Connecting People to Science
ASP Conference Series, Vol. 457
Joseph B. Jensen, James G. Manning, Michael G. Gibbs, and Doris Daou, eds.

Engaging Girls in STEM: How to Plan or Revamp Your EPO Resources or Activities to be More Effective for Girls

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Abstract. This two-hour workshop, which was held as a follow-on to the plenary session "Engaging Girls in STEM: A Discussion of Foundational and Current Research on What Works," offered research-based insights, resources, and tips to help participants plan or revamp programs and resources aimed at encouraging girls in science. Led by Karen Peterson, PI for the National Girls Collaborative Project,[1] the workshop included: a brief discussion about effective strategies recommended for encouraging girls in STEM; hands-on experience, where participants—availing of the expert's guidance—applied the recommended strategies to alter or tailor an existing or planned program/resource to be more girl-friendly; and a sharing out, where the participants reflected on the results of the hands-on exercise and developed action items to continue carrying out the girl-friendly best practices in science, technology, engineering, and math education and public outreach.

1. Introduction

Scientists, teachers, parents, and policy makers all echo the need to get more students involved in science. There is a national impetus to broaden the science participation of girls, in particular. Efforts such as the National Science Foundation-funded National Girls Collaborative Project (NGCP)[2] are creating and fostering new programs and initiatives that use research-based strategies, tools, and collaborations to create gender equity in the areas of science, technology, engineering, and math (STEM). This effort and others like it are providing a large body of best practices that can be utilized by the astronomy, earth, and space science education and public outreach (EPO) communities when developing new programs, or altering existing programs, to be effective at engaging girls and maintaining their interest in STEM.

This two-hour workshop was organized as part of a professional development strand on engaging girls in STEM led by the NASA Science Mission Directorate As-

[1]http://www.ngcproject.org

[2]http://www.ngcproject.org

trophysics and Planetary Science EPO Forums.[3] Ms. Karen Peterson, PI for the NGCP, led the workshop. Earlier in the day, meeting participants had the opportunity to attend the related plenary session titled, "Engaging Girls in STEM: A Discussion of Foundational and Current Research on What Works" that was also led by Ms. Peterson (p. 7 in this volume). This article reports on the highlights of the workshop.

After participating in speed networking, where participants had a chance to meet each other and learn about each other's programs, needs, and resources, Ms. Peterson introduced the NGCP and led participants through a review of the research presented during the plenary session. She then continued with an examination of gender bias in our society, a discussion of effective strategies, and provided an opportunity to use the strategies on the development or modification of new or existing programs. After reporting on their efforts and action plans, participants were presented with a variety of printed materials, including copies of the "SciGirls Seven: Proven Strategies for Engaging Girls in STEM," [4] "Summaries of Research Presented by the Social Science Advisory Board" from the National Center for Women & IT meeting [5] held in May 2010, a rubric for evaluating a program's effectiveness for engaging girls, and various flyers that serve as examples of successful programs.

2. National Girls Collaborative Project

The NGCP brings together organizations that are committed to informing and encouraging girls to pursue careers in STEM. Currently about eight thousand programs are part of the NGCP network, serving more than five million girls. The NGCP's project goals are to maximize access to shared resources, strengthen the capacity of existing projects, and collaborate to create the tipping point for gender equity in STEM. NGCP works to meet these goals by fostering collaborations between uncoordinated services to girls interested in STEM careers, reducing competition for scarce resources, strengthening relationships among organizations, gathering information in a centralized location accessible to the general public, and sharing promising practices.

3. Current Status of Gender Equity

Following a topic introduced in the earlier plenary session, workshop participants were presented with a review of current research on gender equity, much of which is covered in the American Association of University Women's report "Why so Few?" [6] and the proceedings from the plenary session associated with this workshop. A short review is presented here. Girls grow up in an environment and context that shapes them via implicit bias, stereotype threat, fixed traits, and self-assessment. The idea of implicit bias suggests that we grow up "knowing" things implicitly as norms of society. For example, math and science are generally considered to be "male" fields and arts and

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[3] http://smdepo.org

[4] http://www.pbs.org/teachers/includes/content/scigirls/print/SciGirls_Seven.pdf

[5] http://www.ncwit.org/pdf/SSAB_Research_May2010.pdf

[6] http://www.aauw.org/learn/research/upload/whysofew.cfm

humanities are generally viewed as "female" fields. In the case of stereotype threat, girls tend to do worse on a test or project if they perceive a negative stereotype threat, such as having to fill in a bubble on a test indicating that they are female. Fixed traits imply that a person is born with an innate ability to achieve in a particular area, such as playing basketball or doing math, whereas the reality is that with hard work and practice anyone should be able to get better at anything. As for self-assessment, girls tend to self-assess at a lower level than boys. In short, girls often enter into STEM educational settings with the preconceived notions that they will not do as well as boys and that they will not do well if they are not naturally talented in the subject area, both of which are compounded by a tendency to harshly self-assess their performance.

Girls may face additional challenges related to their family and cultural systems when trying to engage in STEM activities. For example, in Native American cultures girls are often caregivers for younger siblings. Including younger siblings in an educational program may allow more girls to participate than would otherwise.

Many of the female workshop participants commented on the "aha" moments that they had during and after the plenary session, as well as the challenges that they had personally faced in pursuing a STEM career. For example, many participants recognized a tendency in themselves to harshly self-assess their performance and/or to be too timid to ask questions in certain situations. Others commented on the differences in attitude and behavior they have observed between their own male and female children.

