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Female Graduation Rate in STEM Programs in Tertiary Education: The Case of the Gulf Cooperation Council Countries (GCCs)

George K. Fomunyam

Durban University of Technology

georgek@dut.ac.za

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Abstract **- There is increased demand for professionals with science, technology, engineering and mathematical (STEM) skills globally and with the advent of the fourth industrial revolution, it is expected that there will be new jobs which requires new skills. It is therefore imperative that there are increased demands in enrolment and graduation rate in STEM programs so as to curtail the disproportionality between current skills and the skills that are vital for the future. The study focused on the percentage of graduates from STEM programmes in tertiary education in the GCCs who are women. Data from World Bank provided insight into the graduation rate in STEM programs. Findings from the study revealed that the higher education landscape in the Gulf Cooperation Council (GCC) has had significant development over the past two decades and one of the things that made this possible is the revenues from oil and gas exports and the diversification into the knowledge driven economy. It was also found out that females are important in STEM programs, and this was considered from a human, scientific and development perspective. The study recommended that that there should be intensification of effort on females transiting from the universities into employment to encourage sustainability and contribute to the sustainable development goals (SDGs).**

Index Terms **- female, graduation rate, Gulf, STEM, STEM programs, tertiary**

INTRODUCTION

This STEM is an acronym for science, technology, engineering and mathematics and there is increased demand for professionals with science, technology, engineering and mathematical (STEM) skills globally and with the advent of the fourth industrial revolution, it is expected that there will be new jobs which requires new skills. It is therefore imperative that there are increased demands in enrolment and graduation rate in STEM programs so as to curtail the disproportionality between current skills and the skills that are vital for the future. The times we are in is also a period of massive change along political, economic, social, technology, environment and legal paradigm which requires new skills to address the changes.

With these changes, the world has become more complex, and it necessitates that people be equipped with a new set of core knowledge and skills that are vital for solving various problems that befalls the world. Evidence from labour market data revealed that the major cognitive knowledge, skills, and abilities that are in sync with STEM education are in high demand in all sectors and positions (Carnevale, Smith & Melton, 2011: Rothwell, 2013)

Globally, it has been revealed that only 35% of students in higher education that are into STEM fields are women. This statistic shows a dearth in female participation in STEM studies which has various consequences on development. With the importance of STEM education crucial for addressing changes in all sectors of life, female participation must be encouraged to ensure that there is inclusion and diversity while also focusing on sustainability which is pivotal for overall growth and development in any nation. Also, the 2017 UNESCO cracking the code report showcased disparity in girls and boys educational and career expectations, gender prejudice in the teaching sphere and the dearth of female role models in STEM programs. The persistent inequities in access, participation and graduation rate in STEM programs are manifested along racial, socioeconomic, gender and geographic lines and the Gulf cooperation council countries (GCCs) are not exempted from this.

This study will focus on percentage of graduates from Science and Technology programmes in tertiary education who are females. The countries are Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates. Data gotten from the World Bank (2021) would be applicable in providing insight into percentages of graduates from science and technology programmes in the Gulf cooperation council and the study would begin by providing insight on tertiary

education in the Gulf nations, understand the relevance and opportunities of STEM education.

An Insight Into The Current State Of Higher Education In The Gulf Nations

There has been various transformation along the higher education line in the Gulf Cooperation Councils (GCC) and key among this transformation is that prior to the late 1990s, the major tertiary educational institutions in the region were public universities which were under the direction of national governments (Madichie 2015). This shows that the higher education domain in time past in the Gulf Cooperation Council was chiefly under the control of the government but as times changed and things got better, there are now investment made in the higher education landscape by private entities. Like other sectors of the economy, the higher education landscape in the Gulf Cooperation Council (GCC) has had significant development over the past two decades and one of the things that made this possible is the revenues from oil and gas exports (Hayes & Al'Abri, 2019). As a result of the revenues from oil and gas exports in the Gulf Cooperation Council (GCC), there has been increased investment in K-12 and higher education which was done with the aim of increasing access to and quality of education in the countries. Though, there is a degree of specificity in investment in higher education in the Gulf Cooperation Council Countries (GCCS), the level of investment was dependent on how wealthy a nation is and some features that are applicable to all include drive towards equality and diversity in higher education, creation of technical and vocational education and training (TVET) programs and newer support for research and innovation (Madichie 2015).

