

Encouraging Female Participation in STEM Degrees

Kendra J. Ahmed, Mahbub K. Ahmed, Scott McKay

Southern Arkansas University

kjahmed@saumag.edu, mkahmed@saumag.edu, SEMckay@Saumag.edu

Abstract

Recently, more is being done to encourage high school students to enroll in STEM degrees. The STEM workforce is important and needs encouragements so that the USA can compete globally. However, despite these programs, female participation in STEM degrees is still considerably lower than that of their male counterparts especially in engineering. Women make up almost half of the total workforce but only hold about a quarter of STEM jobs. A few of the reasons typically listed to explain this discrepancy in STEM jobs are a lack of female role models, gender stereotyping, and lack of family friendly flexibility. Despite current programs that are being used, some suggestions to help include, mentorship programs that break down gender stereotypes, STEM discovery days at universities where female high school students interact with female university STEM students, female STEM summer camps at universities and university recruiting done by female faculty members in STEM.

Keywords

Female students, STEM, STEM in America

Introduction

More and more programs are being implemented into school curriculums across the nation to get students interested and participating more in STEM related activities and performing better in science and math as well. Programs are being started in elementary schools giving students an introduction into engineering and technology and continue the whole way through high school with programs like STEM camps and STEM job experience days. The United States was once the leader in science and math but has fallen from the number one spot to ranks well below the global average. Having a strong and larger STEM workforce in America is extremely important so that there is an innovative advantage and the USA can keep up as well as compete globally. Even with these encouragement programs female student participation is still greatly lagging compared to their male counterparts especially in engineering. In the USA women make up 48% of the workforce but only make up 24% of the STEM workforce¹. As well, women who do work in STEM related jobs make 33% more money than women who do not work in STEM jobs¹. Historically some of the reasons that have been given to explain the gap between females and males in STEM has been a lack of female role models that work in STEM jobs, gender stereotyping that leads female students to believe that they cannot study these male oriented

subjects or they are not smart enough to study these subjects, and that STEM jobs are not family friendly when it comes to factors like flexibility. This raises the question as to what can be done and what needs to be done to encourage more female participation in STEM degrees at colleges and universities across the nation so that more women join the STEM workforce. Some possible ideas that will be discussed in this paper are having high school female students interested in STEM majors as well as female students enrolled in STEM degrees participate in a mentorship program, have university sponsored STEM discovery days where high school female students can interact and do activities with female university students that are enrolled in STEM degrees, university sponsored STEM summer camps specific for high school student encouragement and specific for junior high student encouragement, and finally to have university STEM program recruiting focused on female high school students being done by female faculty members that teach STEM classes.

STEM in America and the gender gap

Different organization like the OECD who rank nations based on PISA test scores around the world give us a glimpse into how America ranks in comparison to other countries. The PISA test is administered every three years to fifteen year old students around the globe. Looking at the last set of results which are from 2012, the first key finding to notice is that USA students are performing well below average in math and below but closer to average in science². The second key finding was that there has not been a significant change in these performances over time². The USA needs to be able to keep up with other nations around the globe so that it can keep up with innovations, the global market, and as a global leader. With students lagging so far behind it is going to be harder and harder for the USA to keep pace let alone gain an advantage over other nations. These factors have been part of the reason that so many programs encouraging STEM activities in schools starting from kindergarten and going the whole way through twelfth grade have been put into place by state governments as well as the federal government. These programs range from introductions to sciences early on, to hands on experience days, to special co-op agreements with businesses and universities, to high school STEM job shadow days and STEM camps. More attention has been brought to the need for programs like these to increase student performance in STEM subjects as well as to get more students interested and participating in STEM not only in the early school years but also at the college and university level. These programs are encouraging and bringing more light to STEM but the question that needs to be asked next is if they are also helping to close the gap between male and female participation in STEM in the USA.

