TPT SciGirls ITEST
Evaluation Year 2

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References
I. Purpose and Background

This external evaluation is designed to examine the nature and effects of professional development and implementation of gender equitable teaching strategies in high school classrooms. In Year 1, the evaluation examined: 1) the professional development course, 2) the effect of the professional development and implementation on the seven participating teachers and, 3) the effect of the role model training. This Year 2 report examines: 1) changes made in the course and, 2) the effect on the 11 teachers involved in the professional development.

II. Design

This evaluation uses a mixed methods approach (Frechtling, 2010) to collect both quantitative and qualitative data through observations, surveys, and interviews. Results were provided quickly in keeping with a collaborative responsive design model (Davis and Scalise, 2014; Rodriguez- Campos and Rincones-Gomez, 2013, Clarke et al, 2006) to inform the project design and implementation.

II.A. Logic Model

The logic model below shows the inputs, outputs and outcomes for the total project. The student outcomes are part of the research study. This report is about the evaluation of the educator and role model activities and outcomes.

[Logic model image]
The formative evaluation from Year 1 was used to refine the content and delivery of the professional development (course) in gender equitable teaching strategies for increasing the number of girls who choose STEM career and technical education pathways. The summative evaluation of both years measured the expected/intended outcomes of the professional development for STEM teachers to determine the extent to which each teacher used the strategies, resources, and role models. The evaluation study questions are:

Year 2: Formative Study Questions
- To what extent are educators already using SciGirls strategies?
- What are the educators or their schools doing, or what do they feel they need to do to get more girls into CTE/STEM classes?
- What are components of effective PD for CTE/STEM faculty?

Year 2: Summative Study Questions
- What is the effect of the PD on educators’ understanding, confidence, mental models, and intent to use the SciGirls strategies?
- To what extent and under what conditions do educators’ implement what they learned?
- How do the educators think the changes they made affected their female students?

II.B. Methods and Measures
The evaluator viewed video of the professional development and collected data on faculty participation, the nature of the PD, and participants’ intent to use (what and how) what they learned. During the course and afterwards, faculty were encouraged to log and share their activities, impressions, questions, and resources via SeeSaw. These, along with interviews with the faculty, are used to characterize the nature of the effects of participation on the participants’ mental models, use of gender equitable teaching strategies and their use of role model videos and visits.

In April 2017, 11 Year 2 participants were observed and interviewed about their implementation of the SciGirls strategies, and the effects on their students’ interest, attitudes and perceived sense of self-efficacy in STEM studies and careers.

Quantitative data from the surveys was analyzed using basic statistics for pre/post gains. Qualitative data was analyzed for themes and patterns using discourse analysis (Johnstone, 2002) to identify changes, such as in participants’ mental models (Gentner and Stevens, 1983, Carley and Palmquist, 1992).

<table>
<thead>
<tr>
<th>Measure</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline/needs assessment survey</td>
<td>Identify their technology access, experience, and use, their current teaching practice, and their ideas about encouraging girls in STEM</td>
</tr>
<tr>
<td>Observation of professional development</td>
<td>Analyze professional development for objectives, design and implementation</td>
</tr>
<tr>
<td>Post PD module and course surveys</td>
<td>Gauge teacher understanding, satisfaction, intention to use what they learned</td>
</tr>
<tr>
<td>Obvservation of teachers using strategies, interviews with teachers</td>
<td>Examine presence of strategies in teaching Describe how teachers perceive changes in their practice and its effects on students</td>
</tr>
<tr>
<td>---------------------------------------------------------------</td>
<td>----------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Year later follow up survey</td>
<td>Discover what strategies have become part of the teachers’ routines and what school practices have become institutionalized with what effect</td>
</tr>
</tbody>
</table>

### III. Findings

The findings are presented for the educators; eleven from three schools in Year 2.

**Educators participating in Years 1 and 2 of SciGirls professional development.**

**Year 1 SciGirls Educators**
- St. Paul Preparatory School
  - School Counselor, College Prep Teacher, Student Advisor
  - Aerospace Engineering, Pre-Calculus, Algebra 2, Aviation
  - AP Calculus, AP Computer Science, Statistics, Intro to Computer Programming
  - Physical Science, Physics, Robotics

**Apple Valley High School**
- AVID Teacher, Language Arts
- Earth Science

**Patrick Henry High School**
- Intro to Engineering

**Year 2 SciGirls Educators**
- Open World Learning (6-12)
- Math (Algebra 2, Pre-Algebra)
- Science (Biology, Environmental Science, Life Science)
- Math (Algebra 1, AP Calculus) AP Computer Science
- Science, Not sure what classes, Leah?

**Central High School Teachers**
- Science (Chemistry)
- Science (Biology, Physical Science)
- Science (Chemistry)
- Science (Chemistry)
- Science (Physics)
- Science, Not sure what classes, Leah?

**Shakopee High School Teacher**
- CTE (Woodworking)

### III.A. Educator Formative Study Questions

- To what extent are educators already using SciGirls strategies?
- What are components of effective PD for CTE/STEM faculty?

**To what extent are educators already using SciGirls strategies?**

The educators reported that they had some experience with gender equitable training and strategies, such as:

- Attended the Cool Chem workshop at UMN
- Technovation (MN) a girls only coding competition
- Equity training as part of AP and NEXUS at the Science House
- Taught in a pre-college summer program at University of Wisconsin - Madison (PEOPLE Program) for students of color
- Worked in UNSP’s Science Research Institute (SRI) for six summers with high school students of color, those in financial need, and young women
• 3M to recruit students from St. Paul Public Schools to enter projects into the Twin Cities Regional Science Fair which has been mostly students of color and women. One of these students, an incoming 12th-grader, is a young woman who is Asian-American, and has taken the initiative to open a high school chapter of SASE (Society of Asian Scientists + Engineers) at our school, for which I will serve as one advisor.

• I try to provide variety in project choices in an effort to provide activities that appeal to all.

• I coach robotics and we have female and male leadership to encourage and provide access for all.

• I did some coursework in college that looked at how to make the sciences more approachable to all students.

• Last year, I did some work with a trio program that involved women from the U of M coming in and teaching a class that emphasized STEM, and showing how women are capable.

• For the last 24 years, I have worked in schools with a Free/Reduced Lunch rate 90% or higher and where white students were in the minority (30% or less self-reporting white). 16 of those years, I have taught math with an eye towards equity: constructivist based curriculum, collaborative groups, writing as a tool of communication and persuasion, group presentations and most importantly, making my students aware of all the careers and opportunities available to them within the field of STEM. I actively recruit students for participation in internships/camps with a STEM focus: Scrubs, SWE, Dunwoody, First Step Summer Institute, Leonardo's Basement, MITY and more. For the remaining eight years, I was a K-12 school counselor working with the American Indian students and their families.

When asked about use of specific SciGirls strategies, educators reported above average use of them before the professional development. On a scale of 1-10, they are already encouraging students to think critically (8.0/10), providing specific positive feedback on things students can control like effort, strategies and behavior (7.6/10), having students work in collaborative groups (7.6/10), encouraging students to participate in projects in their own ways (7.4/10), finding ways to make projects personally meaningful to students (6.6/10) and offering hands-on, open-ended projects (6.6/10). The big area for growth was exposing students to role models and mentors (4.9/10).

<table>
<thead>
<tr>
<th>Rate your use of these strategies, 1-10=highest</th>
<th>Ave</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collaboration in small groups in which students talk about their ideas</td>
<td>7.6</td>
</tr>
<tr>
<td>Finding ways to make projects personally meaningful to students</td>
<td>6.6</td>
</tr>
<tr>
<td>Hands-on, open-ended projects and investigations</td>
<td>6.3</td>
</tr>
<tr>
<td>Encourage students to approach projects in their own ways</td>
<td>7.4</td>
</tr>
<tr>
<td>Providing specific, positive feedback on effort, strategies and behaviors</td>
<td>7.6</td>
</tr>
<tr>
<td>Encouraging students to think critically</td>
<td>8.0</td>
</tr>
<tr>
<td>Exposing students to role models and mentors</td>
<td>4.9</td>
</tr>
</tbody>
</table>
These 11 educators reported that their schools did not openly discourage girls from participating in STEM/CTE but that in general, families and society did not support them in pursuing these areas. They reported that girls have told them, “I’m not good at science.” Some have found that even though girls do not always pursue careers in STEM, they are more successful in class. Several of the teachers say they actively confront negative messages about girls in STEM/CTE.