With the knowledge that dependence on oil might not last for long and as a result of the global financial crisis of 2008, and the instability in some of the countries then, there was the need to have an overhaul to their reform efforts (Hayes & Al'Abri, 2019). There was now the plan to have a developed and well-educated population that will help transform their knowledge into productive output for the society at large. Globalisation and internationalisation drive globally also helped this effort and there has been intensification of efforts on advancement in knowledge transfer and mobility of students across national borders across the Gulf. With this, there has been quite an increase in the number and diversity of institutions and educational programs that are available in the Gulf nations. To achieve this, there has now been effort towards ensuring massive access to higher education and increasing higher education differentiation (Madichie 2015). With the rise of the knowledge economy, various contribution has made to societal development, and this is manifested in various magnificent edifices towering across the educational cities in the region which shows that education can contribute to a vibrant economy.

Exploring The Relevance And Opportunities Of STEM Education

STEM education has various applications, relevance and opportunities which are crucial and confers many advantages on people, nations, and systems. The times we are in is one of great changes which are seen across all sectors and with this, there are enough challenges now which will be more grievous in the future. So, the world needs new knowledge that will culminate into new solutions to overcome the challenges of the world. The old system of knowledge cannot appropriately provide solution to the challenges that befalls the world, so we need the knowledge of STEM to achieve this. Much more than this, there are other relevance's and opportunities in STEM education which needs to be considered.

There are various conceptions of what STEM really is and one of the most important modern conceptions of STEM education is the purposeful integration of various disciplines in solving real-world problems (Labov, Reid, & Yamamoto, 2010; Sanders, 2009). This opinion suggests and intentionality and purpose behind the teaching and practice of STEM education and the purpose typifies that there must be a goal in mind while teaching and practicing STEM education. Another factor that lends more credence to it is the integration of various disciplines which is applicable in solving real world problems. STEM is an educational perspective that sees various disciplines in science, technology, engineering, and mathematics as one entity and by this synergy, STEM professionals follow an integrated approach in their practice which offer better understanding of the various scientific, mathematics, technology and engineering design and application.

Bailey et al (2015) and Betrus (2015) argue that learning and practicing STEM education can reinforce student's zeal and passion for inquiry, discovery and fostering skills which includes persistence, teamwork, and the use of knowledge gained for new ventures and situations. With this type of knowing, a growth mindset is encouraged in students, and they become more open to learning, desirous and curios about providing solution to various challenges they encounter on their way and for the society at large. Apart from this, there is demonstrated ability for resilience and tenacity for academic pursuit and future learning in a world that is constantly changing (Dweck, Walton, & Cohen, 2014; Sharples, 2000). It is important to note that learning do not just take place, it is done with intentionality and the teacher delivers lessons to the students while the students willingly accept what is taught with an end in mind. There must be a change happening in the life of the learners which are the students, and the change must be that there are noticeable differences in the life of the students which is manifested in their attitude, knowledge, and skills.

With STEM education, such drive is encouraged and learning and practicing it results in the creation of new

knowledge applicable for solving challenges and addressing various concerns.

The United States demonstrated much commitment to STEM education as evidenced in the steps taking by President Obama to encourage the learning and practice of STEM education. Some of these actions include Every Child Succeeds Acts (ESSA), the president made an initiative tagged computer science for all initiative and there was competitive priority to prioritize STEM education which is necessary for providing well rounded education for all students. Education in its real sense is all encompassing and does not only influence the learning sphere. Education must reflect in all that revolves around man, and these are the outlook, manner of communication, lifestyle, appreciation of life, worldviews, and ideologies etc. With these myriads of factors which can be likened to context or prevailing condition in which man thrives, he is trained to be better in all facets of life which STEM education encourages. With STEM providing the opportunity to access the sciences, social sciences, literature, the arts, physical education and health, new language etc., the development of skills that will make the individual learner a perfect and complete man is encouraged. Therefore, man being a figure in the society and inhabiting a territory influences his social sphere by deploying these skills for productivity and for betterment of his world.

