Keeping Women in Science:

How Emotional Intelligence Training Supports Healthy Classroom Environments

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Abstract

A field traditionally dominated by white men, science has seen a dramatic shift in recent years toward encouraging diversity in the professional world as well as the classroom. While more efforts are being made to place women and minority groups in positions as professionals and students in science, there has been little effort to shift the culture in these positions from the traditional perspective to that of inclusivity where underrepresented groups have value. Connecting literature on STEM representation statistics and emotional intelligence research, this paper argues that emotional intelligence training can help to shift this male-dominated culture.

Keywords: Emotional Intelligence, Science, Women and Minorities

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Among the groups underrepresented in myriad areas of science, women face unique challenges on the road to success as professional scientists. Many of these challenges arise as a result of the static attitude within science – even if subconscious – that males are more suited for the role of a scientist (Ashbacher et al., 2010). Past research has repeatedly shown that this effect can be negated by creating an encouraging atmosphere within science education, forming a sense of belonging in a science classes, and supporting self-efficacy in each individual science student. The following analysis will serve to answer how emotional intelligence theories and results can be implemented in classrooms to improve retention rates of underrepresented groups, with a focus on women, in scientific fields. After describing the challenges specific to women in science, I will provide four suggestions for improving current education techniques that will benefit all students, but most importantly female students in STEM. I end by discussing outcomes of these strategies and potential future research projects.

What Pushes a Student to Leave Science

Although having a natural affinity for science from a young age can spark a long term interest in the subject, there is often a defining point in a student's journey in science in which that student becomes either encouraged to stay or driven to leave. Past research has shown that despite taking similar courses throughout K-12 education, much fewer women graduate than men in almost every scientific area of study (Hill et al., 2010). To understand why there is this significant difference in retention rate, it is necessary to explore what discourages students from continuing on in STEM.

The degree to which someone is interested in a field is largely considered the primary factor behind a person's decision to pursue an education or career in that field. However, it has been shown that confidence in a subject often overlaps with interest; as a student's confidence level rises in a class, he or she is more likely to stay interested in and enjoy that class. (Dennissen et al. 2007). While this may seem like an intuitive result, it has also been found that women consistently ranked themselves as having lower confidence levels in their abilities in STEM compared to their male counterparts (Dayton, 2013). Because a lack of confidence then leads to a lack of interest, females leave STEM more frequently, contributing to the low retention rates.

Along with the roles that confidence and interest play in maintaining one's motivation to stay in science, evidence suggests that feeling a sense of belonging and being able to relate to science educators and other professionals impacts motivation as well (Ashbacher et al., 2010). Throughout history, the names of the most famous scientists have predominantly been those of white males. As scientific fields were built upon this perspective of what a scientist usually looks like, even young, aspiring scientists must create an identity for themselves within a community that is biased to be culturally homogeneous. Continued lack of diversity perpetuates the idea that STEM fields are for men, and women who subscribe to this idea are less likely to obtain that sense of belonging in science that is so essential to achieving a level of satisfaction in any field (Farland-Smith, 2009). As a result, this general disconnect with the majority of the scientific community combined with reinforcement of traditional viewpoints regarding gender roles is a dangerous mix, often leading to the self-fulfilling prophecy of students conforming to the roles placed upon them by their societal environment (Trujillo et al., 2014). This stereotype threat that has persisted throughout the years is one of the many reasons why the gender gap in STEM

fields has taken so long to diagnose. It also helps explain why efforts to increase diversity in science have just recently begun to gain a foothold in STEM.

Multifaceted Problem-Solving: An Introduction to Emotional Intelligence

Despite the flaws of the current systems both in the academic setting as well as the professional world, there are direct steps that can be taken to make a change. To build the strongest scientific community possible, more needs to be done than basing students' prospects in scientific fields on academic performance alone. By integrating approaches from psychology and education research, a new set of norms can be created ubiquitously across science classrooms from the start of a student's formalized science education in elementary, middle, and high school classes to college lectures and seminars. Altering the mindset of a centuries-old area of study will take uniform training and commitment to supporting students of all backgrounds instead of pitting them against each other.

The problems discussed above are based on a paucity of beneficial social and emotional practices in science and describe a lack of techniques for implementation of new strategies. The strategies will focus on improving the primary environment in which a scientific mind is cultivated: the classroom. They will involve informing individual students and their classmates about emotional intelligence but will also require more training of their educators. Solutions for the current challenges can be classified into four different categories, each with a distinct goal for emotional intelligence training implementation that would improve the environment in science not only for women but for all scientists in any stage of their careers. They include developing growth-based mindsets of students, discouraging the internalization of failure, understanding students' backgrounds directly, as well as building a community of learners and more

experienced role models. Though each of these categories focuses on a nuance of the current issues confronted by women in science, they are united by a common theme of positive reinforcement and are supported by the theories of emotional intelligence, as the results desired to create a better scientific environment are also an effect of having skills and training in emotional intelligence. Each of these individual categories will be discussed further in the following sections with a focus on the incorporation of emotional intelligence-based techniques into the proposed solutions for improving retention rates of women in STEM.

