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Encouraging Women and Girls in Stem in Nigeria for Sustainable Development

(A Keynote Speech)

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Abstract

STEM education has taken a role of prominence in many countries, where the leaders are trying to figure out how to appropriately grow the economy and create a sustainable future. With this in mind, one of the most important things that can be done regard to STEM to address many of the United Nations's Sustainability Goals is to provide more assistance to get young people involved who may not have been involved before such as girls. This is particularly true in countries like Nigeria, where there are many young people, where there is opportunity for growth, and where the government seems to understand its role. With this in mind, this speech provides a framework through which one can understand the challenges of STEM education in reference to girls in Nigeria for sustainable development.

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Introduction

Worldwide many nations have looked at methods to solve the issue of involving their entire population in Science, Technology, Engineering and Math fields. The world is moving to digitisation of information, monetary systems and farming. In terms of politics, economics, and social issues, the future belongs to those who know how to use mathematics and the sciences in order to solve problems. With this in mind, nations are undertaking a variety of efforts with the hope of bolstering the abilities of their own citizenry. In so doing, they are hopeful that their citizenry can benefit, and that society at large will be better and able to achieve new things. Importantly, many countries in Africa have invested more money in education generally and in STEM education specifically. Nigeria is one of those countries, as both foreign sources and domestic funding has been used to generate more opportunities for students. This has, of course, been supported by the business world in Nigeria because of the belief that the country's education system needs to be modernised in order to combat the challenges facing it in the so-called knowledge economy. Here, we will assess the strengths of these efforts, comparing the work done in Nigeria to the work done elsewhere in this regard.

Background and Perspective

As responsible researchers in any field we should first acknowledge our own biases and explore our own way of viewing the world. With this in mind, I have taken the opportunity to examine my own potential biases in researching this topic. While I am invested personally in the development of the sciences, this should not influence my ability to conduct the research in a way that is reasonable.

My sincerest thanks go to the RAGA 2018 Conference Local Organising Committee for extending the invitation to me. I am very passionate about encouraging girls and women in STEM. As an astronomer this is something I have run into time and time again. I expanded out my activism to include all areas of STEM. I also expanded my expertise from the school where I work to include my larger community. Today I expand that to include Nigeria. I am a learner, so when asked to speak at this conference and write a paper, I searched many papers and books on Nigeria. With this in mind, a big part of

what I bring to the table here is the broad view of what is happening in Nigeria in the context of the rest of the world, as well as an understanding of which future opportunities may exist for Nigeria moving into the future. I ask in return that you critically evaluate my ideas and keep what is useful to you, build on it and share your perspective on educating Girls and Women in STEM with me.

My father was in the STEM field, and he had four daughters. He encouraged each of us to go into STEM and take care of ourselves. He pushed us not to think about our lives in terms of who we were going to marry, but rather, what things we could do to change the world. To live the lives that we chose and contribute to society. My sister Natalie is an Accountant, Georgia is a Nurse, I am an Astronomer, and Samantha is a surgeon. When I was in graduate school, I fell in love with teaching, and I soon found that not every student had had the same opportunities and encouragement that I had the benefit of hands on learning. With this in mind, there may be some ways in which I am biased toward learning the sciences, but this will not impact my ability to identify opportunities for growth in Nigeria.

Nigeria: Land of Opportunity

I had typical stereotypes of Nigeria in my mind when I received the invitation to speak at this conference, and my fellows subsequently reacted with incredulity when I informed them. Is this invitation an internet scam? Are you sure you will be safe? After doing my research, I found that here in Nigeria was exactly where I need to be. I know you are all here because you know this, but please humor me.

You have a new democracy that is primed to provide the same opportunity to all of your citizens. The government is not only growing in size, but it is growing in terms of its scope and ability. This presents plenty of potential upside that you all will be able to take advantage of in the years to come.

Nigeria is incredibly young right now, especially in comparison to the rest of the world. While many countries might be aging, and they are dealing with the effects of this, many hold that Nigeria is suffering from a “youth bulge.” For instance, of your more than 180 million citizens, more than half of them are under the age of 30. This presents an amazing opportunity for Nigeria. Holding this large percentage of the world's young population, if these people are given

the chance to succeed in science, then they can help make Nigeria a place where innovation comes to grow (Okeke *et al.*, 2017).