As revealed by the United States Department of Education Office for Civil Rights' (2014), STEM disciplines have been noted to be the gateway to Americas perpetual economic competitiveness and national security which will result in admission to higher education and higher standards of living for the country's underrepresented populations. This is another dimension where STEM education offers relevance and opportunities and from the point above, it is a portal or gateway for continuous economic competition and national security which the United States typify. Therefore, STEM has the potency for significant and increased economic progress in countries where it is sufficiently embraced, the United States being a major example. By the concerted action on STEM education in countries of the world, new skills tailored to meet the challenges of the now and the future are developed which also results in newer ventures and industries crucial for economic growth and development.

Evidence from data gathered has revealed that the major set of cognitive knowledge, skills and abilities that are necessary for STEM education are in high demand in all job sectors and business (Carnevale, Smith, & Melton, 2011; Rothwell, 2013). And this presents an opportunity to have an overhaul in educational policies to plug into these opportunities that the job and business sector offers. With the fourth industrial revolution on course, some skills are vital for the moment and the future and these skills, STEM education offer.

This will ensure that people have the right knowledge and skills necessary to thrive in a rapidly changing workplace and the society at large. To confer vocational goals, there is the need for STEM education and the vocational goals are those that have relation to deficiency in science and engineering disciplines. With the learning and practice of STEM education, there is the creation of a pathway to a brighter future which helps in unearthing a myriad of interesting and exciting career opportunities (Central Office of Information, 2008). This implies that STEM education has the capacity to develop in people the skills they need to have a better transitioning and positioning career wise, and this opens them to the myriads of opportunities in their career path. With this, there is the development of the necessary competence and experience, better career, upward social mobility, and a positive effect on the society at large. There is the need for a major supply of scientists, engineers, technologist, and mathematicians according to the Department for Education and Skills (2006) and how these supplies will be filled has become an issue of concern to various government of the world, hence, the interest in STEM education. The 21st century is peculiar as a result of the grand challenges it suffers and key amongst this is the environmental concern manifesting as climate change globally. There is therefore the need for more investment in STEM education to address these concerns and others that the world faces now and in the future and major amongst this include the developing of clean sources of energy that reduces reliance and use of fossil fuel and also finding cures for diseases (The White House, 2010).

Female Graduation Rate In STEM Programs In Tertiary Education In Gulf Nations

Data gotten from World Bank provide deep inside on female graduation rate in STEM programs in tertiary institutions in the Gulf Cooperation councils (GCCs). In Bahrain, findings indicate that in 2003 female graduation rate was 50% which thus increased in the year 2005 to 53.78%. going forward from this, in the year 2006 and 2014, there was a decline in female graduation rate from 45.93% to 42.56% (World Bank, 2021). The general trend revealed that female graduation rate peaked in the year 2005 and suffered a decline thereafter. Bahrain has high female graduation rate in STEM from the chart below and this can be attributed to various efforts by the government of the country to encourage women participation in all sectors of the society which include the Bahraini government support for women in all fields, especially after establishing the Supreme Council for Women in 2001 upon Amiri order No. 44 which was amended by the Amiri Orders No. 55 in 2001, No. 2 in 2002, and the Royal Decree No. 36 in 2004 (SCW, 2021). According to Ahmed (2007) women in Bahrain were the first in the Gulf Cooperation Council (GCC) to receive education and to be appointed to senior positions in the country.

This typifies the commitment made by the government towards female education which has culminated in them occupying major positions in the country. Some of the positions held include first woman minister and ambassador

(Glosemeyer, 2006). Also, it has been reported that Bahraini women have demonstrated efficiency and resilience in some disciplines such as engineering (BNA, 2017).

In Kuwait, on the other hand, findings indicated that female graduation rate in STEM programs in tertiary education and in the year 2013 was 28.17% (World Bank, 2021). Lauren Maffeo (2013) revealed that Kuwait is tilting towards equality with near parity at 49%, and girls have now overtaken boys in engineering subjects. This typifies increase in female graduation rate in STEM programs which will confer many benefits on the country going away from patriarchy and from a gendered perspective.

