INCLUSIVE EDUCATION: THE GENDERED PERSPECTIVE IN MAKING THE STEM DISCIPLINE AVAILABLE TO ALL

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Abstract
Inclusive education is educating ALL students in age-appropriate general education classes in their neighbourhood schools, with high quality instruction, interventions and supports so that all students can be successful in the core curriculum. Inclusive education is not just about including children with special needs, but about including all children. Inclusive education is being interpreted in this paper to mean the education of all students including girls, especially in the Science, Technology, Engineering and Mathematics (STEM) disciplines. Getting girls to finish primary education and providing them with fair opportunities to complete secondary school is a priority in UNICEF's Gender Action Plan. UNICEF helps countries build stronger education systems that deliver quality education to boys and girls. These include removing gender stereotypes from learning materials, teaching teachers about gender, helping schools and governments use learning assessment data, and providing communities with key data so they can hold education systems accountable. Making sure that national education plans and policies consider gender is key to ensuring that girls and boys enter and succeed at school. In this paper, the concern is not only on girls' general education but in their education in the area of Science, Technology, Engineering and Mathematics (STEM). This paper will therefore address issues of how girls will be adequately and effectively included in the STEM disciplines. The barriers hindering their full participation in STEM will be highlighted and measures that had worked in ensuring removal of these barriers, thus ensuring inclusiveness will be discussed.

Introduction

Inclusive education is when all students, regardless of any challenges they may have, are placed in age-appropriate general education classes that are in their neighbourhood schools to receive high quality instruction, interventions, an supports that enable them to meet success in the core curriculum (Bui, Quirk, Almazan, & Valenti, 201d0; Alquraini & Gut, 2012). Around the world, children are excluded from schools where they belong because of disability, race, language, religion, gender, and poverty. But every

child has the right to be supported by their parents and community to grow, learn, and develop in the early years, and, upon reaching school age, to go to school and be welcomed and included by teachers and peers alike. When all children, regardless of their differences, are educated together, everyone benefits—this is the cornerstone of inclusive education. Inclusive education also means different and diverse students learning side by side in the same classroom. They enjoy field trips and after-school activities together. They participate in student government together. And they attend the same sports meets and plays.

Inclusive education values diversity and the unique contributions each student brings to the classroom. In a truly inclusive setting, every child feels safe and has a sense of belonging. Students and their parents participate in setting learning goals and take part in decisions that affect them. And school staff have the training, support, flexibility, and resources to nurture, encourage, and respond to the needs of all students. Successful inclusive education happens primarily through accepting, understanding, and attending to student differences and diversity, which can include the physical, cognitive, academic, social, and emotional. This is not to say that students *never* need to spend time out of regular education classes, because sometimes they do for a very particular purpose—for instance, for speech or occupational therapy. But the goal is this should be the exception.

The driving principle in inclusive education is to make all students feel welcomed, appropriately challenged, and supported in their efforts. It is also critically important that adults are supported, too. This includes the regular education teacher and the special education teacher as well as all other staff and faculty who are key stakeholders; and that *also* includes parents. In the case of females and STEM, even the laboratory assistants have to be carried along and appropriately trained on strategies that makes for inclusion.

Why Inclusion?

Inclusive systems provide a better quality education for all children and are instrumental in changing discriminatory attitudes. Schools provide the context for a child's first relationship with the world outside their families, enabling the development of social relationships and interactions. Respect and understanding grow when students of diverse abilities and backgrounds play, socialize, and learn together. Education that excludes and segregates perpetuates discrimination against traditionally marginalized groups. When education is more inclusive, so are concepts of civic participation, employment, and community life

1. Research tells us when all children are included in a class, they learn more.

Studies carried out with learning disabled children reveals that the percentage of courses students with learning disabilities take in general education classrooms is related to both their academic performance and their social adjustment at school. However, having access to the general education curriculum means more than simply being present in a general education classroom; it means that students' educational programs are based on the high expectations that each student will contribute to society and that students with disabilities receive the supports needed to benefit from instruction. The same scenario plays out when all children are allowed to study in the same classroom to acquire STEM skills. In individual studies, thirty years of research show that when students with disabilities are included in regular classrooms, all students learn and achieve more. The same applies to all forms of learning, STEM inclusive. When they are included, students with disabilities have greater access to the general education curriculum