Developing a Growth-mindset through Positive Affirmation

The beginning of a semester provides a prime opportunity to set the tone in a science classroom. Initially, professors play the largest role in determining the class dynamic; educators who are enthusiastic about the material, who employ effective pedagogical methods, and who work toward building relationships with students have a greater positive impact on their classes than less involved teachers (Wentzel et. al., 1998). One of the many influences teachers have on their students is encouraging a growth-mindset in STEM learning. A growth mindset is the perspective that talent and skill in an area of study can be developed, as opposed to someone starting off with fixed abilities. Research has consistently confirmed that students who looked at learning in science as opportunity for development and who focused on a growth-based perspective had the advantage compared to students with fixed mindsets (Dweck, 2008).

A study performed among computer-science students demonstrated that students who maintained a growth perspective were more likely to have consistently higher confidence levels despite any setbacks, which contributed to their overall academic performance and interest in the class topics (Murphy et al., 2008). In related work approached from a slightly different avenue,

Ilan Dar-Nimrod and Steven Heine ran a study in 2006 to determine how different theories on why a gender gap existed in STEM would affect women on performance-based exams. Women who were told that ability in STEM was genetic before taking a math exam had worse results than those who were told that fewer women were represented in STEM due to situational variations between the genders (Dar-Nimrod et al., 2006; Dweck, 2008). These similar studies illustrate that a mindset shift can positively affect a female student, helping her understand two main ideas: that science concepts and problem solving abilities are traits that can be built up until subject mastery and that lack of diversity of STEM does not come from a static, biological talent that is much more rare in women than in men. This understanding removes the idea that women are limited in their scientific skills and empowers them to gain confidence and motivation within their field.

Students will come into a classroom with different mindsets regarding science learning based on their backgrounds as well as what they have heard most from the people around them. An educator trained in emotional intelligence will better understand a student's needs and can help push a student toward a growth-focused perspective by employing several different positive affirmation techniques based on different situations that are experienced in a classroom. First, educators should be aware of their own beliefs in order to prevent subconscious acts of implicit bias, a negative reinforcement of stereotypes that may occur while teaching or helping students. Research has confirmed that professors carry a set of expectations about certain students that will eventually cause those expectations to be reflected in their achievement and ultimate academic growth (Rosenthal, 1968). This conscious recognition of internal biases will prevent women from being unintentionally limited as a result of stereotype threat and a fixed-trait mindset being

pushed upon them. Women in science can also benefit from direct positive reinforcement, such as a statement from the professor showing his or her understanding that the material being covered is challenging. Even a simple "intervention" to inform students how to channel their emotions toward a growth viewpoint and the benefits of doing so can have significant impact on the performance and satisfaction of students (Schmidt et al., 2015). Application of different Social and Emotional Learning (SEL) techniques is also useful; teachers can be trained on how approach different emotional responses to learning scientific concepts as well as how to use positive affirmation for a student's process in problem solving. This encourages an atmosphere focused on collective growth and development of all students, but is especially important for female students.

Although training in some form is generally a given for educators before they begin teaching professionally, the usual training process – whose main goal is to teach educators how to effectively relay information to students – is wanting with regards to psychological and social strategies and how these environmental factors can impact student success. Through training in emotional intelligence, teachers learn how to make students more comfortable and confident within their classes (Brackett et al., 2007). They also can learn how to guide students to adopt shifts in their mindset so that they continue developing as scientists. This perspective of comfort, confidence, and development is essential for women in STEM specifically.

Removing the Internalization of Failure

One of the main consequences of having a growth-mindset is the ability to better confront challenges that one will inevitably face throughout a scientific education and career. This is due to the students reevaluating the cause behind certain outcomes in their academic performances.

By adapting this mindset of development and growth, students are more likely to "view effort as something positive that aids the environment, attribute failure to low effort, and persevere after encountering failure" (Wentzel et al., 2016). While training to create these new perspectives is essential as discussed above, there are other emotional intelligence strategies teachers, as well as students, should employ as well to create a healthier environment for all students in their classes.

For an effective and inclusive science learning atmosphere, both teachers and students need to understand how emotions can help them bounce back after failure. From a professor's perspective, there should be a set process established for the class that allows students to examine their mistakes, understand the things that challenge them, and then find a solution to fix any gaps of knowledge they may have. For example, educators could proactively set up individual meetings with students. This creates a private situation for students who feel intimidated about discussing their personal setbacks in a more public setting — which is more likely to be the case for groups such as women who are underrepresented in science.

Along with making specific changes to class routines around exam time, teachers who are trained in emotional intelligence can emphasize how emotion regulation skills can help someone succeed even after they haven't been performing as well as they would have liked. Development of these skills is even more essential for women and other underrepresented groups. Lack of success among students in these groups who haven't been trained in emotional intelligence or growth-mindset can cause them to internalize their failures as examples that reinforce the stereotype that they weren't made to do science (Wentzel et al., 2016). Informing students can be done both directly, through telling students about emotion regulation, and indirectly, by helping students through small conversations and interactions with them. These conversations are best

one-on-one with a student so that they can engage with you on a more honest level. Questions that would help a student open up include asking them about them about their feelings with regards to the subject material as well as the class structure and general environment.