The UAE on its part which is a federation of seven emirates findings revealed that between 2011 and 2014 graduation rates have been fluctuating. In the year 2011, the female graduation rate in STEM programs was 41.60% which is below average which then increased in the year 2012 to 45.80%. There was a subsequent decline afterwards and the female graduation rate in STEM program declined to 41.48% in 2013 and 39.57% in 2014. With UAE being an oil and gas industry tilting towards knowledge economy, innovation, tourism, science and technology, STEM is crucial for its continuous growth. Ridge (2010) argued that female Emiratis make up about 70% of the higher education population while the male Emiratis have lower levels of achievement and higher dropout rate. The graduation rate of female in STEM in tertiary education in UAE is quite commendable and according to the World Economic Forum`s 2015 Global Gender Gap Report (Al Hinai, 2019), the UAE has been reputed to be a leading country in gender equality in the region. The government of UAE has made various efforts at encouraging women participation in STEM program which has culminated in high female graduation rate in STEM. Some of these include establishment of Dubai women establishment (DWE) which promotes gender equality within the GCC countries.

Saudi Arabia has a unique educational system in that it is the only Islamic country which has a separate and unique system for male and female education. In Saudi Arabia, there has been a steady increase in female graduation rate in STEM programs in tertiary education, although the numbers started declining in 2010. Female graduation rate in STEM programs in tertiary education for the year 2003 was 16.09% which increased till the year 2007. With the oil wealth and lifestyle changes, this might have encouraged the need to have more females in STEM education. As a result of the influx of female American oil workers driving cars and shopping unveiled, this display of freedom (Doumato, 2010) led Saudi women to agitate for the same right and this would have encouraged the increase in female graduation rate in STEM programs in the kingdom.

The graduation rate in STEM education increased to 39.23% in the year 2004 and then 40.27% in the year 2005. The increase continued in the year 2006 to 49.37% which peaked in the year 2007 at 57.88%. There was a decline in the female graduation rate in STEM programs in tertiary education in the year 2008 to 57.47% which increased slightly to 57.49% in the year 2009. The female graduation rate in STEM programs in tertiary education declined in the year 2010 to 38.00% and 36.87% in the year 2011 which later increased in the year 2012 to 39.75% and reduced to 38.92% in the year 2013. What necessitated the increase in female graduation rate in STEM in tertiary education can be attributed to so many factors which include government commitment to education in general. It has been observed that the government of Saudi Arabia allocates over 25% of the total budget for education which also include vocational training and the government spends about 13.17billion US Dollars on all educational activity. According to MoFA (2017) about 8% of the adult population in Saudi Arabia were literate in 1970, this increased to 94.4% by 2014. This typifies concerted effort by the government to improve education generally which will have a bearing on female graduation rate in STEM. Also, as power changed hands in Saudi Arabia and crown prince Mohammed bin Salman emerged the kingdoms ruler in 2015, he has made effort at some liberal reforms in Saudi Arabia and with the implementation of various initiatives since the launch of the 2030 vision, there has been the aim of engaging 30% of Saudi women in the workforce (Kinninmont, 2017). With the recognition that Saudi women are vital for economic, political, and social development of the kingdom, there has been various effort to increase their participation and hence the increasing number of Saudi women graduating from universities. Culturally, from a tender age, females in Saudi are taught their role is to be a wife and mother thus taking good care of the home (Hamdan, 2012b) but has changed lately and as a result of liberal policies under the new ruler, more females are getting involved in STEM education.

In Oman findings revealed an increase in female graduation rate in STEM programs in tertiary education and in the year 2007 graduation rate was 44.06% which increased to 45.86% in the year 2009 and peaked in the year 2010 at 49.58%. Female representation in science program has been revealed to be strong in Oman (Charles, 2011) and hence, the high rate of female graduation in STEM programs in tertiary education which has been on an increase.