- more time "on task"
- more academic gains
- more progress on literacy skills
- increased communication skills
- improved social skills
- improved IEPs
- more friendships

2. Inclusion leads to lower rates of suspension and drop out, and to higher rates of completion.

When the outcomes of 11,000 students with a range of disabilities were examined, it found that more time spent in a general education classroom was positively correlated with fewer absences from school, fewer referrals for disruptive behavior, and better outcomes after high school in the areas of employment and independent living (Wagner, Newman, Cameto, & Levine, 2006). By searching through ERIC, several studies can be found that link inclusive education experiences to postsecondary education, career and technical education, employment, and other adult outcomes. These outcomes include performance in community living and work contexts, interactions with schoolmates and co-workers, independent participation in naturally-occurring activities, and quality and size of a natural support network. These findings are true for individuals with learning disabilities as well as those who require significant and life-long supports. It can also be deduced that this will be true

of all students being encouraged to learn and engage in STEM discipline under the same environment.

3. It is a civil right and the socially just thing to do.

The implication here is that Education is the right of every student. Every child should therefore be given same opportunity to learn under the same condition.

What Strategies can be beneficial in an Inclusive classroom?

Advocates of inclusive classrooms have suggested some strategies that will be most beneficial in a inclusive classrooms. These include

1. **Use a variety of instructional formats.**

Start with whole group instruction and transition to flexible groupings which could be small groups, stations/centers, and paired learning. With regard to the whole group, using technology such as interactive whiteboards is related to high student engagement. Regarding flexible groupings: for younger students these are often teacher-led but for older students, they can be student-led with teacher monitoring. Peer-supported learning can be very effective and engaging and take the form of pair-work, cooperative grouping, peer tutoring, and student-led demonstrations.

2. **Ensure access to academic curricular content.**

All students need the opportunity to have learning experiences in line with the same learning goals. This will necessitate thinking about what supports all individual Students need, but overall strategies are making sure all students hear instructions, that they do indeed start activities, that all students participate in large group instruction, and that student's transition in and out of the classroom at the same time. For this latter, not only will it keep students on track with the lessons, their peers do not see them leaving or entering in the middle of lessons to be pulled out, which can really highlight their differences.

3. **Apply universal design for learning.**

These are methods that are varied and that support many learners' needs. They include multiple ways of representing content to students and for students to represent learning back, such as modelling, images, objectives and manipulatives, graphic organizers, oral and written responses, and technology. These can also be adapted as modifications for students with sight or other problems where they have large print, use headphones, are allowed to have a peer write their dictated response, draw a picture instead, use calculators, or just have extra time.

Now let's put it all together by looking at how a regular education teacher addresses the challenge and succeeds in using inclusive education in her classroom.

The basic elements of inclusive education in a regular classroom

- **Use of teaching assistants or specialists:** These staff have the potential to be inclusive or divisive. For instance, a specialist who helps teachers address the needs of all students is working inclusively. A specialist who pulls students out of class to work with them individually on a regular basis is not.
- **Inclusive curriculum:** An inclusive curriculum includes locally relevant themes and contributions by marginalized and minority groups. It avoids binary narratives of good and bad, and allows adapting the curriculum to the learning styles of children with special education needs. It does not over emphasis male or female images.
- **Parental involvement:** Most schools strive for some level of parental involvement, but it is often limited to emails home and occasional parent–teacher conferences. In a diverse school system, inclusion means thinking about multiple ways to reach out to parents on their own terms.

To make inclusive education a reality we need to do the following:

- ensure that educators have the training, flexibility, and resources to teach students with diverse needs and learning styles
- ensure that schools receive adequate and sustainable financial support so that all activities and services are fully inclusive
- empower parents to assert their children's right to education in inclusive settings
- enable the entire community—including mainstream and special educators, social workers, parents, and students—to work together and participate in the design, delivery, and monitoring of education, thereby reframing inclusive education as a shared responsibility
- hold governments accountable for implementing antidiscrimination legislation, legal mandates for inclusion, and policies to remove barriers

Girls Education: Why do we need girls to be educated?