Your population is largely untapped. Most people do not have a chosen career field nor do their parents have a skill or trade to pass down to them. Due to changes in major fields, it is important to develop new skills and competencies. The oil industry in Nigeria has long been such an important player for driving growth in the region. However, that industry is slowly and surely drying up. The world is changing, with sustainable technology becoming more important today than ever before. This leads to important questions. As people become less reliant on oil, and as the Nigerian oil industry runs into uncertainty, what is next? Where will the skilled people in this industry go for work? Where will those skilled people who could work adjacent to the oil industry go to work next?

You are traditionally a patriarchy. This is really not different than most of the world. But many of your compatriot countries have systems in place that are very established that silently discriminate against women and those from disadvantaged backgrounds. I know because I was in one such system. While women were allowed to do everything, some things were made more difficult for us. The numbers at increasingly higher levels of education reflect this.

With this in mind, you have the opportunity now to start from the bottom and create a system that captures all youths not just the males. You have the opportunity to be the world leader in science and technology by including women. A population that no country has yet taken full advantage of. Your industries know this. They want to employ the best regardless of gender. For example the Next Einstein Forum was disappointed in the number of female entrants for their Einstein contest, and so put out a call specifically requesting female entrants. This resulted in more women seeking out the opportunity (PR Newswire, March 8, 2016). There are women in Nigeria who want to grow in this knowledge and become better. They want to be the future.

We all know that a society benefits when all members can participate. The education of women here in Nigeria has been shown to lead to better health outcomes for children. With this in mind, an important question has to be asked. How do we establish a system now that is inclusive of girls and women? We know that just building a system that is how it was always done does not work. We know simply providing “equal” access does not work. We know that

you cannot grow into a system that was not built for you. One way to understand the situation in science education is through the so-called “leaky pipeline.” There is inadequate representation of women in the sciences at the highest levels. Beyond that, the opportunities for women at the lowest levels are lacking. At every level of the pipeline, there are leaks, and this leads to fewer women being elevated into important positions at the end of the day. It is an issue that can be fixed and should be fixed moving forward.

Policy Solutions

What can we do policy wise to support our girls and women in STEM? It begins with taking that extra step to hire female workers and support them in the workplace (Eraikhuemen & Oteze, 2015). It continues with family friendly policies for all workers, male and female. This can improve the work lives of women and show them that the STEM world is there for them to provide opportunities rather than barriers. When men are able to take family leave and care for a newborn, they are able to bond with the child and play a greater role in the parenting so that home life is more evenly shared between the genders. This sort of equality affirms organizations and improves the lives of the people who happen to work in these.

Getting Girls into STEM

When we put out competition advertisements, we can make sure to specifically target groups that we know tend to be under represented, such as women and girls, and demand to have equity in our applicant pools. The Airbus foundation holds workshops specifically aimed at girls called “The Airbus Little Engineer,” where girls are introduced to various airplane parts and encouraged to do teamwork to solve a problem (This Day Live, May 9, 2018). However, as with almost every good idea, there were some problems that kept this from being as good as it might have otherwise been. Namely, they ran into the issue of not having the internet connection to run the workshop and not having a suitable replacement. The responsibility is on all of us to make sure that these good opportunities and programmes do not fall by the wayside because of things that might have been fixable and preventable. The government needs to invest in infrastructure for a sustainable pipeline of talent.

Speaking of that government, there is a lot to know about what the Nigerian government can do to improve the opportunities for young people in the sciences. The government has not been slack in this regard. In fact, the Nigerian government has implemented competitions to encourage young people in STEM. In 2018, the Ministry of Science and Technology offered a N1million reward to the best overall student in the Young Nigerian Scientist Presidential Award. (Nigerian Tribune, February 19, 2018) They also provided laptops to the runners up. There is an understanding on the part of the government that the youth in Nigeria can lead the way, bringing the country into the modern era.