Traditionally females have always lagged in participation of STEM degrees and STEM jobs. Over time many different reasons have been given to explain this difference in participation. The first one that many people think of when asked is gender stereotyping. Many females have been told at some point that STEM related jobs are for boys and that boys can do those jobs better for

various reasons like boys are better at math than girls are, or boys are better able to handle difficult subjects like science, as well as things like girls in STEM related jobs do not have time for family life or will not be able to raise children with their career. Some other more current reasons given include things like a lack of female role models in STEM fields and lack of flexibility for family in STEM jobs. Women make up 48% of the workforce in the USA but only make up 24% of the STEM workforce¹. Men make up 52% of the workforce in the USA and make up 76% of the STEM workforce¹. This gap is not just in the workforce but women also hold a disproportionately smaller share of STEM related diplomas from colleges and universities in the USA too¹. The biggest gap between male and female participants in STEM degrees and jobs is in engineering where only about 1 in every 7 engineers in the USA is a female¹. This gap between male and female participation has been unchanged over the past decade despite the fact that more women are now obtaining college degrees¹. Women in the USA who do hold STEM jobs earn 33% more than women who hold non-STEM jobs and because of this experience a much smaller gender wage gap too^{1,3}. In STEM jobs there is a 14% gender wage gap meaning that for every dollar a male worker makes a female worker makes only eighty-six cents compared to in non-STEM jobs where there is a 21% gender wage gap¹. This high pay and smaller gender wage gap make STEM jobs a very good choice for women in the workforce.

Recommendations for encouraging female students

The first suggestion to help encourage more females to study STEM and to participate in STEM is the idea of a continued mentorship program. The idea for this program is to start in high school with female students that are interested in studying a STEM related degree when they go to college. They would be enrolled in a mentorship program when they enter the ninth grade. Through all four years of high school they would have the same mentor which would be a female who works in STEM. The mentor could be even a university professor who teaches STEM classes. The mentor would work to encourage the student and give her advice on how to succeed. If the student continued onto pursue a degree in STEM the mentor would stay on with her and continue to mentor her through her college experience. For university students that were not in the high school portion of the mentorship program, they would be assigned a mentor upon entering the university. The mentoring could be done in a variety of ways from email, personal one-on-one meetings, skype conversations, phone calls, etc. Technology today would allow for a wide variety of ways that the mentor and mentee could meetup and talk. The mentorship would provide female students with someone on their side who would also be helping to break any gender stereotypes and also provide positive role models from the STEM workforce. This program would work to break two of the reasons typically given for why fewer females are in STEM. This type of program would also give schools the opportunity to collaborate with local universities and local businesses.

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The second suggestion to help encourage more females to study STEM and to participate in STEM is the idea of STEM interaction days. These interaction days would be sponsored by universities. The university would hold the program on a Saturday and invite high school female students interested in pursuing STEM degrees from grades nine through twelve. The university would preferably have female professors in STEM lead the discovery activities and would have female students that are currently studying STEM degrees work as volunteers in each of the sections. In this program, the professor would lead activities and the university students would interact with and talk with the high school students. For example, a professor of computer science could have programming type activities where the high school students could learn to program with various stations such as making a basic website, programming a simple java program, and maybe working on building a simple video game scene. A professor of engineering could have activities set up in stations such as a pick and place robot, building robots and programming them using Lego Mindstorms, solid modeling with tools like AutoCad and/or SolidWorks, and Audrino robotics programing. Other sections could be set up in physics, biology, chemistry, etc – whatever science programs the university has available for students to major in. The students would go from section to section doing the activities that the professors had set up. They would get to experience a wide variety of STEM activities in one day which would help to spur their interest in studying more about that subject. At the same time, the high school students would get the chance to interact with the university students and see that girls just like them are succeeding and they can too. This program would work on breaking the gender stereotyping reason and would provide positive role models in STEM as well. This program would also give schools the opportunity to collaborate with local universities.

The next idea to work at encouraging more females to study STEM and to participate in STEM is the idea of a STEM summer camp. The idea of the summer camps is similar to that of the discovery days. These programs would be run in the summer during high school students' summer break. The high school summer camps would be focused on high school students in eleventh and twelfth grades. The camps could be three to five days in length and would be a sleep over camp with the high school students staying in the university dorms. The university would have female professors again providing a variety of activities set up for the students to participate in very similar to those of the discovery days. One of the differences between this and the discovery days would be that students would not be as short on time and could do more in-depth activities. Like the discovery days it would be most beneficial if the activities were led by female professors that teach STEM classes and that the volunteers be female university students studying STEM degrees. In the summer camp, universities could have women in STEM jobs as speakers to come and share with the campers about the ups and downs in their careers as well as what has helped them succeed the most. During camp various contests could be held for the students to earn prizes in design competitions or invention competitions, camp souvenir t-shirts could be handed out, and a website with photo albums could be shared so campers could have access to photos to share with friends and family. The goal of the camp would be to have it be a fun lifetime memory making experience that the students would always be able to look back on

