

'Gendered' hard Core Sciences in a Male World-Across ODL and non-ODL institution.

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Abstract

There has been a lot of concerns over the years on gender differences in enrolment into the hard core science, technology, engineering and mathematics, with men clearly predominating. This is supported by research reports linking the low enrolment of female students to proximity to institutions, learning styles, gender stereotypes and bias. If institutional proximity is one of the limiting factors then one would expect a rise in the female students enrolment in the sciences from ODL (that are accessible) and Non ODL(traditional) institutions that were also shut down during the COVID pandemic. It became important therefore to look at the gendered science in the male world especially during this period. Four Institutions including ODL and non ODL in two countries were selected based on convenience and easy access to data. For a comparative analysis, only programs run in sciences for two sessions across the institutions were considered according to gender using quantitative analysis. The result except in a particular non ODL institution supported previous studies of having more females in life sciences and males dominating the hardcore sciences. The life sciences and Mathematics recorded an increase in female students in the non ODL institution and a decrease in ODL institutions for the period under review. However information technology and computer science gave an increase in enrolment of female students In ODL institutions during the period. One is also tempted to infer from the results that the flexibility and accessibility of ODL bringing education to the door steps of learners may have encouraged more female students into delving into one of the hardcore science (IT and computer science) but not all. Since this is only a case study, it cannot be generalized.

Introduction/Background

There has been continuous emphasis in researches over the years on gender differences that includes gender gaps in mathematics and science (Darcy Hargo 2021, Jenming et al 2020, Okeke 2019, Ogunsola- Bandele 1996,2000, 2001,2003,2010). This uneven distribution in gender according to Nassi-Calo (2020) can be clearly seen amongst academics in the fields of hard science, technology, engineering and mathematics, with men clearly predominating.

Junming, Alexandra, Sinatra & Albert (2020) also provided empirical evidence that suggests significant gender differences in the total productivity and impact of academic careers across science, technology, engineering, and mathematics (STEM) fields. This gender difference has been affecting the quantity and quality of scholarly activity of women who already suffer from gender gap and biases in science world despite their crucial contribution to social development. (Hajar Sotudah & Nahid Khoshian 2014).

In Scotland, Telima (2020) also carried out an analysis of enrolment and attainment in core science subjects of biology, chemistry and physics by gender. The study found gross under representation of girls in physics and called for a need for further research work on the persistent under representation of girls despite all efforts by the government to correct the imbalance.

In Canada Darcy Hargo (2021) reported that although women represent the majority of young university graduates, they are still under represented in the field of technology, engineering, mathematics and computer science (STEM). Even in choice of academic disciplines, women despite their mathematics ability are not likely to choose the STEM programs. The report further stated that the National Household Survey (NHS), found that women accounted for 39% of university graduates aged 25 to 34 with a STEM degree in 2011 compared with 66% in non STEM degree programs. That is Canada like other countries elsewhere in the world have women still less likely to choose a career in STEM areas, especially in engineering, mathematics and computer science. This contrast with disciplines such as health and social sciences where women represent the vast majority of graduate. But the question keep coming up-why are women shying away from STEM programs?

Lucie Judy (2021) published the statistic showing the total number of students enrolled in postsecondary institutions in Canada in the academic year 2018/19, distinguished by gender and field of study in 2018/2019. From the statistics, 27.9% of females against 72.1% male enrolled in Mathematics, computer and information science, While the reverse was the case with the humanities having more females (59.8%) against males (40.2%)

Within the Nigeria context, are various reports on the gender disparity in favour of male against female students which constitutes a major characteristic of science and technology education. (Okeke, 2019; Ogunsola-Bandele 2003). The researchers claim that at all levels of the educational system, male students in science and technology-based programmes outnumbered the female. Infact the gendered science in a male world has long been expressed by high school students (ogunsola-Bandele 2001). This was so prominent in the use of computers (Ogunsola-Bandele 2003) and gender differences in the way they prefer to learn (2009, 2010). The questions then was: Is the presentations of these hard core sciences to learners not gender friendly?