The Nigerian National Petroleum Corporation offers a quiz competition. It has done so for two decades, urging young girls to get out and participate in this sort of thing. In addition, at the ceremonies, the achievements of girls in the competition were highlighted and the need to encourage such behavior was emphasised.

There has also been some partnership with big companies that can potentially provide assistance in getting young people involved;the credit card giant MasterCard is in the game with their initiative G4T or Girl4Tech. While it is worldwide, Emma Okonji, Vice President and Area Business Head, created a hands on inquiry based workshop that shows the many facets of STEM fields.(Africa News Service, May 9, 2018) It showcases the MasterCard payments technology and uses current employees and mentors. This particular effort focuses on coding as understanding a computer language, which in turn allows girls to engage with technology from a ground up perspective.

Perhaps, the next step involves getting more people involved in the lives of those young people who are showing promise when it comes to this kind of education. Nigeria is known as a country where communities and families are a pillar. They are the support systems through which young people grow, as they rely on the assistance of others to help them through. This means that perhaps the best solution for Nigeria is involving the whole family in whatever is going on. Getting parents to encourage their children in something that they have never done can help to move society as a whole forward.

Supporting Girls and Women in STEM

While some of the solutions are big and broad, others require us to shift our focus right here, locally. We can do this by making sure that we are buying and hiring tech locally. Nigeria has a wealth of tech start-ups. If your company needs some programming done, you can hire a Nigerian. If your website needs to be hosted, you can hire a Nigerian. These businesses are out there, and they just need to be noticed in order to move forward.

We can look at ways to make sure that all students are supported all the way in their education. One of the existing issues is that many students just do not have the financial support to see their way through education. They begin, learn some skills, and then have to drop out because they do not have the money to finance it. This can be a major problem on the whole because it drains the economy and society of the talent that would have otherwise existed. We can ensure that these future leaders are not abandoned by putting into place programmes to support them (Khan & Rodrigues, 2017).

What we start, we should finish. For example, just this May, the International Center For Investigative Reporting found that the Akwa Ibom Top Science College was not maintaining the campus facilities due to a lack of funding (I reports, 2018). Students were forced to purchase materials on their own and live in conditions not conducive to learning. The college was built in 1986, but funding had dwindled and so that there was no money for upkeep and the needs exceeded the abilities of the students to do on their own. When we make these pushes for new facilities and systems, we need to make sure we have also included funding for the future, so that our endeavours are in vain. We also show those students who would like to pursue opportunities that we are very serious about what we are doing in STEM. Often, it is taking the first step in the process that is critical for allowing these students to explore their motivations and make good on their talents.

It is important that we think of new ideas rather than just falling back on the same old things that have been done in the past. This means that we cannot do what we have done. Student debt is not the answer. Around the world, and particularly in the US where I am, debt has been a bad thing for many students, limiting their options after college. It is creating the kind of crisis that may eventually fall the economy. Currently we limit opportunities for students in higher education due to cost. Students must finance their own education and often go very far into debt to do so. I do not have answer here, but perhaps

one of you does. It is important that we are constantly thinking in a forward-facing manner.

Pedagogy Solutions

Once we get girls and women in the STEM classroom, we need to make sure we are teaching using the tools that we know will reach them and keep them pursuing a career in STEM to the highest levels. To create a sustainable future we also want to be sure that we give these girls in STEM the tools to address the United Nations Sustainability Goals.

Contextualisation

Luckily, one of the teaching strategies that have been shown to have greater results for retaining women and girls in STEM also proves of greater benefit to the entire community. This is what we should seek—those solutions that affirm society as a whole while also boosting groups that have been marginalised in the past. That is the contextualisation of learning. Handled a problem in the community, girls and women are more likely to see the utility of pursuing careers in the STEM fields. To date some of the STEM problems solved in Nigeria by girls and women include issues with water quality, issues in engineering, and much more. Wherever there is a problem, there is a woman who is applying new learning to solve it.

One of the ways that I have seen this in my own work is with the exploration of the universe through telescopes. In my labs I take real data, freely available from telescopes across the world and ask my students to make a real-life discovery and contribute to what we know about the universe. It is amazing to see how engaged girls become when they understand how their project will benefit humanity. I had three women present at the Society for Astronomical Sciences Symposium 2018 in Ontario, CA as a result of running a course where they got hands on.