The girls they have seen being successful in STEM/CTE over time often have great support from home and know role models in their families or social circles. They are confident, curious and willing to be wrong.

They would like to see their schools make female students more aware of programs that are for girls, resources for role models, and help develop a social network of other girls interested in STEM. The school needs to offer more general science electives that help students get interested.

**What are the components of effective professional development for SciGirls educators?**

The objective of the professional development was to develop teachers’ understanding, confidence, and intent to use the SciGirls teaching strategies.

The ITEST Grant research hypothesis is that girls will develop more positive STEM identities and interests when their educators employ research-based, gender-equitable and culturally responsive teaching practices enhanced with female STEM role models. The professional development was designed by a team of professors and specialists in gender equitable teaching strategies to prepare teachers to have classrooms that are inviting to girls.

The PD in Year 2 had the same six modules as the first year, but based on participant feedback, the seminars were scheduled every other week with online work and homework expected through a Weebly and SeeSaw in between. As in Year 1, Year 2 participants receive a stipend and, in addition, could receive continuing education units for completing all the assignments. The face-to-face portion was on Wednesdays from 3-8 pm at Twin Cities Public Television for 12 weeks from September to December 2016 and included dinner.
Feedback from Year 1 teachers was that having the class every week did not give them time to implement the ideas they were learning. They also suggested moving the class from Mondays to Wednesdays so they could incorporate what they learned into their lesson plans for the next week. TPT also started email reminders about the topics and assignments on the non-class weeks. In Year 1, participation online was lower than hoped, in part because of using the technology. To ameliorate this, time was spent in the first class getting everyone online and comfortable with the Weebly course navigation and the SeeSaw for interaction. Feedback in Year 2 indicated these changes had many of the intended benefits. Online participation increased but still not to the extent hoped. The changes from Year 1 to Year 2 are summarized below.

<table>
<thead>
<tr>
<th>Year 1</th>
<th>Year 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nov-Dec</td>
<td>Sept-Dec</td>
</tr>
<tr>
<td>Every week</td>
<td>Every other week</td>
</tr>
<tr>
<td>Over 6 weeks</td>
<td>Over 12 weeks</td>
</tr>
<tr>
<td>Monday nights</td>
<td>Wednesday nights</td>
</tr>
<tr>
<td>Survey links in D2L</td>
<td>Put links to surveys in SeeSaw - easy to get to</td>
</tr>
<tr>
<td></td>
<td>Email reminders from TPT every other week</td>
</tr>
<tr>
<td>Module 1</td>
<td>More time on how to use Weebly and SeeSaw right up front</td>
</tr>
<tr>
<td></td>
<td>Didn’t do jigsaw on research articles (not enough time)</td>
</tr>
<tr>
<td></td>
<td>Added TPT’s overview of how to use role models</td>
</tr>
<tr>
<td>Module 2</td>
<td>More time to think about this while they were still in class; gave them 15 min to do survey and have personal reflection time</td>
</tr>
<tr>
<td>Module 3</td>
<td>Modeling respectful conversations: Write, then talk, then turn and talk to encourage more reflection and voices</td>
</tr>
<tr>
<td>Module 4</td>
<td>Same</td>
</tr>
<tr>
<td>Module 5</td>
<td>Same</td>
</tr>
<tr>
<td>Module 6</td>
<td>Same</td>
</tr>
<tr>
<td>Reviewed SciGirls 7</td>
<td>Reviewed SciGirls 7</td>
</tr>
<tr>
<td>Reviewed the PSAs on SeeSaw – let them peruse themselves</td>
<td>Talked with researcher about case study approach</td>
</tr>
<tr>
<td>Homework assignments</td>
<td>Different way to post (SeeSaw), more conversation</td>
</tr>
</tbody>
</table>

The course material was in the Desire2Learn (D2L) platform in Year 1. In Year 2, a public Weebly environment was created. [http://genderequitabledetachingstrategies.weebly.com/](http://genderequitabledetachingstrategies.weebly.com/) due to comments by teachers that D2L was difficult to navigate and learn to use. To make the assignments easier to post and see from each other, a private SeeSaw space was used.
The module objectives and assignments from the course Weebly are shown below followed by the feedback on each class.

1: Role Models
Introduction: Women are outperforming men in almost all academic fields today. However, they continue to lag at statistically inexplicable levels in computer science and engineering. This 2009 video, she++ introduces us to a variety of young women in the computer science field. The message strives to demonstrate that they are both extremely successful in their fields while meeting stereotypically female social "norms."

Women outperform men in almost all academic fields today. However, they continue to lag at statistically significant levels—in computer science, engineering and many career and technical education fields.

This 2009 video introduces us to a variety of young women in the computer science field.

As you watch consider: How might seeing women computer scientists influence your students?

Strategies for Successfully Engaging Role Models

Learn more about best practices with role models with these resources:
- NAPE's Role Model Resource Page
- TechBridge Role Model Strategies Kit
- Guideline: How to Host a Panel Discussion
Objectives | Assignments
--- | ---
1. Explain the importance of role models in engaging and maintaining girls’ interest in technology and engineering-related fields and use live and video-based role models in classrooms, through mentoring opportunities and/or in advisory settings.

1. Watch and reflect SHE++ and explore additional online resources for accessing female role models [https://vimeo.com/6387745](https://vimeo.com/6387745)
2. Discussion Board: Women as Role Models in CTE/STEM and STEM; Explore Digital Resources for Role Models
3. Check the strategies and reflect on daily use of strategies on a check sheet.

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**2: Student-Focused Instruction**

Introduction: Teachers can be excused for confusing "student-focused" or "student centered" instruction with "student-directed" instruction although the difference is critical. The research on teaching strategies that lead to the best outcomes for girls supports the idea of facilitating rehearsal and application times that afford students multiple avenues for directly interacting with the materials and being able to test their own understanding. This doesn't make the students in charge of the classroom, but it does make them **empowered** to enact their own learning around the teacher facilitated objectives. Even direct instruction can be done in a way that facilitates an empowered student learning experience.

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**Maker Spaces** are examples of student centered, constructivist environments. Research shows that this type of environment encourages meaningful student-learning, inquiry, character building and executive functioning.

- Video from Maker Ed from the Teacher perspective.
- Maker Ed from Student perspective.
- Martinez, S. and Stager, G. (Invent to Learn: Making, Tinkering, and Engineering in the
### Objectives

1. Create a plan to maximize student-centered learning, and increase the time that they spend facilitating (versus directing) new learning.
2. Practice specific strategies designed to engage all students and create an environment where students are responsible for their own learning and share observed results and outcomes online with colleagues.

### Assignments

1. Jigsaw: read selected resource, reflect on Discussion Board.
2. Discussion Board:
   - Student Centered Instruction: Use a Google Form to gather data on the extent to which your instruction is Student-Centered and plan for improvements
   - Plan, Try, Reflect on Student-Centered Instructional Strategies: Using one of the models shared in the face to face instructional session, give one new strategy a try and share on the discussion board.
   - Preparation for Growth Mindset: Choose a source to listen to, watch, or read before next week.

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3: Thoughtful, Respectful Communication and Promoting a Growth Mindset

Introduction: Nothing puts an end to learning faster than when an insensitive comment is made, whether intentionally or inadvertently, within the group. **How do teachers provide for a high level of student interaction while also ensuring a safe and nurturing environment for everyone?** **How can teachers prepare students for group work or class discussions so that all students, regardless of their confidence or personality characteristics, become engaged in the learning?**

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**Fixed v. Growth Mindset**

Nothing puts an end to learning faster than when an insensitive comment is made, whether intentionally or inadvertently.

This might happen if a teacher has a ‘fixed’ rather than a ‘growth’ mindset around human capacity.

Students also may insert discouraging thoughts or ideas into a learning environment—especially when the structure for interaction has not been fostered proactively to promote constructive interaction.

Consider these questions related to the potential for communication that promotes growth with ALL learners in your setting.