Further question by Chaochao Jia et al (2020) also tried to find out if boys' superiority in science learning is a myth or a reality? This latter question that produced different answers from different

researchers led Chaochao et al 2020 to investigate the gender differences between boys and girls in science performance in China. The concern was that if gender differences do not exist, then educators should discard their belief about boys' superiority. But on the contrary, if there are significant gender differences in learning science, then the education profession should take up the responsibility to enable boys and girls to fulfill equally their cognitive potential in science.

Nassi-Carlo (2015) reported a study by Sarah-Jane Leslie in the USA in which evidence was made that women are present to a lesser extent in fields in which it is believed that academic brilliance and innate talent are the major prerequisites, rather than hard work and dedication. According to the authors, women are taught from childhood to believe in this distinction, which can discourage them from following a career in academic disciplines such as physics, engineering and mathematics. Given that women are frequently viewed as negative stereotypes in this regard. As expected, the study showed an inverse correlation between the disciplines which value innate talent and the number of women represented in them. Considering the importance given to mathematical skills for one to be successful in STEM, for example, it would be interesting to see if this skill is considered an innate aptitude. If so, one would expect a lower representation of women in the fields in which mathematics plays a central role which, according to the study of Leslie et al, is what actually happens.

But if regardless institutions based in developed or underdeveloped countries, past studies still reported that women were less likely than men to enter and complete a STEM university program due to gender differences in mathematical ability—a prerequisite to success in these fields of study or innate talent, family responsibility and stereotype, then it might be important to also consider stay home factor when most institutions cancelled all in-person and change to virtual learning in all disciplines including the STEM disciplines, Could there be a rise in the science female students enrolment who now learn at the comfort of their homes?

Sample

Two leading ODL and two Non ODL universities in two different countries were selected from the several around the world based on convenience and easy access to data. This became necessary since these are easily accessible to the two authors and will also provide a comparative data from developed/undeveloped countries.

The two Universities in Canada are based in one of the northernmost cities. With both having students population of over 40,000. While the non ODL institution established in 1908 is a public research university among others, the ODL institution was the only public university in charge of on-line delivery. The delivery mode includes individual study with course materials, collaborative study using the Moodle learning management system and group study. It has three other campuses.

Similarly the two Institution (ODL and non ODL) institution in Nigeria are based in the northern part. The leading ODL institution is the only institution in Nigeria that offers single mode of distance learning and has several study centers scatted around. It currently has over 100,000 active students. The non ODL institution on the other hand is one of the traditional universities and was established in 2002 with enrolment of over 20,000 students,

To be able to make a comparative analysis as regards the four institutions, only programs run in the sciences across the institutions were considered. Although there is a great disparity in enrolment within these institutions, the use of percentages gave a levelling ground.