Why do we have to single out the education of girls as an issue that needs special attention when we discuss inclusive education?

Education empowers girls to change the world.

Globally, there are more than 1.1 billion girls in the world today. They are part of a vibrant generation poised to take on the future. Investing in their education frees them to reach for their dreams. It allows them to build better lives for themselves and contribute to the health, safety and prosperity of their families, communities and the world. We know that investing in girls secondary education, not just primary, has benefits that change not only families, communities, but economies.

For example:

- If all women had a secondary education, there would be 49 per cent fewer child deaths

- If all women had a secondary education in sub-Saharan Africa and South and West Asia, child marriage would drop by 64 per cent

- Investing in girls so they can complete the next level of education could lead to lifetime earnings of up to 68 per cent of annual gross domestic product. (UNICEF, 2017)

Why are girls out of school?

We have made great strides in primary education. But we need to make sure that education does not stop there for girls. Half of the world's out-of-school children are girls and 32 million girls who should be in lower secondary school are actually out of school.

- The reasons are many. Too often families favour boys when investing in education. Poverty compound factors such as child marriage, early pregnancy, child labour, house work, cost and distance keep girls out of school. In addition, some schools do not meet the needs of adolescent girls in terms of safety, available water and sanitary facilities, quality of education or relevance of the curriculum to girls' lives. Gender-based violence also robs girls of education.
- We need to provide every girl with the quality education she needs to succeed in life.

Despite legislative attempts to eliminate gender stereotyping from society, the propensity to evaluate people on the basis of their sex remains a pernicious social problem. There is a critical interplay between cultural and cognitive factors in the establishment of stereotypical beliefs, and the extent to which culturally transmitted colour–gender associations

Why single out the STEM discipline?

Why is it necessary to single out the STEM discipline when we talk about the education of girls and women? The reasons are many but we will give some of them to buttress the case being made here.

- Enrolment of women in science, technology, engineering, and mathematics (STEM) majors is disproportionately small and declining. (Morganson 2010)
- Women have achieved substantial success in postsecondary education for the past few decades (Buchmann, DiPrete, and McDaniel, 2008). However, women do not enjoy the parallel success in STEM fields, including science, technology, engineering, and mathematics. While women have surpassed men in college attendance and completion rates, women received only 19 percent of bachelor's degrees in engineering, and 19 percent in computer science and 21 percent in physics in 2007 (NSB,2010). JerryJacobs (1995) has termed the persistent underrepresentation of women in certain STEM fields as "the most stubborn basis for gender segregation."
- Whereas women are attending college at unprecedented rates and constitute more than half of university and college populations, they continue to be underrepresented in science, technology, engineering, and mathematics (STEM) fields (Nzewi 2014) The decline in STEM enrollments along with retention problems raise concerns about the "shrinking" and "leaking" pipeline, the metaphor most often used to describe declining enrollments and the differential retention of women in STEM fields (Major & Morganson, 2008). As enrollments of women in STEM majors continue to decline, the pipeline "supplying" them to these fields is said to be shrinking (Okeke 2010). College-age women have been reported to be less likely to major in STEM fields and to be retained at a lower rate than are men (Nzewi 2014). When women complete undergraduate training, they continue to be underrepresented in and are more likely to leave the workforce than are men (Nzewi, 2014). .

To buttress these points, the two figures that follow illustrate the representation of young girls in the STEM discipline at the Undergraduate level. As these women mature to get into the job market/employment, the number dwindles as shown by the number of women who take up lectureship jobs.