There has been a decline in female graduation rate in STEM programs in tertiary education in Qatar over the years. In the year 2003, the female graduation rate in STEM programs in tertiary education was 47.36% which peaked in the year 2007 at 57.74%. There was a decline afterwards and in the year 2008, 2009, 2010 and 2011, the female graduation rate in STEM programs in tertiary education declined to 53.86%, 48.51%, 43.73%, and 25.07% respectively.

There was increase in the female graduation rate in STEM programs in tertiary education in the year 2012 at 31.01% and 33.97% in the year 2013.

Conclusion And Limitations

It has been observed that the Gulf Cooperation Councils (GCCs) are tilting towards the knowledge economy due to the knowing that their dependence on fossil fuel might not be sustainable in the long run, and this has encouraged them in equipping women with knowledge and skills in science, technology, engineering, and mathematics which is important in realizing the full potential each country in the council has to offer. Much more than this, there will be contribution to an interconnected world, better lives and much growth and development in the countries. This paper revealed that that Science, Technology, Engineering, and Mathematics (STEM) Education is the central element to achieving a knowledge-based economy and the knowledge gained from STEM is expected to influence the overall facet of the society. The third MDG was to promote gender equality and empower women but was not achieved by any country. Consequently, gender equality is currently goal number 5 of the United Nations 2030, Sustainable Development Goals (SDGs) (United Nations, 2017a). It can be said that the Gulf Cooperation councils are making giant strides towards aligning with these goals and from the graduation rate in STEM programs, it is obvious that there has been much commitment into female education in the countries as evidenced in the chart. This paper therefore recommends that that there should be intensification of effort on females transiting from the universities into employment to encourage sustainability and contribute to the sustainable development goals (SDGs).

The findings discussed in this paper, as limited due to the availability of data in the set region. And since data is often published late, more recent data on the graduation rates is these countries are not available. Further research must be conducted in due course to ensure that the progress of these countries with respect to STEM education is understood.

References

[1] Al Hinai, M. (2019). The UAE's empowerment of women is an example for the world to follow. Entrepreneur Middle East, 7. available at: www.entrepreneur.com/article/329624

[2] Alblooshi, H.A. and May, L., (2018). Engaging women to study STEM through empowerment: A case from the United Arab Emirates (UAE). In 2018 IEEE Aerospace Conference (pp. 1-5). IEEE.

[3] Bailey, A., Kaufman, E., & Subotic, S. (2015). Education, technology, and the 21st century skills gap. Retrieved from https://www.bcgperspectives.com/content/articles/public_sector_education_technology_twenty_first_century_skills_gap_wef/

[4] Betrus, A. (2015). Through STEM education our future is bright. Retrieved from http://www.fourthcoastentertainment.com/story/2015/08/01/entertainment/through-stem-education-our-future-is-bright/242.html

[5] Blickenstaff, J. C. 2005. Women and science careers: Leaky pipeline or gender filter? Gender and Education, Vol. 17, No. 4, pp. 369-386. DOI: 10.1080/09540250500145072

[6] Carnevale, A., Smith, N., & Melton, M. (2011). STEM. Washington, DC: Georgetown University Centre on Education and the Workforce. Retrieved from http://cew.georgetown.edu/stem

[7] NAGANTHAN, E., 2020. Efficient Graph Structure for the Mining of Frequent Itemsets from Data Streams. International Journal of Advanced Computer Engineering and Architecture, 5(2), pp.279-281.

[8] Central Office of Information (2008) DCSF appoints agencies for STEM. London: The National Achieves

[9] Doumato, E. A. (2010) Getting God's ear: Women, Islam, and healing in Saudi Arabia and the Gulf. Columbia University Press.

[10] Dweck, C. S., Walton, G. M., & Cohen, G. L. (2014). Mindsets and skills that promote long-term learning. Seattle, WA: Bill & Melinda Gates Foundation.

[11] European Commission. (2012). Meta-analysis of Gender and Science Research. Luxemburg, European Union.

[12] Hayes, A., & Al'Abri, K. M. (2019). Regional solidarity undermined? Higher education developments in the Arabian gulf, economy, and time. Comparative Education, 55(2), 157-174.