- When we think about students *not doing as well* as others, what causes do we ascribe to students’ results—whether positive or negative?
- What relationship do we see between a student’s choices or outcomes and our own actions and responsibilities?
- What words and tone do we use to communicate with students about opportunities for growth?
- How can teachers and counselors provide for a high level of student interaction while also *ensuring a safe and nurturing environment* for everyone?
- How can we prepare students for group work or discussion so that all students, regardless of their confidence or personality characteristics, become engaged in the learning?
Objectives | Assignments
---|---
1. Provide feedback in ways that encourage persistence and provide students with further opportunities to improve on their learning outcomes.  
2. Implement at least one new strategy that fosters effective student communication, and analyze learning results accomplished (or problems encountered) with colleagues. | 1. Post a lesson plan that you’ve redesigned to increase student creativity.  
2. Discussion Board -- **Choose two** of these four options for this week’s discussion.  
• Growth Mindset, reflect on varied applications of growth mindset in your setting;  
• Thoughtful Respectful Conversation; Consider strength areas  
• Facilitating Productive Conversation, encouraging peer to peer conversations;  
• Use Digital Tools to Increase Depth or Frequency of Feedback

4: Promoting Student Creativity

Introduction: Creativity may not be the first word that comes to mind when contemplating the important work done by scientists, computer programmers, engineers and technical workers. However, being able to generate novel responses to constraints or problems is a requirement for a successful person in any of these fields. Creativity is a critical aspect of the work experience of these fields and needs to be emphasized if we want to facilitate more young women considering STEM and CTE fields. Research has identified that girls have a proclivity for viewing failure in a project to be a personal fault rather than a condition of learning, building, or iterating as part of the creative process. This is in contrast to boys who are more inclined to attribute failures externally and to enjoy rising to the challenge of a failure to formulate a creative response.

*Creativity* may not be the first word that comes to mind when contemplating the important work done by scientists, computer programmers, engineers and technical workers. But **being able to generate novel responses to new constraints or problems** is actually an integral requirement for a success in any of these fields.

Creativity—as a practice and attribute of technical/IT/STEM employment—should be emphasized to facilitate more young women considering STEM and CTE fields.

Girls benefit from opportunities to transfer their interest in developing creative solutions to STEM/CTE coursework so they can develop confidence and resilience in this arena. It may help, for instance, to make “failing quickly” a celebrated element of the creative process and to encourage all learners to understand that there isn’t "a" solution to a significant problem. There are many possible solutions, and all of those can have strengths and areas for improvement.

- How do we encourage students to be creative in our classrooms?
- How do we convey to our students that these fields are excellent choices for a person with creative skills and interests?
Objectives | Assignments
---|---
1. Design a new lesson or develop advisory strategies that inspire students' creativity and motivation
2. Share examples of classroom projects and advisory strategies that focus on creativity and personal motivation and share student feedback with colleagues online. | 1. Apply new strategies for creativity in your setting.
2. Discussion Board:
   - Foster Creativity in Others--Share a new lesson or advisory strategy you create to inspire your students’ creativity and motivation. Give an example of other ways you use creativity to motivate students.
   - Dare to be Playful -- Use an animation of digital storytelling tool for your own communication needs this week. Share your experience learning/using the tool.
3. Think ahead: Public Service Announcements: How can we inspire critical thinking?

5: Critical Thinking
Introduction: How can we foster critical thinking skills when "answers" seem to be just a click away? Using frameworks to guide the process of critical thinking helps to curb the interest in jumping to an answer before the full nature of the problem and potential solutions have been considered. Hovering over the "Elements of Thought" web page, you can explore additional ways of considering the topics around the graphic.
Objectives | Assignments
--- | ---
1. Discuss, compare and employ models to increase students’ critical thinking capacities to make a positive difference in their achievement levels. | 1. Preview TED talk for next class: The Danger of the Single Story
2. Share student feedback about a lesson that develops critical thinking and reasoning skills with colleagues online. | 2. Employ one or two strategies this week that can increase student intellectual engagement, and therefore increase critical thinking, and provide feedback for your students.
3. Use evidence to support the importance of gender equity in science trade and technology fields within a digital video they create as a PSA. | 3. Share student feedback about a lesson that develops critical thinking and reasoning skills with colleagues online.
4. Choose how you want to respond on the discussion forum (or VoiceThread). | 5. PSA due by next week.

6: Cultural Awareness and Relevant Learning Experiences
Introduction: The language of coding has yet to be critically analyzed in terms of the cultural blending/warping/ expanding that it can/might/ought to do. In this module, we consider the ways in which our presentation of STEM content is not only gendered, but also culturally specific. What possibilities exist for us to reposition STEM opportunities as culturally diverse and/or specifically appealing to the unique backgrounds of the students with whom we get to work?

Cultural change is necessary before girls will be as likely to see exciting prospects for themselves in science, technical, engineering, computer science, math or physics careers as boys.

But evidence suggests that local shifts can significantly impact the culture.

- What are some steps you can take to try and build capacity locally to inspire high school girls to pursue career pathways traditionally held by men?
- The Public Service Announcement project provides one example of how you can creatively pursue changes in your own cultural landscape.
- What else might you do, alone or in collaboration with others, to help improve girls’ outcomes in career and technical education fields traditionally held by men?

Challenged to "see" the cultural assumptions within our pedagogical choices, we may feel like we are being asked to change the water in our own fish tank. Role playing can help us to make some more elements of our environment visible.

If you stretched yourself to consider the disposition, attitudes, interests, and style of students whose cultural background differs from your own, what would you notice?
Objectives

1. Implement at least one new strategy for successfully engaging diverse students, with the goal of making the information and overall learning/advisory experience more personally relevant for all students.
2. Gather input from female students on the extent to which the girls can see a connection between the content they are learning, or CTE/STEM post-secondary opportunities they are considering and their own life interests.

Assignments

1. Looking forward, how will you continue moving your own learning and that of your community to enhanced practices for inspiring young women to consider post-secondary options in traditional male STEM and CTE/STEM fields?
2. Assuming the role of an anthropologist, deconstruct the cultural norms of a student with a non-dominant cultural life.
3. Using flipgrid or your own means, gather data from students about the extent to which they see CTE/STEM in their post-secondary futures based on their current future life interests.

Module 1: Role Models Survey Results

Objectives

1. Explain the importance of role models in engaging and maintaining girls’ interest in technology and engineering-related fields and use live and video-based role models in classrooms, through mentoring opportunities and/or in advisory settings.
Rate how much you knew before and after this module about each of the following on a scale of 1-10, 1= nothing, 10=very knowledgeable

<table>
<thead>
<tr>
<th></th>
<th>N=11</th>
<th>Before</th>
<th>After</th>
<th>Gain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender equity in STEM (stereotypes, growth mindset, identity)</td>
<td>5.9</td>
<td>7.9</td>
<td>2.0</td>
<td></td>
</tr>
<tr>
<td>Biases that push women out of STEM</td>
<td>5.2</td>
<td>7.5</td>
<td>2.3</td>
<td></td>
</tr>
<tr>
<td>Brain differences between genders</td>
<td>3.9</td>
<td>4.6</td>
<td>0.7</td>
<td></td>
</tr>
<tr>
<td>Sources for role model videos</td>
<td>3.5</td>
<td>7.3</td>
<td>3.8</td>
<td></td>
</tr>
<tr>
<td>Sources for in person role models</td>
<td>3.2</td>
<td>6.5</td>
<td>3.3</td>
<td></td>
</tr>
<tr>
<td>Strategies for using role models in class</td>
<td>3.6</td>
<td>5.8</td>
<td>2.2</td>
<td></td>
</tr>
<tr>
<td>How girls can be role models for each other</td>
<td>4.3</td>
<td>5.9</td>
<td>1.6</td>
<td></td>
</tr>
</tbody>
</table>

All the educators felt that it is important for girls to have female role models. A third of the teachers had not used role models before, 27% had used them once a year, 27% twice a year, and 9% three to four times a year. Those who had used role models felt it was empowering, that girls enjoyed to talking to someone in the field with practical experience, that it was good to see a variety of careers, and that it helped girls feel capable of pursuing any careers. They found girls became more interested in the careers they were exposed to through role models. Most had not focused on female role models in particular in the past but plan to in the future through videos (64%) or in person visits (45%), and to make change to their practice to increase gender equity.

The educators reported their takeaways from the seminar as it is important to have explicit role models for girls and that female role models are positive for both girls and boys. They realize there are specific strategies and resources. They plan to frame conversations with explicit language and examples, use more examples of women scientists, get role models in. start recruiting female students and networking with role model, and use videos to show students possible outcomes for their lives. After the seminar, they had questions about what to do with boys during activities for girls, what strategies they could use, what effect they would have on their students, and how student age affects their choices.