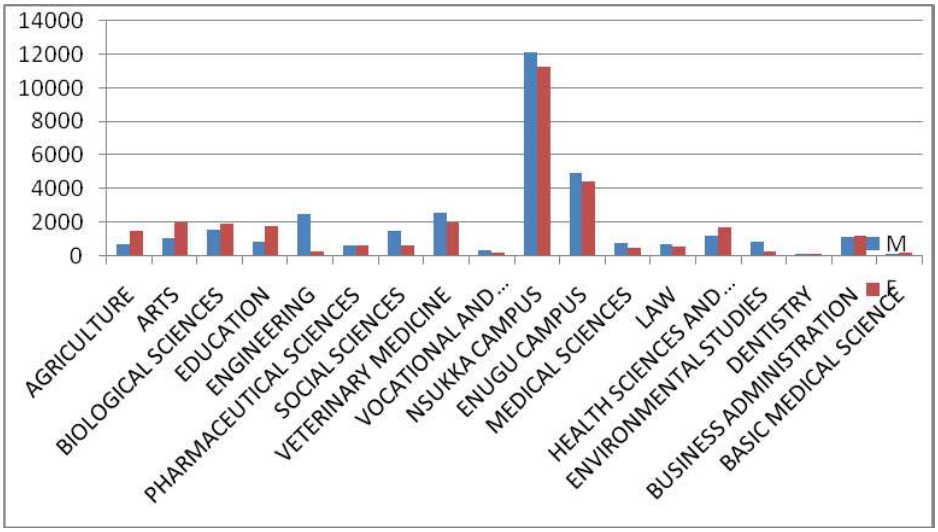

Fig 1: Student's enrolment by faculty (UNN) 2016/2017 session

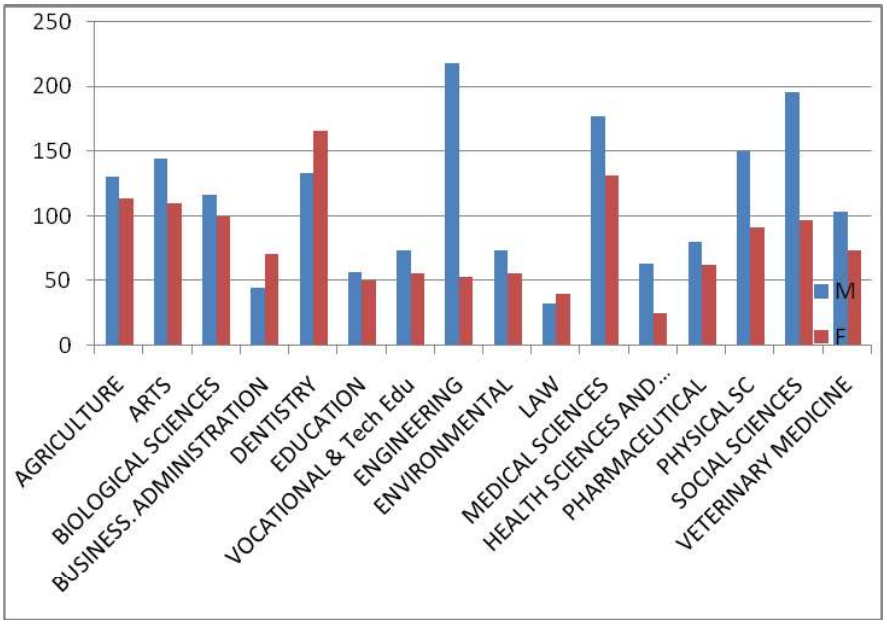

Fig 2: Staff gender by faculty (UNN) 2015/2016 session

Barriers to women engagement in STEM

The STEM environment is often characterized as a chilly climate, which tends to be male-dominated, highly impersonal, and individualistic (Suresh, 2006). The lack of support in the traditional STEM environment may be particularly harmful to women given that researchers and theorists (Fletcher, 2004; Jordan, Kaplan, Miller, Stiver, & Surrey, 1991) have repeatedly emphasized the importance of relationships and interpersonal connections to women's psychological development and well-being.

Some scholars have identified numerous barriers to the success and persistence of women in STEM curricula, including lack of viable mentors, low self-efficacy, and the glass ceiling effect. In the next section, we want to look at these factors from two perspectives; the school factors and the non-school factors.

Factors that negatively influence Female Participation and Performance in Science & Technology

The non-school factors and the school factors.