Ms. Peterson also asked the participants if they had any questions or concerns remaining after the plenary session. One participant mentioned that she was concerned about actually being able to induce gender equity in classrooms, which typically has a rigid structure. This sentiment was echoed among other participants. Karen suggested that we start by working with colleges and universities to train pre-service teachers. Another participant asked the question "What about the boys?" She went on to mention that some schools are banning the advertisement of programs that are for "girls only." The group agreed that it might be better to remove the word "only" when advertising such programs and to simply stress that they are "girl-friendly." Another participant mentioned that their institution had received backlash for hosting "Take Your Daughter to Work Day." They reverted to hosting girls and boys at the same time, which caused the number of attending girls to go down. They recently started separating the girls and boys while still hosting them on the same day, which has caused the number of attending girls to go back up. Another topic that was discussed was the difference between gender equity and gender neutral. Gender equity is parity in areas where girls and women were once underrepresented. Gender-neutral programs make efforts to avoid stereotypes.

4. Awareness Raising—A Gendered World

In order to demonstrate implicit bias in our society, Ms. Peterson presented workshop participants with an assortment of birthday cards that she picked up at a local grocery store before the conference. Participants were asked to study the cards to look for evidence of gender bias. They noted that cards intended for girls were typically pink and contained images of mythical creatures, such as fairies, and words describing the receiver as "pretty," "sweet," "cute," etc. Cards intended for boys were likely to be in a variety of colors, to contain depictions of boys in career roles, such as a fireman, and to describe the receiver as "strong," "smart," "super," etc. Many participants commented on their own experiences with searching for non-gender biased cards, especially for

girls. One participant mentioned that she was recently unable to find an astronaut or space-themed card for a girl.

In addition to raising our awareness of the gendered world in which we live, Ms. Peterson also discussed the need for our awareness of a few key points. First, proven, practical strategies exist for effectively engaging girls in STEM. However, it is also important to remember that not all research applies to everyone. For some girls, hearing that they can't do something is enough to make them want to prove that they can. And last, the involvement of more men is crucial in making a real change in this arena. We need more men to be aware of the implicit bias against girls in our society and to choose to be a part of the solution.

5. Effective Strategies

Ms. Peterson discussed several effective strategies for engaging girls in STEM. These strategies include: 1) making sure that the real-world relevance and meaning of an activity is effectively communicated; 2) providing authentic content and examples; 3) making sure that activities are collaborative; 4) providing opportunities for hands-on, investigative activities; 5) addressing varied learning styles; 6) building participant confidence; 7) providing opportunities for participants to grow and use career-relevant skills; 8) providing opportunities to address stereotype threat; and 9) providing role models and stories from near-peers (in person or via video) for girls to relate to. Adding context to a STEM project helps girls care about why they are doing it. If girls are asked to simply build a robot and make it go in a straight line they will ask "Why?" An example of adding context and real-world meaning would be to tell them that the robot is going to plug an underwater oil leak. One participant asked if it was okay to occasionally separate boys and girls for certain activities. Ms. Peterson indicated that doing so might help girls in some cases, especially for spatial activities, such as those using Legos, where girls usually do not have as much experience in these types of activities as boys. By separating them there is less pressure on girls to complete the activity as quickly as many boys could.

Examples of additional strategies were provided to participants in the form of a program rubric that was developed by the EdLab Group[7] for use with the TechREACH project.[8] The rubric lists elements that should be considered and included when developing an effective STEM program for low-income and underrepresented minority middle school students, including girls. For each element, the rubric helps the user determine how well they are incorporating it on a scale that ranges from "accomplished" to "competent" to "needs improvement" to "limited."

Accomplished programs are inclusive, congenial, supportive, collaborative, and democratic. They focus on STEM, promote student attitudes, and use technology. In addition, they focus on questions/problems/issues that students have identified as interesting and worthwhile, are project-based, make use of adults as mentors or guides, intensely involve students, and involve well-planned and motivating daily activities.

Programs that are rated as limited in their ability to engage underrepresented minority and low-income middle school students, including girls, in STEM allow students

[7] `http://www.edlabgroup.org/`

[8] `http://www.techreachclubs.org/`

to work alone or in friendship-based cliques, are not inclusive of student decision making, provide activities that are uninteresting or not enjoyable to students, do not include STEM topics by design, do not make use of technology (or in the case of the Internet it is only used for surfing), are classroom-like in their organization, are dominated by teacher-directed learning, and do not make good use of students' time.

6. Activity Analysis

With these tips and recommendations in hand, participants worked in groups to assess the effectiveness of existing programs or activities, either those that they had brought with them or examples that Ms. Peterson provided during the workshop. Participants found that it was relatively easy to tweak program and activity elements to be more promising for effectively engaging girls now that they knew what to look for and include. For example, encouraging students to work in groups instead of in isolation and including videos or descriptions of female role models associated with the activity topic were mentioned as simple strategies that would make the programs/activities more girl-friendly.

One of the sample activities that was provided for participants to analyze involved having students determine the difference between a pseudo-science article and a real article. The scientists in the pseudo-science article were all female, whereas the scientists in the real article were all male. Although this disparity was probably not intended on the part of the activity's authors, girls who are asked to complete the activity may pick up on it and perceive a negative stereotype threat. By being aware of how we may inadvertently impose such threats and by being armed with the right tools to modify our programs and products accordingly, we can work to reduce the number of these types of incidences.

7. Next Steps

At the end of the workshop, Ms. Peterson asked participants to write down one or more action items for how they would incorporate some of the information they learned during the workshop into their new or ongoing programs and activities. Ms. Peterson will follow up with participants a few months after the conference to inquire about their progress and to offer advice if needed.

Acknowledgments. We gratefully acknowledge the Astronomical Society of the Pacific for organizing the conference such that we had an opportunity to plan and implement this workshop. We also appreciate the interest and participation of the workshop participants. The Astrophysics and Planetary Science EPO Forums also gratefully acknowledge the support of NASA's Science Mission Directorate.