In summary, after the Module 1 seminar:

- Seven educators completed the survey
- Educators reported they knew more about role models in all seven areas (4.3 before, 6.5 after, 2.2 gain)
- A third of the teachers had not used role models before, 27% had used them once a year, 27% twice a year, and 9% three to four times a year.
- All recognized the value of using role models and had ideas for how they would.

**Module 2: Student-Focused Instruction Survey Results**

Instructional Outcomes: On successful completion of the module, faculty will:

1. Create a plan to maximize student-centered learning, and increase the time that they spend facilitating (versus directing) new learning.
2. Practice specific strategies designed to engage all students and create an environment where students are responsible for their own learning and share observed results and outcomes online with colleagues.

*Rate your comfort using each of the following on a scale of 1-10, 1=not at all comfortable, 10=completely comfortable*

<table>
<thead>
<tr>
<th>N=9</th>
<th>Min</th>
<th>Max</th>
<th>Ave</th>
</tr>
</thead>
<tbody>
<tr>
<td>Google Drive/Docs</td>
<td>5</td>
<td>10</td>
<td>8.3</td>
</tr>
<tr>
<td>Back channel</td>
<td>0</td>
<td>7</td>
<td>1.6</td>
</tr>
<tr>
<td>VoiceThread</td>
<td>0</td>
<td>4</td>
<td>1.2</td>
</tr>
<tr>
<td>Discrepant event (predict, observe, explain)</td>
<td>4</td>
<td>10</td>
<td>7.7</td>
</tr>
<tr>
<td>Think, Ink, Pair, Share</td>
<td>7</td>
<td>10</td>
<td>8.7</td>
</tr>
<tr>
<td>Student-centered learning</td>
<td>7</td>
<td>9</td>
<td>7.9</td>
</tr>
<tr>
<td>How to keep kids engaged in class</td>
<td>3</td>
<td>9</td>
<td>7.4</td>
</tr>
</tbody>
</table>

*How often do you use each of the following strategies from Module 2? 1-10, 1=never, 10=all the time How likely are you to use these strategies in the future? 1-10, 1=won’t, 10=definitely will*

<table>
<thead>
<tr>
<th>Average</th>
<th>Now</th>
<th>Future</th>
<th>Gain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student-generated learning strategies</td>
<td>5.4</td>
<td>6.7</td>
<td>1.3</td>
</tr>
<tr>
<td>Start class with a mind warm up</td>
<td>9.3</td>
<td>9.7</td>
<td>0.4</td>
</tr>
<tr>
<td>Use movement to get students focused</td>
<td>5.6</td>
<td>7.1</td>
<td>1.5</td>
</tr>
<tr>
<td>Making each student accountable for learning</td>
<td>7.0</td>
<td>8.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Teach students how to collaborate before expecting success</td>
<td>5.2</td>
<td>7.3</td>
<td>2.1</td>
</tr>
<tr>
<td>Use quick-writes when you want quiet time and student reflection</td>
<td>4.3</td>
<td>5.9</td>
<td>1.6</td>
</tr>
<tr>
<td>Run a tight ship when giving instructions</td>
<td>7.2</td>
<td>8.0</td>
<td>0.8</td>
</tr>
<tr>
<td>Use fairness cup to keep students thinking</td>
<td>6.4</td>
<td>6.9</td>
<td>0.5</td>
</tr>
<tr>
<td>Use signaling to allow everyone to answer your question</td>
<td>5.1</td>
<td>6.8</td>
<td>1.7</td>
</tr>
<tr>
<td>Use minimal supervision tasks to squeeze dead time out of regular routines</td>
<td>6.9</td>
<td>8.1</td>
<td>1.2</td>
</tr>
<tr>
<td>Mix up your teaching style</td>
<td>7.2</td>
<td>7.8</td>
<td>0.6</td>
</tr>
<tr>
<td>Create teamwork tactics that emphasize accountability</td>
<td>5.1</td>
<td>6.1</td>
<td>1.2</td>
</tr>
<tr>
<td>Direct instruction</td>
<td>6.3</td>
<td>6.4</td>
<td>0.1</td>
</tr>
</tbody>
</table>

All the educators felt that it was important for girls that they use student-centered strategies (67% very important, 33% somewhat important) do they were more engaged, learned self-direction, gained self-confidence, invested in their learning. They reported having some insights into student-centered learning as a result of this seminar, including ways to do it, how to have grading reflect student understanding, calling on all students, the way problem-based learning focuses learning on the students. They reported they learned how to:

- Use some technology tricks to get feedback from a large group
- Set expectations for student collaboration
- Use inductive learning practices
- Assign quick writes for student instruction
- Squeeze dead time out of routines
- **Start class with a mind warm-up.**
Keep track of the student-centered strategies I use.

- Use Plickers
- Mix up my instructions between students
- Do better at holding students accountable for their learning.
- Call on every student

In summary, after the Module 2 seminar:

- Nine educators completed the survey.
- Educators reported comfort with five of the seven strategies for student-focused instruction including, think, ink, pair, share (8.7/10), google drive (8.3), student-centered learning (7.9), discrepant events (7.7), and keeping students engaged in class (7.4). They were not comfortable with using a digital back channel (1.6) or VoiceThread (1.2).
- Educators reported they expected to use all 13 of the strategies reviewed more in the future (6.2 pre; 7.3 post, gain 1.1).
- Two-thirds of the educators reported that they think it is “very important” for girls that they use student-centered strategies.

MODULE 3 – Thoughtful, Respectful Communication and Promoting a Growth Mindset

Survey Results

Instructional Outcomes: On successful completion of the module, faculty will:

1. Provide feedback in ways that encourage persistence and provide students with further opportunities to improve on their learning outcomes.
2. Implement at least one new strategy that fosters effective student communication, and analyze learning results accomplished (or problems encountered) with colleagues.

Where do you see the girls in your classes in terms of their mindsets? 1-10, 1=fixed, 10=growth

<table>
<thead>
<tr>
<th>N=9</th>
<th></th>
<th>Min</th>
<th>Max</th>
<th>Ave</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Intelligence is static vs. can be developed</td>
<td>2</td>
<td>8</td>
<td>5.5</td>
</tr>
<tr>
<td></td>
<td>Challenges are to be avoided vs. embraced</td>
<td>1</td>
<td>8</td>
<td>5.6</td>
</tr>
<tr>
<td></td>
<td>Obstacles – give up vs. persist</td>
<td>1</td>
<td>10</td>
<td>5.9</td>
</tr>
<tr>
<td></td>
<td>Effort – fruitless vs. path to mastery</td>
<td>1</td>
<td>8</td>
<td>6.4</td>
</tr>
<tr>
<td></td>
<td>Feedback – ignore vs. learn from</td>
<td>1</td>
<td>9</td>
<td>6.3</td>
</tr>
<tr>
<td></td>
<td>Others’ success – be threatened by vs. be inspired by</td>
<td>1</td>
<td>7</td>
<td>4.5</td>
</tr>
</tbody>
</table>

As a result of this seminar, the educators reported they will use strategies to move girls more toward a growth mindset, including:

- Use the term deliberately and explain what it means. I can discuss this in light of the constructivist lab we just completed that involved brainstorming ways to separate mixtures.
- Provide formative feedback and practice for mastery.
• Students complete several small assignments (low possible points) that offer a challenge and an answer that is not immediately known. I want them to be comfortable with failure and improving.

• Continue to work on supporting all students, and show students that it's okay to fail terribly, and they can keep working.

• Group work with more intent.

• Keep encouraging my students to take small steps and you can reach your goal even though you may not be there yet.

• Encourage all students to work towards quality rather than simply completion.