Non- school factors

a) Child rearing practices

Child rearing practices in different part of the world especially Nigeria especially in Igbo land, contribute to the values held by girls as to what they can do and what they are to be in life. Often one can hear parents using certain adjectives to describe their children. These adjectives betray their belief of the personality characteristics of their children. For example the words **hard, strong, independent, daring etc.** may be used to describe a boy's behaviour, while **soft, fragile, dependent, fearful, and weak**, qualify girls' behaviour**)**

Sex role stereotyping: This may be regarded as the most critical of all factors that affect/influence female participation and achievement in Science and Technology (S&T), since it appears to be the root of most of the other factors**.** Sex role stereotyping is the socio-cultural classification of human activities by sex in line with what the society considers as appropriate for one sex or the other. The arbitrary arrogation of roles to either of the sexes has given rise to the masculine image of Science and Technology. These disciplines are seen as male domain. Consequently females' upbringing tends to shape them away from S&T, which are socio-culturally considered inappropriate for them. Right from the homes, dolls are bought for girls with the accompanying dressing kits and baby girls are encouraged to care for and pamper their dolls.

School Factors

1. **The nature of Science:** Science is often represented as abstract and it employs methods that disembody objects and matter in order to study them. This contrasts with the worldview of women that is more person-centred. Women are more often than not concerned with the context of an activity than the inherent processes. Thus, they are responsive to their environment and social responsibilities. Women usually operate within the concrete world in their day-to-day life, thus they apply other ways of knowing and solving problems other than those espoused by science, which most often is abstract theorizing. If Science is presented as a whole and in relation to how it will affect life, women will do very well and will want to remain in it. This is a challenge for teachers.
2. **Gender bias in curriculum materials:** Science and Technology materials used in Nigerian classrooms are grossly gender biased in favour of males and decisively against the females. (Erinosho, 1997). The content of textbooks have been shown to be biased in favour of males in terms of language used in communicating the ideas contained in the books, the illustrations, pictures, and examples. The activities depicted in the texts are male oriented. Studies done outside Nigeria have also shown that school science material such as textbooks, bulletin board display and software programmes demonstrate male biases. (Njoku, 2000).
3. **Science Teaching Strategies Used by S&T Teachers (Teachers' classroom behaviours):** Pedagogically, it is believed that healthy academic competition among students would enhance achievement; hence teachers tend to sustain academic competition in their STEM classrooms. However it has been found through research that not all the learners benefit in a competitive learning environment. Female students loose out in a competitive academic environment. They prefer cooperative academic environment for their optimal performance (Okeke 2000; Nzewi & Osisioma, 2000). And yet most of what goes on in S&T classrooms are competition-based.
4. **Teacher Expectation of Female Students:** Dueto sex role stereotyping it is generally believed that S&T subjects are suitable for boys and not for girls. Consequently S&T teachers, whether they are males or females do not expect the girls to perform well in S&T subjects

   Tsayang and Nguako (1989) reported a study carried out in Botswana on teacher expectation of students. Teachers who participated in the study were given the school report card of a form 3 student and asked to write their expectations for the student. Half the group was given the report card with the name "Patrick" and the other half with "Patricia". Results of the

study showed that there were some similarities in the way the "two" students were perceived. For example, Patrick or Patricia could become lawyer or a teacher. In other areas however, there were marked differences. Patrick on one hand could become a diplomat or manager: while Patricia could become a secretary, wife, or mother. Generally, a greater range of jobs were mentioned for Patrick; the expectations for Patricia were not only lower, but were vague. For example one of the recommendations made for Patricia was that she could 'do all sorts of work and study all sorts of subject'. Back home in Nigeria, Nzewi (1994) investigated the assertions made by Tsayang and Nguako(1989) in relation with Science students. In this study, a report card of a science-based Senior Secondary Class II student was reproduced and given to forty-five teachers and counsellors from Igbo land. Twenty two of them received the report card with the name Patrick, while the other half received the same report card with the name Patricia. The teachers were asked to advice the student and recommend possible future careers.

The finding of the study revealed that 80% of the respondents recommended that Patrick or Patricia could become a medical doctor, pharmacist, teacher, or could study Zoology, Botany, and Microbiology or combined Biological Sciences. There are however other marked differences. Ninety percent of the respondents indicated that Patrick could become an Engineer in the area of Electrical, Electronic, Mechanical or Civil Engineering. Other careers or jobs listed for Patrick include Mining Engineering and Geology. On the other hand such careers as Food Scientist, Dietician, Nutritionist, Nurse and Medical Laboratory Technologist were reserved for Patricia.