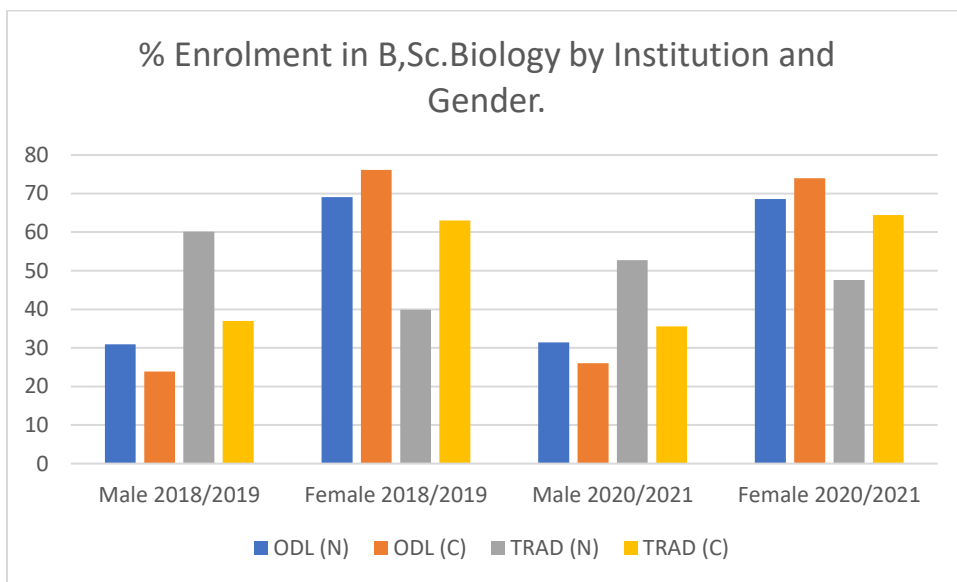
Methodology

The enrolment statistics for the four institutions for two consecutive years were taken into consideration. The year presiding and during the COVID pandemic (2018/19 and 2020/2021). Four programmes in the faculty of science were found comparable in the two institutions, which are: Bachelor of Science in Biology, Mathematics, information technology and Master’s in information technology/system. it was noted that some nomenclatures are slightly different for instance-B.Sc. Mathematics and B.Sc. Applied Mathematics. The enrolment in each programme was categorized according to gender. Quantitative analysis in percentages was used for each program and represented virtually in bar diagrams.

Analysis/Results

Table 1. Percentage Enrolment in B.Sc. Biology by Gender and Institutions.

B.Sc Biology/ Institutions	Male 2018/2019	Female 2018/2019	Male 2020/2021	Female 2020/2021
ODL (N)	30.9	69.1	31.4	68.6
ODL (C)	23.9	76.1	26.0	74.0
TRAD (N)	60.1	39.9	52.7	47.6
TRAD (C)	37.0	63.0	35.6	64.4



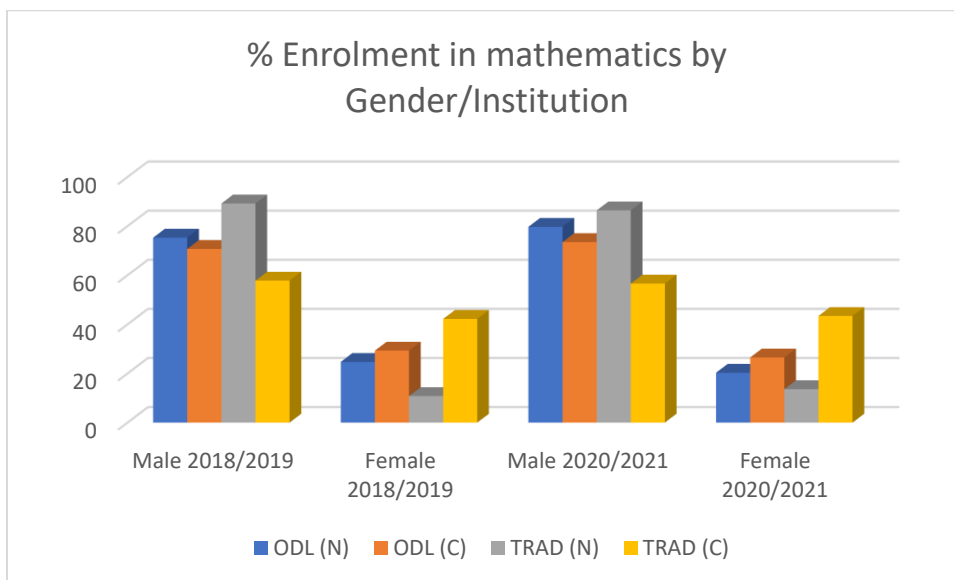
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From the results for Bachelor of Science -biology, it could be seen that there is an increase in enrolment with the female having a greater percentage except for the Non ODL institution in Nigeria that records a higher percentage of the males over the females. The male to female ratio in the three other universities

is over 1:2 for the two sessions under consideration. The highest percentage of females recorded was in the ODL institution in Canada, followed by ODL institution in Nigeria . While the least recorded percentage of females was in the conventional (Traditional) institution in Nigeria. The result of having more females in the three universities inclined to Biology than the male students supported previous studies reviewed.

Table 2. Percentage Enrolment in B.Sc. Mathematics by Gender and Institutions.