We must be willing to connect our students with the world around them so that they see that what they are learning can truly have an impact on those around them. With this in mind, it is critical that you involve your students in public outreach. It is never too early to teach students to give back. My students may not prioritize their own learning, but when charged with teaching others they will go above and beyond. In the meantime, they accidentally learn the

material. For example, my school runs the very successful Festival of Tales. My astronomy students are very creative about how to convey science material to the 3,000 young people and their families that attend this event. Topics that they have taught before include marshmallow constellations.

Active Learning

Active Learning has been shown to increase scores for all genders and ethnicities and further it has been found to effectively level the playing field, reducing the score difference between genders and ethnicities. In graduate school, I had direct contact with one such programme. I was a teaching assistant in a physics lab for biological science majors. The students were required to discover through prompts the laws of the universe on their own. There are multiple ways for the students to come to these conclusions and all students experience the uncomfortable feeling of not knowing the right answer.

When the content is broken down into smaller chunks, and students are requested to test their knowledge, it creates better results. Students who fall behind and don't speak up are rescued. Another way that I do this is with multiple choice questions in my lectures. All students must consider the content and compose a response. I am able to visually see how much the class has retained and how much I need to reconsider what I have done.

Social Learning

Girls and women tend to do better when the class looks at the whole person and discussion and socialisation is encouraged. Tools such as the One Minute Paper allow students to process their thoughts around a subject at an individual level and discuss them as a larger group. This will allow the group to process struggles as a team.

Speaking the Right Language

Teaching STEM content in the native language of the student assists in the student seeing STEM as for them (Babaci-Wilhite, 2017). As a part of their world not as a part of a different culture. This of course requires working within the local community. This adds the benefit of creating STEM jobs locally. A great example of this is the telescope in South Africa that held a naming competition for their new telescope. The telescope was named Lesedi, as pupils

were given a chance to play a role in this. It helped to create engagement and excitement for the process. A second example that I frequently encounter in the Physics and Math classrooms is the use of contextualised word problems. Math and physics problems are frequently generic enough that many situations can be applied to them. So the names of people may be changed to those common in the native language of the student. The math problem can be based around the purchase of common staples of the native culture and physics problems can be contextualised to a common household responsibility of the student. This not only reduces a barrier of understanding for the student, but hopefully places a recall when they go about their daily life that Math and Physics are relevant to their lives and are useful tools.

Authentic Role Models

Role models have been shown to positively affect girls and women in STEM fields. The key variables to make a mentorship programme work is to make sure that the mentors have an understanding of the challenges faced by the people under their charge. Those mentors have to be available and willing to work closely with the mentees. By exposing the mentees to new ideas and environments, it is easier to help them succeed.

Partnerships

Future Opportunities

Exchanges for US citizens in the Sciences to Nigeria, currently many in the arts. We need to expand these exchanges to include Science, Technology, Engineering and Math. A Paper by Okeke *et al.* in CBE – Life Sciences Journal makes recommendations to include the participation of Africans in Science globally. Their paper points out that this under representation in the world leads to the 90/10 gap where only 10% of the funding for global health research goes to 90% of the population. Nigeria needs a voice in global science to eliminate such gaps. We need to bring the science to Nigeria so that Nigerian scientists can benefit from this proximity. One such example would be, inviting me to this conference. I am so grateful to the planning committee because I am so excited to be here in such a place of potential for girls and women in STEM. I hope to learn much from you in my time here and that you find value in the perspective that I bring to you.

Conclusions and Questions

How can we build in Nigeria the best ever STEM education system that brings parity for women and girls? How do my ideas resonate with you? Are some of these things ideas that you think you can apply? In reality, there is so much talent in Nigeria right now that it should be easy to work with these young people. They are there and they are excited to get involved. With so many young people who are so anxious to get involved, can we not do our part to ensure that they have proper opportunities? If we can, then Nigeria can be a model for development in STEM education the world over.

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