending a message about where girls and women belong. These choices are driven, to a large degree, by gender roles stereotypes about who typically does specific science-based occupations or professions, and who has the ability to succeed in such STEM fields. In fact, the assumptions are that these stereotypes have as much implication for male applicants' choices of STEM fields as they have for female applicants.

Recommendations

Following from the above, it is recommended that:

- there should be a conscious policy of STEM-subjects clinic for junior and senior secondary schools in Nigeria that will help to dispel socially constructed gender stereotypes.
- there should be government intervention in the revitalization of facilities especially science laboratories in secondary schools in Nigeria to encourage female students, and
- training and re-training of science teachers in secondary schools should be encouraged. This may motivate female interest in STEM subjects.

 UJH is published under the Creative Commons License of Attribution & Noncommercial ***(CC BY-NC)***

References

Baron-Cohen, S. (2003). *The essential difference: Men, women, and the extreme male brain*. New York, NY: Penguin Basic Books.

Brotman, J. S. & Moore, F. M. (2008). Girls and science: A review of four themes in the science education literature. *Journal of Research in Science Teaching 45*, 971-1002.

Ceci, S. J. & Williams, W. M. (2010). *The mathematics of sex: How biology and society conspire to limit talented women*. Oxford: Oxford University Press.

Ceci, S. J., Williams, W. M. & Barnett, S. M. (2009). Women's underrepresentation in science: Sociocultural and biological considerations. *Psychological Bulletin 135*, 218-261. DOI:10.1177/0963721410383241.

Diekman, A. B., Brown, E. R., Johnston, A. M. & Clark, E. K. (2010). Seeking congruity between goals and roles: A new look at why women opt out of science, technology, engineering, and mathematics careers. *Psychological Science 21*(8), 1051-1057.

Diekman, A. B., Steinberg, M., Brown, E. R., Belanger, A. L. & Clark, E. K. (2017). A goal congruity model of role entry, engagement, and exit: understanding communal goal processes in STEM gender gaps. *Personality and Social Psychology Review 21*(2), 142-175.

Diekman, A. B., Weisgram, E. S., & Belanger, A. L. (2015). New routes to recruiting and retaining women in STEM: Policy implications of a communal goal congruity perspective. *Social Issues and Policy Review 9*(1), 52-88.

Eagly, A. H. & Wood, W. (2011). Social role theory. *Handbook of Theories in Social Psychology, 2, 458*-476.

Feist, G. J. (2012). Gender, science, and the psychology of science. In N. Kumar (Ed.), *Women in science: Is the glass-ceiling disappearing?* New Delhi: Oxford Press India.

Ganley, C. M., George, C. E., Cimpian, J. R. & Makowski, M. B. (2017). Gender equity in college majors: Looking beyond the STEM/Non-STEM dichotomy for answers regarding female participation. *American Educational Research Journal 55*(3), 453-487. DOI:10.3102/0002831217740221.

Goetz, T., Bieg, M., Ludtke, O., Pekrun, R. & Hall, N.C. (2013). Do girls really experience more anxiety in mathematics? *Psychological Science 24*, 2079-2087.

Good, C. D., Rattan, A. and Dweck, C. S., (2012). Why do women opt out? Sense of belonging and women's representation in mathematics. *Journal of Personality and Social Psychology, 102*, 700-717. DOI: 10.1037/a0026659.

 UJH is published under the Creative Commons License of Attribution & Noncommercial ***(CC BY-NC)***

Hango, D. (2013). *Gender differences in science, technology, engineering, mathematics and computer science (STEM) programs at university*. Statistics Canada, Ottawa (ON), Catalogue no. 75-006-X, 2013.

Keller, E. F. (1995). *Reflections on gender and science*. New Haven, CT: Yale University Press.

Kolmos, A., Mejlgaard, N., Haase, S. & Holgaard, J. E. 2013. Motivational factors, gender and engineering education. *European Journal of Engineering Education 38*(3), 340-358. DOI: 10.1080/03043797.2013.794198.

Lippa, R. A. (2010). Sex differences in personality traits and gender-related occupational preferences across 53 nations: Testing evolutionary and social-environmental theories. *Archives of Sexual Behaviour* 39, 619–636. doi:10.1007/s10508-008-9380-7.

MATRIX (2018). *Women in STEM. MATRIX position paper*. Dublin: Northern Ireland Science Industry Panel.