An interesting deduction from the above study is that while "Patrick" and "Patricia" are science-oriented with the same grades in the same secondary school subjects, some courses were reserved for "Patrick" and some for "Patricia". For instance, no respondent suggested that "Patrick" should train to become a Nurse, Dietician or Nutritionist, nor did any of them suggest that "Patricia" could become an Engineer. The above findings suggest that girls move away from sciences not necessarily because they cannot do science but because they are pointed away from science by the people who should encourage them.

5. **Gender biased Guidance and Counselling Services to Girls in STEM subjects:** School guidance counsellors give boys' and girls' gender-biased counselling with regards to STEM subjects (Okeke 1997). School guidance counsellors are known to encourage the boys to enrol and work hard in the physical sciences because of the relevance of the subjects to

future studies in the disciplines of engineering, technology, basic sciences and mathematics. Conversely, the counsellors discourage the girls by telling them that physical sciences and mathematics are difficult and are meant for boys; that they would not need the subjects in future since they would invariably not be in the disciplines of science and engineering; and that they can easily make good grades in art subjects and the humanities. This point is further buttressed by the findings from the study cited earlier (Nzewi, 1994), where no teacher or counsellor found "Patricia" fit to study to become an Engineer in spite of the fact that it was the same result that was presented for the two students named "Patrick" and "Patricia"

How to Attain Gender Equity in Science Classroom

Though the problem of science disparity may be said to have its most profound effects on students at the university level, addressing the issue requires a mix of approaches at every stage of education. Younger students must be introduced to the subjects of STEM in a way that makes it clear that they can, and should, strive to attain excellence. In high school, a greater range of scientific electives, along with a broader range of related requirements for all students and higher availability of after-school tutoring, will help to eliminate the stigma of math and science as being too difficult or irrelevant. At the college level, a well-crafted curriculum with emphasis on the scientific components of a general education will help students of all backgrounds to explore their interests in the scientific world at the stage of life most likely to kindle a new career.

Coping Strategies

Exploring which coping strategies are effective for girls and women in STEM curricula has implications for school and career counsellors and for academic policies. By understanding the barriers that women in STEM curricula face and the coping strategies known to be effective in STEM environments, counsellors can help clients recognize obstacles and learn to cope in ways that are likely to be effective. Coping is a transportable skill that can continue to assist girls and women in overcoming barriers as they move forward in their careers. In terms of policy, identifying the most effective coping strategies for women in STEM fields can provide information regarding where additional resources should be allocated and what kinds of resources are likely to help girls and women in STEM curricula to cope.

The Importance of Role Models and Mentors

The number of women embarking on science careers has been increasing steadily during the past several decades. Although women scientists continue to be underrepresented at the faculty level, many women have established rewarding and successful careers in science—thanks in part to having had role models and mentors whose paths they could follow.An American lady, **Judith Weis** knows about the value of role models. Last spring, the biology professor received a heartwarming e-mail from a woman who had been inspired to pursue a career in science by a television commercial—one that Weis had starred in.

In the 1970s the makers of a popular orange beverage in the United States of America called Tang shot a series of television commercials featuring women scientists with their children. Weis, who had recently joined the faculty at Rutgers University in New Jersey, took part in one of them. The e-mail writer saw the commercial as a child and went on to obtain a Ph.D. in pathology in 1987. "I vividly remember the commercials and thinking—I can do that!" she wrote. "So, thank you—for deciding to make the commercial and become a positive role model, not only for me but hopefully many other women."

When Weis started her research career in marine biology, there were few women scientists, particularly at the faculty level. "The department I joined was exceptional because it had three tenure-track female faculty," she says. "It was very unusual for back then." The situation has changed dramatically in the past three decades. "Up until the 1970s women were not even allowed to go out on oceanographic vessels. In the 1980s things changed a lot. I remember one of the first signs was going to a conference and there was a line for the women's bathroom," recalls Weis laughing. "Since then women have been flocking to marine biology."