Educators should also ask about student's feelings regarding their performance and learn more about the factors that elicited the specific emotional responses in the student. Rather than discussing only the academic skills a student was lacking after a particularly bad performance, approaching these conversations from a perspective on emotions helps understand the causes of poor performance beyond simply a misunderstanding of the class concepts. Understanding emotions – one of the key tenants of emotional intelligence learning (Brackett et al., 2013) – also validates the emotional experience the student is having and expresses the educators personal interest in making the best possible situation for all students, male or female.

In addition to teacher training, emotion regulation skills learned through direct training of the student can be greatly beneficial as well. As discussed in a presentation by Jessica Hoffmann, if the correct strategies are used, emotion regulation can improve a student's well being, including bettering a student's academic performance (Hoffmann et al., 2016). The adaptive strategies included in her work can be useful to students both before exams, when altering typical emotional responses to stress is necessary to handle intense studying or an overwhelming workload. One of the "Master Thought Strategies" Hoffmann also discusses is the power of positive reappraisal (Hoffmann et al., 2016). Applied in any situation, but particularly by a women in science — for example, after she has just received a bad grade — places the control back in the hands of the student. From there, she can empower herself to understand what

happened and move forward, something that wouldn’t happen as often with a peer who has not been exposed to emotional intelligence training.

Understanding Students' Diverse Backgrounds

In a field with such a large imbalance in representation, understanding the background of female and minority students who don't have as many numbers becomes even more essential. The presence of diversity among people will bring with it a diversity of emotional backgrounds as well. Too often, educators focus on solely the academic background of students entering a class, especially in STEM subjects whose understanding and concepts tend to be more objective on assignments and examinations. The attitudes and confidence of students is constantly swayed by the beliefs of people in their life. Studies have shown repeatedly that families can influence a student's interest in pursuing science long-term (Aschbacher et al., 2009; Dasgupta et al., 2014). Therefore, knowledge of students' emotional relationships with science cultivated by their personal backgrounds is pertinent information a professor should understand.

One potentially effective way to achieve this understanding is to offer a "background pretest", administered at the beginning of a semester and referred to throughout the class. This brings emotional awareness not only to the professor but the students too, allowing them to explore their ideas about STEM in a way they might never have before. By allowing students to share as much or as little as they want, educators will be able to demonstrate that their students' emotions matter while at the same time showing them who needs extra attention and encouragement.

Community-Based Learning and Mentorship

The strategies presented above involve using emotional knowledge to improve

interactions in science classrooms with the goal of bettering the overall environment in STEM. Emotional Intelligence and SEL techniques can help strengthen interpersonal relationships, which is the first step in building a supportive science community. The relationship between high emotional intelligence and social skills has been consistently confirmed through research (Schutte et al., 2000). This improvement in social skills would make it more simple to change a class's structure to encourage more communication and teamwork. Classrooms set up with smaller tables would allow students to first attempt problems together as they gain the skills to eventually figure them out on their own. This setup would also make sure that all students, even those who aren't as well represented as others, would be able to talk to more people, and potentially create longer lasting relationships leading to formations of inclusive study groups.

Female science students need role models who are women and communities that support the image change they want to see within science. Research has confirmed that female role models in science are imperative to a younger woman's success in the field and can make a significant impact on their motivation to stay in that field (Farland-Smith et al., 2009). These role models can be found by pairing women with older, more experienced women in the same science field or through organized groups focused on supporting women in a specific STEM field. One reason why women still are not seeing an improvement in the classroom or professional environment within STEM is that in order to make a change, everyone needs to be involved — male or female, old or young. Though organizations for women and other minorities in science are absolutely necessary for emotional support and guidance through various experiences in STEM, these groups also need the ability to communicate to a larger audience. Educating people as part of STEM curriculum about the human side of science as well as the truth in

representation statistics and attrition rates will raise awareness of the deficits present so that efforts to improve the situation are supported by everyone.

Conclusion and Discussion

Starting with an overview of the problems currently faced by women and underrepresented groups in science, this analysis examined a variety of methods the environment within a science classroom can be improved. These strategies were built upon a foundation of research that synthesized two main ideas: that women in science would benefit from increased confidence, an encouraging atmosphere, and a sense of belonging within the field, and that these solutions could be achieved through the application of emotional intelligence research results and theories. The changes proposed achieve the original purpose of this research: to explore how to drive down attrition rates for women and other minorities in scientific fields. However, all students and educators, not only women, will benefit from these changes as well.

The ideas provided for classroom improvement are based on solid psychological and social theory but would still benefit from confirmation through experimental research. Future studies should examine the effects of having a "background pretest" (as discussed in the strategies above) in a more quantitative manner by having students and professors rate the quality of their relationship throughout the year and the perceived emotional awareness of the student with regards to the class along with statistics on her academic performance. The idea of assigned study groups combined with emotional intelligence training and the impact this combination has on inclusion within STEM should also be examined further. With continued research, small cultural changes, and ubiquitous implementation of emotional intelligence strategies, the future of gender equality and diversity within science is promising.

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