and enjoy. This summer camp experience would allow universities to do collaboration with local businesses and schools. This idea would make STEM more fun, break down gender stereotypes, and provide high school students with positive female role models both from college students and professionals. A program like this would also get students excited about going to college and experiencing more of college life as a result this could also be a great recruiting tool for universities to recruit female STEM degree students. A very similar version could be held for junior high school students but done as more as an introductory level discovery to STEM. Targeting this age group on an introductory level could help to plant seeds and get girls excited about STEM subjects at an earlier age so that when they get to high school they are already interested in and contemplating studying STEM degrees.

The final idea suggested to encourage more females to study STEM and to participate in STEM is the idea of a female university recruiting in STEM. The way that this is suggested to work is to have female professors that teach STEM classes to do recruiting programs at local high schools. The STEM professors could go to different classes and talk to students about working in STEM and the benefits of doing so. They could also have displays at the schools with information about the different STEM degrees their university offers and also have information about women in STEM at their displays too. An example of one of these information handouts could be famous female scientists through history. This is a great way that universities could focus attention on recruiting female students into STEM degrees. This would give universities the opportunity to collaborate with local high schools.

Conclusion

For America increasing participation in STEM education is extremely important but increasing female participation in STEM is even more important. In recent years more and more is being done to increase STEM participation but way more needs to be done. Having more participation in STEM will help the USA to obtain an innovative edge, be able to compete globally, and to be a global leader. Women make up a disproportionately small portion of the STEM workforce but women who work in STEM jobs make more money and face a smaller gender wage gap than women who work in non-STEM jobs. Programs and activities to encourage female participation in STEM degrees need to work actively to disprove or make invalid the reasons that are given as to why females cannot have a career in STEM. Some of the ideas presented in this paper like mentorship programs provide positive female role models, discovery days and camps provide not only positive female role models but also allow girls to experience STEM and see that they can do it even if they have been told they cannot do it. Schools and universities as well as local STEM businesses need to find ways like these and more where they can work together to encourage girls to get into STEM and to pursue STEM degrees and eventually enter the STEM workforce.

Resources

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Kendra Ahmed

Kendra Ahmed is an adjunct professor of computer science at Southern Arkansas University where she teaches video game development and programming. She completed her MSc in Computer Science from Southern Arkansas University in 2015. She previously completed her BBA in Economics from the University of Texas – El Paso in 2007. Her research interests include women in science, online teaching methods, and class development.

Dr. Mahbub Ahmed

Dr. Mahbub Ahmed is an assistant professor of engineering at Southern Arkansas University. He completed his PhD in Materials Science and Engineering with an emphasis in Mechanical Engineering at the University of Texas (El Paso) in 2008. He earned his Bachelor of Science in Mechanical Engineering degree from Bangladesh University of Engineering and Technology in July 1997. He completed his masters in Industrial engineering from Lamar University, Beaumont, Texas in 2001. He spent two years working fulltime at a light fixture design and manufacturing company in El Paso as a design engineer. He has worked part-time as a visiting Assistant Professor at the University of Texas at El Paso as well. Prior to joining the Southern Arkansas faculty as a fulltime Assistant Professor in 2012, Dr. Ahmed was a Lecturer at Georgia Southern University for one year and visiting Assistant Professor for three years. His research interests include combustion, computational fluid dynamics, and engineering education.

Dr. Scott McKay

Dr. Scott McKay is the Dean of Science & Engineering and Professor of Chemistry at SAU. He joined the faculty in 2011. Prior to SAU, he was the chair and professor of chemistry at UCM and Director/Founder of the Center for Alternative Fuels and Environmental Science. Before that he was an assistant professor of chemistry at LMU and postdoctoral associate at The University

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of Alabama studying in the area of crystal engineering. Previous to UA he was a visiting scientist at Lehigh University researching industrial processes of dyes. He has bachelor's degrees in chemistry and geology EKV 1987, a master in analytical chemistry EKV 1989 and a Ph.D. in organic chemistry from The Florida Institute of Technology in Melbourne, Florida 1995. Dr. McKay's research interests are in the areas of alternative energy and fuels, petroleum products, sustainability, crystal engineering, and proton exchange membranes for hydrogen fuel cells.