Weis's experience parallels national trends in the United States. According to the latest figures from the National Science Foundation (NSF)Women, Minorities and Persons with Disabilities in Science and Engineering, 2009,—in 2006 women accounted for more than half of all graduate students in some science fields—76 percent of graduate students in psychology, 56 percent in biological sciences, and 54 percent in social sciences. (But women made up only 23 percent of graduate students in engineering and 25 percent in computer science.) Women also accounted for a rising share of postdocs in all fields except computer sciences; in 2006, 53 percent of psychology postdocs, 46 percent of social sciences postdocs, and 41 percent of biological sciences postdocs were women.

Having Role Models

One of the factors that has inspired more women to pursue scientific careers has been having examples of successful women who have done the same. "When you are 24 or 26 and are looking at different career options—industry, academia, or government labs—men see three clear paths and will know several people who traversed each one. They can see other men 20 years down the line," says **Geraldine Richmond**, a professor of chemistry at the University of Oregon. "But for women it is more of a fog. They may not know anyone who has gone that road, or at least no other women. So they cannot visualize where they are going to go. If you plan to have children, but don't see any women who have gone that path, you may not be sure it's possible."

The Importance of Mentors

The NRC's committee in charge of the Gender Differences report determined that women who had a mentor did better than women without one. They reached this conclusion by analyzing the results of two national surveys, taken in 2004 and 2005, of tenure-track and tenured faculty in six disciplines (biology, chemistry, mathematics, civil engineering, electrical engineering, and physics) at 89 institutions. They found that in chemistry, for example, female assistant professors with mentors had a 95 percent probability of having grant funding versus 77 percent for those women without mentors. Across the six fields surveyed, female assistant professors with no mentors had 68 percent probability of having grant funding versus 93 percent of women with mentors.

Other strategies for ensuring inclusiveness for females in STEM

- **Creating awareness and sensitizing students and teachers about gender issues in STEM education:** The effects of the pervasive masculine image of STEM should be discussed among students and teachers so that everyone understands them and becomes able to identify his/her own roles in the perpetuation of the stereotypes.
- **De-Sexing STEM curriculum/scheme of work and teaching/ learning resources**: This is done through identifying and pointing out gender biases in STEM curriculum contents and language of communication with a view to modifying them and thereby making the curriculum materials gender sensitive and acceptable to both females and males.
- **Adopting gender-inclusive guidance and counselling services for all STEM students**: Males and females and given similar guidance and counselling advice, encouraging them to enrol in as many STEM

subjects as they can, and working really hard to perform well in each of the subject.

- **Placing emphasis on the relevance of STEM education to learners:** This can be done by the STEM teachers during all lessons when they point out the areas of application of the STEM concepts they are teaching to life outside the school. Making science relevant to the everyday life of the learners will increase their learning motivation and interest and participation in the subjects irrespective of gender. This is because they will start experiencing science from the point of problem-solving and wealth creation. This is also an area where the role of women can be harnessed and used positively. As a woman is cooking in the kitchen with her sons and daughters, she should explain the scientific reason behind every action that is taken in the kitchen. Example, why do we not cut our vegetables, like the local "oha" with a knife. This will make the children appreciate that science is for life and life is about science.
- **Providing work environment that are conducive to the things that are important to women:** When females have endured all odds to remain in STEM disciplines, they should be provided working environments that are will enable them succeed in their career and also achieve the things that are important to women especially Igbo women. Okeke (1990) reported that each a high profile and high achieving female is introduced in Igbo land, the first question that is asked about her is: Is she married, and next, does she have children. If the STEM work environment is made such that she can take time off and return later to her career, I am sure more women will want to stay on. I am not talking about the ordinary maternity leave which is not enough to take care of any child, but a more extended leave of absence for those who need them. There is also the issue of getting a helping hand from the male folk

Conclusion

Inclusiveness should be looked at not just from the perspective of children with special needs. It should also be looked at in terms of getting everybody on board, male, females, minorities and the marginalised. When the education system sees inclusiveness as a means to ensure that no one is left behind, then the education system and the society at large will be the better for it.

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