**How often do you use each of the following strategies from Module 3? 1-10, 1=never, 10=all the time How likely are you to use these strategies in the future? 1-10, 1=won’t, 10=definitely will**

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Average</th>
<th>Now</th>
<th>Future</th>
<th>Gain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Keep an Inclusive Environment</td>
<td>7.6</td>
<td>8.3</td>
<td>0.7</td>
<td></td>
</tr>
<tr>
<td>Keep Discussion Positive and Constructive</td>
<td>7.8</td>
<td>8.6</td>
<td>0.8</td>
<td></td>
</tr>
<tr>
<td>Encouraging Participants</td>
<td>8.1</td>
<td>9.1</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>Allow participants to introduce themselves – you can even set up an ice breaker to have pairs of students introduce each other.</td>
<td>5.6</td>
<td>7.1</td>
<td>1.5</td>
<td></td>
</tr>
<tr>
<td>Be clear up front about expectations and intentions amongst participants and the facilitator.</td>
<td>6.6</td>
<td>8.5</td>
<td>1.9</td>
<td></td>
</tr>
<tr>
<td>Use inclusive language.</td>
<td>7.1</td>
<td>8.4</td>
<td>1.3</td>
<td></td>
</tr>
<tr>
<td>Ask for clarification if unclear about a participant’s intent or question.</td>
<td>8.1</td>
<td>8.6</td>
<td>0.5</td>
<td></td>
</tr>
<tr>
<td>Treat participants with respect and consideration.</td>
<td>9.4</td>
<td>9.6</td>
<td>0.2</td>
<td></td>
</tr>
<tr>
<td>Develop an awareness for barriers for learning (cultural; social; experiential, etc.).</td>
<td>8.0</td>
<td>9.0</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>Provide sufficient time and space for participants to gather their thoughts and contribute to discussions.</td>
<td>6.4</td>
<td>8.1</td>
<td>1.7</td>
<td></td>
</tr>
<tr>
<td>Provide opportunities for participants to pair-share</td>
<td>7.1</td>
<td>8.4</td>
<td>1.3</td>
<td></td>
</tr>
</tbody>
</table>

All the educators felt it was important to girls to have a thoughtful, respectful classroom so they feel safe and that they can take risks. The educators reported having insights as a result of this seminar, including the need to be more deliberate in comments on tests and labs, providing more opportunities for practice to improve their skills and knowledge, determine what I want them to know and what will help them reach that goal, work on giving digital feedback, and use feedback to plan next class. They plan to try new practices such as being more deliberate in forming groups and telling the students why, providing sufficient time and space for students to gather their thoughts and contribute to discussions, help low status participants in group works, developing group worthy tasks, doing icebreakers at the beginning of class, and providing opportunities to engage every student. At the end of the seminar, participants had questions about more ways to move students toward a growth mindset, how to scaffold discussion participation, and on how to deal with the effect of student tracking where students are less focused.

In summary, after the Module 3 seminar:

• Nine educators completed the survey on 10/19
• Educators reported that the girls in their classes were about half way on a scale on 1-10, fixed to growth mindset (from 4.5-6.4)
• Educators reported they would be using various strategies to move students toward a growth mindset such as using student’s names, providing formative feedback and practice for mastery, and encouraging them to learn from failure rather than giving up.
• Educators reported they plan to use the respectful communication strategies even more in the future with a previous average of 7.4/10 and an average intended usage after 8.5 for an average gain of 1.1.
• Educator insights about giving feedback included planning to more deliberate in comments on tests and labs, providing opportunities for practicing skills and knowledge with feedback, and not insisting on group work for all students.
• Educators intend to try new practices as a result of Module 3, including more deliberate organization of groups, more discussion about doing group work, use group worthy tasks, and give opportunities to every student.
• 100% of educators report that it is “very important” to have a respective classroom.

**MODULE 4 – Promoting Student Creativity Survey Results**

Instructional Outcomes: On successful completion of the module, faculty will:
1. Design a new lesson or develop an advisory strategy that will inspire students’ creativity and motivation
2. Share examples of classroom projects and advisory strategies that focus on creativity and personal motivation and share student feedback with colleagues online.

*Where do you see the girls in your classes in terms of their creativity? 1-10, 10=highest*

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>N=10</td>
<td></td>
</tr>
<tr>
<td>Being curious</td>
<td>6.2</td>
</tr>
<tr>
<td>Asking divergent instead of convergent questions</td>
<td>5.3</td>
</tr>
<tr>
<td>Seeing creativity in a positive light</td>
<td>7.4</td>
</tr>
<tr>
<td>Embracing the messiness</td>
<td>5.7</td>
</tr>
<tr>
<td>Able to reflect intensely</td>
<td>6.3</td>
</tr>
<tr>
<td>Building on each other’s ideas</td>
<td>6.8</td>
</tr>
</tbody>
</table>

*How often do you use each of the following strategies from Module 4? 1-10, 1=never, 10=all the time How likely are you to use these strategies in the future? 1-10, 1=won’t, 10=definitely will*

<table>
<thead>
<tr>
<th></th>
<th>Now</th>
<th>Future</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Have students ask the questions</td>
<td>5.9</td>
<td>7.5</td>
<td>1.6</td>
</tr>
<tr>
<td>Have students answer questions instead of you answering them</td>
<td>6.5</td>
<td>7.5</td>
<td>1.0</td>
</tr>
<tr>
<td>Foster intellectual curiosity</td>
<td>6.1</td>
<td>7.6</td>
<td>1.5</td>
</tr>
<tr>
<td>Encourage (and giving time) for students to embrace messiness</td>
<td>6.7</td>
<td>8.1</td>
<td>1.4</td>
</tr>
<tr>
<td>Build a community of learners</td>
<td>6.5</td>
<td>7.9</td>
<td>1.4</td>
</tr>
<tr>
<td>Provide an atmosphere in which creative effort is valued</td>
<td>7.2</td>
<td>8.4</td>
<td>1.2</td>
</tr>
<tr>
<td>Allow time for students to ask questions</td>
<td>6.9</td>
<td>8.1</td>
<td>1.2</td>
</tr>
</tbody>
</table>
Teach creative skills explicitly  |  4.5 |  6.7 |  2.2  
Exposé students to creative work |  5.5 |  7.3 |  1.8  
Praise students for creative ideas and questions |  7.3 |  8.3 |  1.0  
Permit failure and help students learn from it |  7.6 |  8.4 |  0.8  

All the educators reported that they think it is very important for girls to be creative in the classroom because it is tied to motivation and ability to integrate new information into old knowledge, keeps students engaged, gives students more freedom to make mistakes, and because it is their work, they are very serious and care more about it. The educators reported that the seminar resulted in some insights about creating thinking, including, having students come up with their own questions so they care about answering them, encouraging girls to “get messy” and make mistakes, asking open-ended questions, being more deliberate about giving students time to form ideas and pursue them, have more opportunities for students to choose the route of their learning, how important it is to not be judgmental, and give students time to “play” with concepts before tackling abstractions. As a result of this seminar, educators plan to try some new practices, such as teaching creativity explicitly, giving students more opportunities to get ideas from each other, using more art work and drawing, including creativity in most lessons, starting lessons with a hook like a story or activity about how the topics fit in the real world, and making projects more open-ended.

In summary, after the Module 4 seminar:
- 10 Educators completed the survey on 11/2/16
- Educators reported that they see girls in their classes seeing creativity in a positive light and building on each other’s ideas (5.3-6.8/10)
- Compared to how they are using the strategies from Module 4 now, educators plan to use the strategies more in the future, especially teaching creative skills explicitly
- 100% of the educators felt it was “very important” for girls to be able to be creative in the classroom

**MODULE 5 – Critical Thinking Survey Results**

Objectives
1. Discuss, compare and employ models to increase students’ critical thinking capacities to make a positive difference in their achievement levels.
2. Share student feedback about a lesson that develops critical thinking and reasoning skills with colleagues online.
3. Teachers will be able to use evidence to support the importance of gender equity in science trade and technology fields within a digital video they create as a PSA.