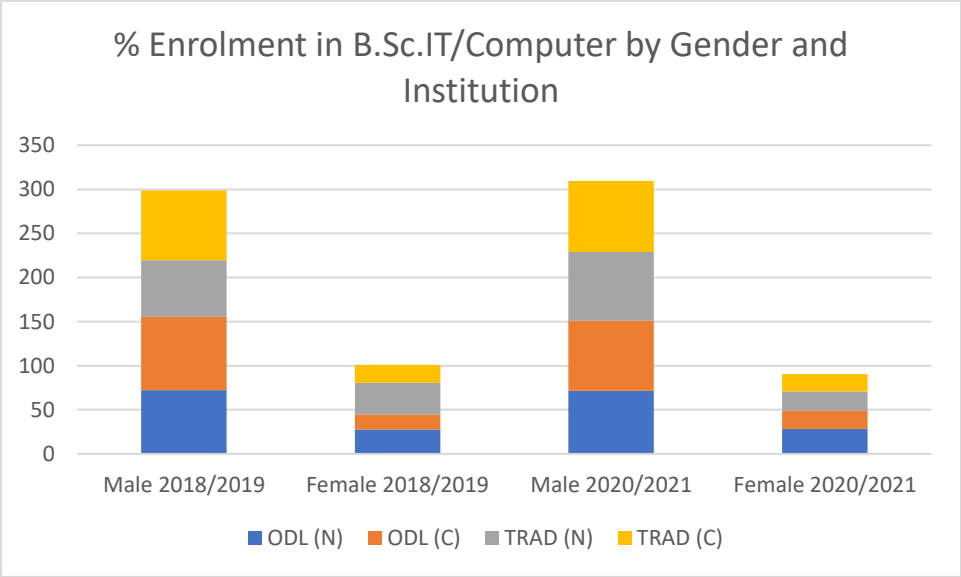
	Male 2018/2019	Female 2018/2019	Male 2020/2021	Female 2020/2021
ODL (N)	75.3	24.7	79.7	20.3
ODL (C)	70.7	29.3	73.5	26.5
TRAD (N)	89.2	10.8	86.4	13.6
TRAD (C)	57.8	42.2	56.6	43.4



The B.Sc. Mathematics analysis revealed a greater percentage of males than females in the four universities during the period. Infact the ratio of Male: Female is about 3:1 in the ODL institution in Nigeria and Canada while an alaming ratio of male to female 8:1 and 6:1 was gotten in the trad. University in Nigeria. However, it can be seen that despite the lower enrolment in biology (39.9 and 47.6) this is still higher than 10.8% and 13.6% for mathematics over the period. For the ODL institutions, instead of the expected rise female enrolment n mathematics, there is a decrease. The statistics gotten for 2018/2019 for the ODL institution in Canada (70.7males to 29.3 Females) in mathematics is in line with Lucie Judi (2021) report of post secondary institutions in Canada having 72.1% male to 27.9% females in mathematics.

Table 3. Percentage Enrolment in B.Sc. Information Technology/Computer science by Institution and Gender