McDaniel, A. (2015). The role of cultural contexts in explaining cross-national gender gaps in STEM Expectations. *European Sociological Review 32*(1), 122-133. DOI: 10.1093/esr/jcv078.

McMaster, N. C. (2017). Who studies STEM subjects at A level and degree in England? An investigation into the intersections between students' family background, gender and ethnicity in determining choice. *British Educational Research Journal 43*(3), 528-553. DOI:10.1002/berj.3270.

National Science Foundation (2015). *Bachelor's degrees awarded, by sex and field: 2002–2012*. Retrieved from http://www.nsf.gov/statistics/2015/nsf15311/tables/pdf/tab5-1.pdf.

National Science Foundation. (2013). *Women, minorities, and persons with disabilities in science and engineering: 2013 (NSF 13-304)*. Arlington, VA: Author.

National Bureau of Statistics (2018). *2017 statistical report on women and men in Nigeria*. Abuja: National Bureau of Statistics.

Ndirika, M. C. & Agommuoh, P. C. (2017). *Investigating factors influencing girl's participation in science and technology education in Nigeria*. *IOSR Journal of Research and Method in Education, 7*(3), 50-54.

OECD (2017). *Education at a glance 2017: OECD indicators*. OECD Publishing. DOI: 10.1787/eag-2017-en

Parson, L. (2016). Are STEM syllabi gendered? A feminist critical discourse analysis. *The Qualitative Report* 21(1), 102-116. Retrieved from https://nsuworks.nova.edu/tqr/vol21/iss1/9

Perry, M. J. (Nov. 26, 2018). *Gender gap in STEM? Women are majority of STEM grad students and they earn a majority of STEM's bachelor's degrees*. Retrieved from http://www.aei.org/publication/gender-gap-in-stem-women-

 UJH is published under the Creative Commons License of Attribution & Noncommercial ***(CC BY-NC)***

are-majority-of-stem-grad-students-and-they-earn-a-majority-of-stem-bachelors-degrees/

Reinking, A. & Martin, B. (2018). The gender gap in stem fields: Theories, movements, and ideas to engage girls in STEM. *Journal of New Approaches in Educational Research* 7(2), 148-153

Reuben, E., Sapienza, P. & Zingales, L. (2014). How stereotypes impair women's careers in science. *Proceedings of the National Academy of Sciences 111*(12), 4403–4408. DOI:10.1073/pnas.1314788111

Spencer, S. J., Steele, C. M. & Quinn, D. M. (1999). Stereotype threat and women's math performance. *Journal of Experimental Social Psychology 35*(1), 4-28.

Stoet, G., Bailey, D. H., Moore, A. M. & Geary, D. C. (2016). Countries with higher levels of gender equality show larger national sex differences in mathematics anxiety and relatively lower parental mathematics valuation for girls. *PLoS ONE 11*(4), e0153857. DOI: 10.1371/journal.pone.0153857

Stoet, G. & Geary, D. C. (2018). The gender-equality paradox in science, technology, engineering, and mathematics education. *Psychological Science 29*(4), 581–593. DOI:10.1177/0956797617741719.

Su, R., Rounds, J. & Armstrong, P. I. (2009). Men and things, women and people: A meta-analysis of sex differences in interests. *Psychological Bulletin 135*(6), 859-884. doi:10.1037/a0017364.

UIS (2019). *UIS data centre*. Montreal, UNESCO Institute of Statistics. Retrieved from http://data.uis.unesco.org/

UNESCO (2010). *Women's and girls' access to and participation in science and technology*. Paris: UNESCO and DAW.

Wang, M. T., Eccles, J. S. & Kenny, S. (2013). Not lack of ability but more choice: Individual and gender differences in choice of careers in science, technology, engineering, and mathematics. *Psychological Science 24*(5), 770-775.

Weber, K. (2012). Gender differences in interest, perceived personal capacity, and participation in stem-related activities. *Journal of Technology Education 24*(1), 18-33.

Weisgram, E. & Diekman, A. (2015). Family friendly STEM: Perspectives on recruiting and retaining women in STEM fields. *International Journal of Gender, Science and Technology 8*(1), 38-45.

Wood, W. & Eagly, A. H. (2012). Biosocial Construction of Sex Differences and Similarities in Behaviour. In J. M. Olson & M. P. Zanna (eds.), *Advances in Experimental Social Psychology, 46* (55-123). Burlington: Academic Press.

 UJH is published under the Creative Commons License of Attribution & Noncommercial ***(CC BY-NC)***