[13] Hamdan, A. (2012b) 'The Role of Authentic Islam: The Way Forward for Women in Saudi Arabia', Hawwa, 10(3), pp. 200-220

[14] Kinninmont, J. (2017) Vision 2030 and Saudi Arabia's Social Contract: Austerity and Transformation. Chatham House, UK: The Royal Institute of International Affairs.

[15] Labov, J. B., Reid, A. H., & Yamamoto, K. R. (2010). Integrated biology and undergraduate science education: a new biology education for the twenty first century? CBE Life Science Education, 9, 10–16.

[16] Maffeo, L. (2013). Saudi girls are more likely to study science than American girls. Here's why. PolicyMic.com.

[17] Lee, H. and Pollitzer, E. 2016. Gender in Science and Innovation as Component of Inclusive Socioeconomic Growth. A Gender Summit® Report. London, Portia Ltd.

[18] Madichie, N. (2015) An Overview of Higher Education in the Arabian Gulf. International Journal of Business & Emerging Markets, Vol. 7, No. 4, pp. 326-335

[19] Marginson, S., Tytler, R., Freeman, B. and Roberts, K. 2013. STEM: Country Comparisons. Report for the Australian Council of Learned Academies (ACOLA). Melbourne, ACOLA.

[20] Pollock, A., Macaulay, A., Önkal, D. and Thomson, M., 2020. A Trading Application Using Empirical Directional Probabilities: GBP/USD. Chinese Journal of Decision Sciences, 1(1).

[21] Köseo, S. and Barut, M., 2020. MARKET EARNINGS RISKS AND SPILLOVER EFFECTS IN TRAMP SHIPPING INDUSTRY. International Journal of Data Modelling and Knowledge Management, 5(1), pp.17-33.

[22] Charles, M. (2011). What gender is science? Contexts, 10(2), 22-28.

[23] MoFA (2017) Saudi Arabia and Political, Economic & Social Development. KSA: MoFA. https://www.saudiembassy.net/sites/default/files/WhitePaper_Development_May201 7.pdf (Accessed: 26th December 2017).

[24] Ridge, N. (2010). Teacher quality, gender, and nationality in the United Arab Emirates: A crisis for boys. Dubai: Dubai School of Government.

[25] Rothwell, J. (2013, June). The hidden STEM economy. Washington, DC: Brookings. Retrieved from https://www.brookings.edu/research/the-hidden-stem-economy/

[26] Sanders, M. (2009). STEM, STEM education, STEM mania. Technology Teacher, 68(4), 20–26

[27] SCW. 2021. The Council. https://www.scw.bh/en/AboutCouncil/Pages/History.aspx

[28] Sharples, M. (2000). The design of personal mobile technologies for lifelong learning, Computers & Education, 34, 177–193. Retrieved from https://www.tlu.ee/~kpata/haridustehnoloogiaTLU/technolohiesforlifelong.pdf

[29] The White House (2010). Educate/innovate campaign, excellence in science and technology. Retrieved from http://www.whitehouse.gov/the-press-office/presidentobama-launches-educate-innovate-campaign-excellence-science-technology-en on Feb 1, 2010.

[30] U.S. Department of Education, Office for Civil Rights. (2014). Civil Rights data collection: Data snapshot: College and career readiness (Issue Brief No. 3). Washington, DC: Author. Retrieved from http://www2.ed.gov/about/offices/list/ocr/docs/crdc-college-and-career-readiness-snapshot.pdf -

[31] UNESCO. (2017). STEM and Gender Advancement (SAGA). http://www.unesco.org/new/en/natural-sciences/priority-areas/gender-and-science/improvingmeasurement-of-gender-equality-in-stem/stem-and-gender-advancement-saga/ (Accessed 1 May 2017.)

[32] UNESCO. 2018. Cracking the code: Quality, gender-responsive STEM education. Paris: UNESCO.

[33] Walby, S. (1990) Theorizing patriarchy. Oxford: Basil Blackwell Ltd.

[34] World Bank (2021). Percentage Of Graduates from Science and Technology Programmes in Tertiary Education who are Female. Washington DC: World Bank. https://ourworldindata.org/tertiary-education