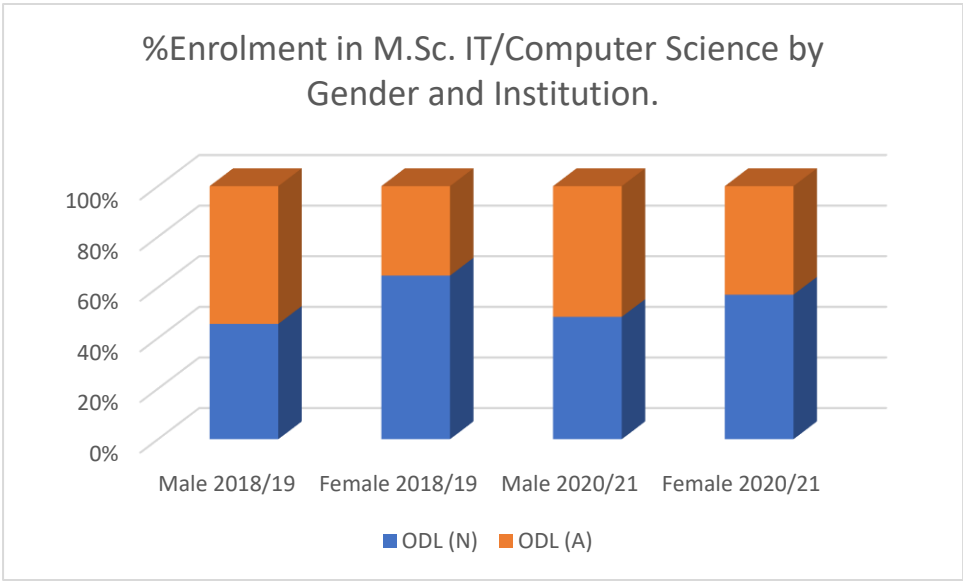
	Male 2018/2019	Female 2018/2019	Male 2020/2021	Female 2020/2021
ODL (N)	72.2	27.8	71.7	28.3
ODL (C)	83.2	16.8	79.3	20.7
TRAD (N)	64.1	35.9	78.1	21.9
TRAD (C)	79.4	20.6	80.6	19.4



The results as regards enrolment in B.Sc IT and computer science also shows a greater percentage of almost 3:1 in favour of the males in the said period in the ODL institutions. It could also be noted that the expected rise in female enrolment in the ODL institutions during this period was gotten while there was a decline in male enrolment. The traditional non ODL institutions however recorded decrease in female enrolment. Although the ratio of M:F 2:1 or 3: 1 in all the institutions, but the fact that there was an expected increase in female enrolment in ODL institutions could be a way forward. The percentage of male (79.4%) and 20.6% of females in the traditional university in Canada supports the Lucie Judi in (2021) report of 27.9 female to 72,1% male in Information Technology and computer science.

Table 4. Percentage Enrolment in M.Sc. Information Technology/System by Institution and Gender.

	Male 2018/19	Female 2018/19	Male 2020/21	Female 2020/21
ODL (N)	70.0	30.0	78.3	21.7
ODL (C)	83.6	16.4	83.7	16.3



With the increase in female enrolment gotten at the undergraduate level for information Technology and computer science for ODL institutions, It became necessary to find out if this trend is sustained at the higher level. From the results there was a decline in female enrolment and an increase in the male enrolment during the said period

Discussions:

The results gotten from this study has provided more evidence to support the claim of previous studies (Chaochao Jia et al 2020, Okeke, 2019; Ogunsola-Bandeled 2003, *Darcy Hango* 2021, of having more male and female studens in hardcore sciences with a reverse of more females to male students enrolled in life sciences except in a particular case. The result except in that particular non ODL institution supported previous studies of having more females in life sciences and males dominating the hardcore sciences. The life sciences and Mathematics recorded an increase in female students in the non ODL institution and a decrease in ODL institutions but information technology and computer science gave an increase in enrolment of female students In ODL institutions during the period. One is also tempted to infer from the results that the flexibility and accessibility of ODL bringing education to the door steps of learners may have encouraged more female students into delving into one of the hardcore sciences and not all. Infact that they could have their computers in their homes could homes to work on during the shut down could have caused the increase in enrolment. However, this is only a case study that cannot be generalized.

It is also important to note research study of Leslie (2015) reported by Carlo that tied gender difference in mathematics ability to gender differences in STEM disciplines. This has been supported in this study by the high ratio up to 8:1 in favour of males. Some other researches have argued that these differences

could be traced to the homes where the girl child starts with playing with doll toys and the male child has the hard toys. According to the Leslie (2015), women are taught from childhood to believe in this distinction of academic brilliance and innate talent which can discourage them from following a career in academic disciplines such as physics, engineering and mathematics . Given that women are frequently viewed as negative stereotypes. But if this stereotypes been found to be one of the underlying factors for these differences across institutions regardless of either developed or underdeveloped, then it would be interesting to have a long span case study research of changing the girl child role to the male child and vice versa to investigate the choice of subjects as the years go. This research would take a long time and effort but may be worth it!

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