*Where do you see the girls in your classes in terms of their critical thinking? 1-10, 10=highest*

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>The purpose of instruction</td>
<td>6.9</td>
</tr>
<tr>
<td>The question at issue</td>
<td>7.6</td>
</tr>
<tr>
<td>The information relevant to the question</td>
<td>7.6</td>
</tr>
<tr>
<td>The key concept they need to understand</td>
<td>7.3</td>
</tr>
<tr>
<td>Whatever inferences they are making</td>
<td>6.0</td>
</tr>
</tbody>
</table>
Whatever assumptions they are making 5.3
The implications of their thinking 5.3
The point of view within which they are thinking 4.6
Striving to make their thinking clear, accurate, precise, relevant, deep, broad, logical, fair, and significant 5.3

How often do you use each of the following strategies from Module 5? 1-10, 1=never, 10=all the time
How likely are you to use these strategies in the future? 1-10, 1=won’t, 10=definitely will

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Now</th>
<th>Future</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Having students analyze case studies</td>
<td>5.9</td>
<td>7.5</td>
<td>1.6</td>
</tr>
<tr>
<td>Provide rigorous feedback on critical thinking</td>
<td>6.5</td>
<td>7.5</td>
<td>1.0</td>
</tr>
<tr>
<td>Expect high intellectual engagement</td>
<td>6.1</td>
<td>7.6</td>
<td>1.5</td>
</tr>
<tr>
<td>Use discrepant events to provoke thinking</td>
<td>6.7</td>
<td>8.1</td>
<td>1.4</td>
</tr>
<tr>
<td>Structure student group work so they push each other’s thinking</td>
<td>6.5</td>
<td>7.9</td>
<td>1.4</td>
</tr>
<tr>
<td>Provide an atmosphere in which critical thinking is valued</td>
<td>7.2</td>
<td>8.4</td>
<td>1.2</td>
</tr>
<tr>
<td>Allow time for struggling with issues &amp; doing critical thinking</td>
<td>6.9</td>
<td>8.1</td>
<td>1.2</td>
</tr>
<tr>
<td>Teach critical thinking skills explicitly</td>
<td>4.5</td>
<td>6.7</td>
<td>2.2</td>
</tr>
<tr>
<td>Expose students to intellectually rigorous work</td>
<td>5.5</td>
<td>7.3</td>
<td>1.8</td>
</tr>
<tr>
<td>Praise students for critical thinking and questioning</td>
<td>7.3</td>
<td>8.3</td>
<td>1.0</td>
</tr>
<tr>
<td>Encourage students to constantly improve their thinking</td>
<td>7.6</td>
<td>8.4</td>
<td>0.8</td>
</tr>
<tr>
<td>Use problem-based learning</td>
<td>7.0</td>
<td>8.0</td>
<td>1.0</td>
</tr>
</tbody>
</table>

All the educators reported that it is important for girls to do critical thinking because it leads to deeper understanding, is part of problem solving, is a big part of living in the electronic world, and imperative in STEM fields.

Educators reported having insights into how to encourage girls to do critical thinking, including letting students know it is ok to take more time to answer hard questions, providing direct help in learning to think critically, and to explicitly teach students how to engage. They plan to try new practices like explicitly teaching critical thinking, building in more time to do it, examining student assumptions, and being more aware of the thinking students are doing rather than just checking for the right answer.

In summary, after the Module 5 seminar:

- 7/10 educators completed the survey
- Educators reported that girls in their classes use critical thinking (4.6-6.7, 6/10): purpose of instruction (6.9), the question at issue (7.6), relevant information (7.6), key concept (7.3), inferences (6.0), assumptions (5.3), implications of thinking (5.3), point of view (4.6), point of view (4.6), and striving to be critical thinkers (5.3).
- Educators report using critical thinking strategies a moderate amount and plan to use them all more in the future: having students analyze case studies (5.9 before, 7.5 in the future), provide rigorous feedback on critical thinking (6.5, 7.5), expect high intellectual engagement (6.2, 7.6), use discrepant events (6.7, 8.1), structure student group so they push other’s thinking (6.5, 7.9), culture that values critical thinking (7.2, 8.4), allow time
for struggling (6.9, 8.1), teach critical thinking skills explicitly (4.5, 6.7), expose students to intellectually rigorous work (5.5, 7.3), praise students for critical thinking (7.3, 8.3), encourage students to constantly improve their thinking (7.6, 8.4), and use problem-based learning (7.0, 8.0). The largest expected gain was in teaching critical thinking skills explicitly (2.2) and exposed students to intellectually rigorous work (1.8).

- 100% of the educators felt it was “important” for girls to be able to be creative in the classroom

**MODULE 6 – Cultural Awareness and Relevant Learning Experiences Survey Results**

**Objectives**

1. Implement at least one new strategy for successfully engaging diverse students, with the goal of making the information and overall learning/advisory experience more personally relevant for all students.

2. Gather input from female students on the extent to which the girls can see a connection between the content they are learning, or CTE/STEM post-secondary opportunities they are considering and their own life interests.

**How often do you use each of the following strategies from Module 6? 1-10, 1=never, 10=all the time**

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Now</th>
<th>Future</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consciously planning for diverse students to be included</td>
<td>6.8</td>
<td>8.4</td>
<td>1.6</td>
</tr>
<tr>
<td>Active teaching methods that engage diverse students with each other</td>
<td>7.5</td>
<td>8.7</td>
<td>1.2</td>
</tr>
<tr>
<td>Planning ways to make the content accessible</td>
<td>7.5</td>
<td>8.5</td>
<td>1.0</td>
</tr>
<tr>
<td>Giving students time to relate to the content from their cultural perspectives</td>
<td>5.2</td>
<td>7.0</td>
<td>1.8</td>
</tr>
<tr>
<td>Accommodating different learning styles</td>
<td>7.7</td>
<td>8.6</td>
<td>0.9</td>
</tr>
<tr>
<td>Providing an atmosphere in which creative value each other’s perspectives</td>
<td>7.1</td>
<td>8.4</td>
<td>1.3</td>
</tr>
<tr>
<td>Teach listening skills explicitly</td>
<td>5.8</td>
<td>7.5</td>
<td>1.7</td>
</tr>
</tbody>
</table>

**How likely are you to use these strategies in the future? 1-10, 1=won’t, 10=definitely will**

All the teachers reported that having culturally relevant experiences for girls in their classes was important (80% very important, 20% somewhat important). Most felt that it was important to actively include girls and their experiences to have learning be authentic and motivating; that all students need to see themselves in the curriculum to be fully engaged. Caveats were that some science is culturally neutral and concerns about treating girls as a subculture. Teachers reported they had insights about cultural awareness from this seminar, including remembering there is no “single story,” realizing they may be uncomfortable with diverse students, recognizing this is a continuous process, and the need to be especially sensitive around holidays. New practices they intend to try are asking their students for help, having more opportunities for sharing cultural experience, do specialized groups, instill an environment of respect among students, and incorporating elements from Dream Keepers.
In summary, after the Module 6 seminar:

- 10/10 educators completed the survey
- Teachers reported they are more likely to use SciGirls strategies in the future: consciously planning for diverse students to be included (6.8 before, 8.4 after), active teaching methods (7.5, 8.7), planning ways to make the content accessible (7.5, 8.5), giving students time to related the content from their cultural perspectives (5.2, 7.0), accommodating different learning styles (7.7, 8.6), providing an atmosphere in which creative value each other’s perspectives (7.1, 8.4), and teaching listening skills explicitly (5.8,7.5).
- 100% of the teachers rated having culturally relevant experiences for girls important or somewhat important.

III.B. Educator Summative Questions – Outcomes

- What is the effect of the PD on educators’ understanding, confidence, mental models, and intent to use the SciGirls strategies?
- To what extent and under what conditions do educators’ implement what they learned?
- How do the educators think the changes they made affected their female students?

What is the effect of the PD on educators’ understanding, confidence, mental models, and intent to use the SciGirls strategies?

When asked how they would describe the effect of the professional development course on the way they think about how they teach and interact with girls, they reported effects on their mental models of what girls need to be successful in STEM CTE/STEM and how to work better with girls in the classroom. We see evidence of this in the public service announcements they created, the lessons that were observed, and the interviews with the teachers four months after the class.

Each teacher created a Public Service Announcement about girls in STEM. One person interviewed her daughter who is studying neuroscience, another made a comic about why women belong in computer science, a third made a poster about the lack of women in various fields. Another educator made a short video to recruit students into her physics classes with the promise, “I explain the world.” Teachers reported that making the PSA was positive because they could use it, their students liked it, and they learned a lot from the interviews they did.

Sample of Public Service Announcements Created by Educators

| Central principal MackBee | Interview of Woman in Neuroscience | HS student working in |
A Dragon Story – how she broke out of her box and pursued her dreams

Having dreams | Finding role models | Planning to break out | Living the dream

Technology education classes mannequin challenge

Women are under-represented - Recent congressional panel on birth control had all male members

At OWL, we are trying to promote gender equity among many other types of equity. Our FIRST Robotics and LEGO teams are coached by females and we actively recruit females to both our teams and our STEM classes. We try to make sure that the problem solvers of the future reflect our country so that the problems are solved in ways that benefit all society.

Who’s Fibbin’? interviews with 4 women, who is telling the truth about her life story?
Why you should take General Physics….  
By Ms. Elizabeth Myers

Why does pizza sauce burn your tongue but the crust does not?

How can you lay on a bed of nails and it doesn’t hurt?

I Explain the World!
To what extent and under what conditions do educators’ implement what they learned?

There is evidence in the SeeSaw posts during the fall 2016 professional development that the educators were trying out new strategies and sharing ideas as shown by the sample posts from SeeSaw below. The PD facilitator reported that this group of teachers was already familiar with a lot of the SciGirls strategies so she tried to make the class more about sharing and brainstorming.
Sample Participant Contributions in SeeSaw

Women of Science Group Order Form - Sign Up Today

Two ways that I am doing culturally relevant teaching this week is "the practitioner as facilitator". Students have been working on a project in a google doc they have shared with me. As they work on various aspects of the project, I read what they are writing and give them comments about ways to improve their writing. I see this as a facilitator role. The second way is tomorrow the students will be using a plus/delta feedback sheet where they will be reading each other’s google doc and giving feedback to the writer. So this is student controlled discourse.

Sorry it took me so long to get this uploaded. Lena has said if anyone was interested in contacting her further, she’d be willing to be another role-model type person.
This video is one that some of my kids really like. It is atomic theory from a gang perspective.

These two students gave specific feedback about the process and rationale for finding the number of subatomic particles. This is how I eventually want all students to sound!
These two students are getting it and gave feedback about being helped by the thinking process. I really hope each year to get students to think about why \# protons = \# electrons for a neutral atom and why protons + neutrons = mass.

I think these two are in different early stages. When I was a student I just memorized p=e and p+n= mass without ever learning what that meant. I now know that understanding nuclear mass and positive charge is essential for upcoming weeks of ions, bonding, reactions, and stoichiometry. I really challenge students at this point to explain why they draw their pictures the way they do. If they can think through one atom, they can solve any of them. It's tricky until it's not, just like most everything in chemistry. These two will hopefully get there soon if they continue to think about why this is the way it is.
I have finally added student creative work submitted yesterday. Students were given a rubric allowing them to earn points for representing sub atomic particles in any format they wished. Most drew posters but I also received several computer-generated and 3D homemade models, four of which I just posted.

We are in the midst of a big project which I have never done before, but they do at Central in physical science. One of the great aspects of the project is that it has these embedded critical thinking steps. (Thanks Tristi!!!) When they are writing their purpose they are asked to include the following. “To protect your egg, explain if you want to increase or decrease the following variables: friction, acceleration, mass, and inertia.” I think this is an excellent critical thinking step. Here are four variables we have discussed and the students should know what they mean. The knowledge base you need to have to be able to do critical thinking. But, now we are asking them to consider the affect these variables will have on the vehicle they are designing and achieving the goal of the vehicle - to protect the egg occupant. It will be interesting to see their reasoning process and then how that affects their design decisions.

I’m working on a 2nd video assignment (Newton’s Cartoons). It’s still Extra Credit but it builds on a previous assignment. Per John’s suggestion, I’ve surveyed my students about their experience using the software.

I’m still a little shaky on the rubric. Thanks Meg for the starting point.
In our grading system, students earn a B+ for passing all tests and need to do something "more" to bring their grade up to an A. I like to use a creative project for this type of assignment. Students are motivated to earn higher grades and can build on their existing content mastery as they work creatively.

**Teacher Interviews**

In the April interviews (four months after the end of the class), all 11 educators reported they had used ideas from the class. The shift in their mental models seemed to be toward noticing what was making girls feel comfortable, actively participate and feel like they belonged in science. As in Year 1, they were noticing that sometimes making all girl groups gave girls more confidence to participate and be engaged in labs and other tasks. All girl groups seemed to also encourage their own members to participate as in taking turns, or asking what others thought about something.

Other shifts occurred around their interactions with individual girls. For example, one teacher talked about how she had realized she needed to encourage girls in a lot of small ways every day to help them feel they were successful in her science class. She noticed that this increased attention resulted in some girls interacting with her more about their work and doing better in class. Another teacher described a similar insight, “I realized they needed to know I had their backs.”

When asked if it is more difficult for girls to succeed in STEM/CTE, they responded, “yes and no.” Their experience was that girls often are afraid to fail, are focused on grades, or are intimidated if boys make remarks about how easy it is to understand something. On the other hand, girls often do better in science classes because they try harder and complete assignments.
This does not always translate into taking more science classes. This analysis led some of the teachers to notice the orientation of the girls in their classes – toward grades, learning, failure and each other. When one teacher noticed that one girl was always asking about assignments, he reassured her that she was doing fine, going to get a good grade, and was really good at science. Another teacher noticed one girl was hanging back when decisions had to be made so she spoke to her individually about what a good critical thinker she was.

Although all of the educators in this Year 2 group already used cooperative groups, several reported looking more closely at how they were working. Did all girls prefer girl groups? Did some prefer working with boys? Why? Did girls prefer working with some boys and not with others? What were the differences between the boys girls liked to work with and those they did not? How could they as teachers structure the groups to support girls’ success? This shift, toward intentional observation of what makes groups work for girls, resulted in educators experimenting with different strategies and discovering things that worked. While each class had its own character, they reported finding that girls liked working with each other more than with the boys because, “it’s just easier.” They “didn’t mind” working with boys who were “nice” which seemed to mean they listened to the girls and accepted their involvement, even welcomed it. Some of the educators were starting to experiment with having groups pick roles to encourage everyone to participate, and thinking about how and when to switch group membership. Others were experimenting with different numbers of students in groups. All were being more explicit about how groups should work together and checking in on how they were actually working.

In Year 1, most of the educators didn’t use role model videos or invite them to class. One school had a breakfast for girls and their families. In Year 2, additional support and expectations were set for using role models so all the educators did used videos and had live speakers. At one school, the invited role model visited several classes. They reported that this was very worthwhile and that the girls seemed to pay special attention and ask more questions. They found the role models were emphasizing perseverance and hard work, but also had a lot of passion for their work which was very inspiring.

Teacher Observations
Teachers were observed for one class period of their choosing and interviews on the same day. Some teachers provided lesson plans ahead of time, others on the spot, some not at all. One teacher had to do a test review lesson because her students had been pulled into something else the day before.

Teacher 1: Chemistry, N=27, F=10, M=17
Students arrive to a “Do Now” on the smartboard - How can we compare bond types? Students had completed a lab in the last class on what happened to four substances when they were heated. The teacher asked students to review their data to answer the question: Did you know ionic bonds are stronger than covalent bonds? Based on this, look for patterns in your lab data. Which substances might be ionic? Which are covalent? They had done the lab in teams (3 all male, 2 all female, 2 mixed gender). The teacher used “Pick Me” app to call on students to report on patterns they noticed. The teacher tallied what the students thought about whether each substance was ionic or covalent on the board so they could see everyone’s results. As they reported out, the teacher asked why they thought the substance was ionic or covalent based on...
what the students observed when it was heated. In each case, most of the teams came up with the same conclusion and accurate reasons for it. If a group had an incorrect conclusion but a correct observation, the teacher probed for clearer thinking. For example:

*If ionic bonds are stronger than covalent bonds, which of these substances might be covalent and which might be ionic? I’m wondering what your hunch is Alene about B?*
*Student: Melted. If something melts, is it held together super tightly or not so tightly? Do you suppose substance B would be held together by ionic or covalent bonds? Which is stronger? Student: It’s probably co-valent. In this lab, if something melted, what kind of bond was holding it together? Student: Co-valent. Brifoster, which ones didn’t melt? Student: A and C. Which type of bond holds things together better? When do things melt? Student: When they are not held together well, they have ionic bond.*

This line of questioning continued until the students were consistently able to explain how they knew the type of bond from their observations. The teacher was consistently respectful in asking for explanations so students were willing to share their thinking. The pattern of asking for so many students to explain and then asking clarifying questions seemed to help students develop their understanding. They often consulted with their lab team before responding if they were called on. The teacher gave positive feedback for partially formed ideas that helped move the students’ thinking forward. Many of the students were thinking about the question on the spot. In the last five minutes, students reflected individually in writing in response to questions about their conclusions. SciGirl strategies were all used except role models and creative thinking.

**Teacher 2: Physical science, N=16, F=7, M=9**
The class started with “Fast Five” questions on the board, which students responded to individually.
1. *What are the four phases of matter?*
2. *Are the phases of matter a physical or chemical property?*

A schedule was also on the board:
1. Fast five / new seats
2. Physical/chemical properties notes
3. Lab
4. Clean up

The teacher walked around the room, reviewing students’ responses and signing off on them. Then led a whole class discussion on physical vs. chemical properties. The teacher elicited ideas for each, asked why, and asked other students if they agreed and why until the properties for each were listed on the board with brief descriptions of each of them. For example,

*What are some examples of physical properties of something on your desk? What about a chemical property? Can I change the substance? Student -yes So how would I change it? Students- burn, cook, rust, pH*

After a few minutes, students were answering consistently about the phases of matter as physical properties and giving good reasons why, so they moved into the lab. The teacher pointed them to the lab overview on their iPads and reminded them of safety issues. She encouraged them to
think about how they would do the lab in their group and capture the results. Cued them to begin, “Ready, set, go.” She rotated among the groups, discussing what they were doing. The groupings were three girls, two boys (3), a boy/girl group, a boy working alone and two girls. In her interview, the teacher reported she had been supporting same gender groups and most students seemed to like it better. She was also consciously calling on different students all the time to be sure all of them were expecting to have to share their thoughts. She has been explicitly teaching and expecting students to do critical thinking. On the wall was a poster on claims, evidence, and reasoning. All the SciGirls strategies except role models and creativity were used in this lesson. Earlier, this class had done a design project that required creativity.

**Teacher 3, Chemistry, N=25, F=12, M=13**
The objectives of the lesson were to: 1) Learn how to interpret equations in terms of particles, moles, and mass, and 2) Analyze and report the number of particles, moles and mass in any given equation and verify the law of conservation of mass. The rationale is that students should understand the various ways equations provide us with information regarding particles and mass so they can use these to do mass-to-mass conversions. Real life applications include being able to calculate amounts of reactants needed and the products made during a chemical reaction.

On the board - Proving the law of conservation of mass through our equation.

*How do we tell the difference between molecules and atoms in the equation: (2NA +2H2) -> 2NaOH+H2? Is water an atom or a molecule? Student -molecule How would you know? Student – subscripts.*

*What if there are no subscripts? Student – if there is more than one atom.*

*What about H? Student – an atom because it is only one symbol and no subscripts*

You can also look at the mass on the periodic table

Questioning continued with students mostly volunteering answers as the teacher went through moles and how to look at an equation in terms of particles, moles and mass to show that the law of conservation is observed. Then the teacher said, *Find a partner or work in a group to do the worksheet.* Students worked individually while the teacher circulated to answer questions, quell frustration and wake up a student. The class ended with instructions from the teacher to, *Finish up at home. This stays in your notebook. You will get your participation points if I have seen your work. This chapter has a lot of pieces, so you can put them together when we move on. If you are not doing the practice, you will have trouble putting the pieces together later this week and next.* All of the SciGirl strategies were used accept role models.

**Teacher 4, AP Chemistry, N=18, F=10, M=5 (15 out for music event)**
In this class, students had begun a lab the previous day and were continuing it. They worked in groups (4 groups of 3 girls, 2 boys, 2 boys and 1 girl). The teacher moved from group to group when asked a question, to troubleshoot equipment, or check in on progress. The students seemed very comfortable working in groups, designing their own data recording process, usually after some negotiation, and even checking with students in other groups to compare results or ask practical questions. The teacher answered basic questions and reinforced that they were on the right track, or asked questions that made them consider other approaches.
The objectives of the lesson were to: 1) conduct an acid-base titration and determine the concentration of acid in common beverages, 2) obtain a titration curve from LabQuest using pH meter, and 3) analyze and calculate from titration data curve the amount of acid in a typical serving size or bottle. The rationale was that students need to understand the effects of adding acids to bases and vice versa so they can determine how a neutral solution can be made which has real world significance when dealing with acid indigestion or acid rain. Students were expected to write an AP lab report within a week. All the SciGirls strategies except role models and creativity were used in this lesson.
Teacher 5, Physical Science, N=25, F=11, M=14

Students were given instructions for an activity on work and force. Concepts were reviewed on the board, then student groups (already seated together), moved to the stairwell to do the activity. There were three groups of boys, three groups of girls and two mixed groups. In the stairwell, students were very engaged and would stop and discuss things like how to get the most accurate data and what it meant. The worksheet asked students to think critically to make claims based on evidence from their data. All the SciGirls strategies except role models and creativity were used in this lesson.

Power Upstairs!!

Purpose: To observe power and work when running and walking up stairs.

Materials: meter stick, scale, stairs, stopwatch.

Procedure:
1. Use a scale to determine your weight in newtons. Record your answers in the data table. Show your work here:
   HINT: 1 lb = 4.45 N
   \[ \text{lbs} \times 4.45 = \text{N} \]
2. Use a meterstick to measure the height of one step in meters. Multiply by the number of steps you will climb to calculate the height of the stairs you climb. Record your results in the table. Show your work here:
   \[ m \times \text{steps} = m \text{ total height} \]
3. You will be calculating your work and power while walking and running up stairs. Make a hypothesis:
   If I running up stairs, then my power will increase/decrease/stay the same (circle one) compared to walking because

4. With a classmate, use a stopwatch to time how long each of you takes to walk quickly up one flight of stairs to the landing (just up! Not down!). Repeat two times. Record your results in the table. Calculate your average walk time and record your results in the table.

5. Repeat procedure step 4, except running up the flight of stairs. Record your results in the table. Calculate your average run time and record your results in the table.

<table>
<thead>
<tr>
<th>Weight (N)</th>
<th>Total height of stairs climbed (m)</th>
<th>Walk up Stairs Time 1 (sec)</th>
<th>Walk up Stairs Time 2 (sec)</th>
<th>Avg Walk Time (sec)</th>
<th>Run up Stairs Time 1 (sec)</th>
<th>Run up Stairs Time 2 (sec)</th>
<th>Avg Run Time (sec)</th>
</tr>
</thead>
</table>

DATA ANALYSIS

Work = Force x Distance

Power = Work/time

CALCULATE WORK FOR WALKING: Multiply your weight in Newtons by the height of the stairs in meters to get the work that you did in joules. Show your work here (equation, sub in numbers and circle answer with units)
Teacher 6, N=28, F=12, M=16

Students had completed a quiz on the key concepts for the class. The teacher showed these items and asked them how they responded (think individually), then to say why, then discuss the answer. Students were attentive and this seemed like a routine which they valued. Then they moved into the Time for a Tune Up Lab. Students were seated with their lab groups (4 boy groups, 3 girl groups, 2 mixed). The teacher demonstrated the use of the equipment, then
circulated among the groups, providing feedback and answering questions. All the SciGirls strategies except role models and creativity were used in this lesson. Earlier this class had done a design project using creative thinking.

Teacher 7, Pre-Algebra, N=29, F=14, M=15
The purpose of the lesson was to have students recognize that inaccuracies in graphs can convey erroneous information – misleading statistics. She drew names on popsicle sticks to call on students. Students observed each graph or set of graphs, jotted down their own ideas, discussed with their group, and reported out (think, ink, pair, share). The examples were from published...
sources for believability. Students who shared out naïve ideas were accepted, and asked to explain. If they expressed doubt in explaining they were asked if they wanted help. If (when) they said yes, the teacher called on someone else. After accurate interpretations were shared, other students were asked to paraphrase. The last task was to portray some data in a graph and with some sort of symbol that would help with understanding the data (see below on right). All the SciGirls strategies except role models were used.

Teacher 8, Algebra 1 (8th grade), N=31, F=15, M=16
Students were preparing for a field trip to the State House the next day to present their research on the question, Does the Minnesota budget match our values? They were reviewing the info for their posters and making edits before printing that day. They had been working on the project since February, identifying the topics they were interested in, studying the budget, and deciding how to represent the data, and present their positions. The project used all the SciGirls strategies. The theatre teacher came in to give them her formula for talking to people: 1) relax, 2) make eye contact, 3) breathe, and 4) practice your power pose. She had them do activities for each one. Samples of their posters are shown below:
Group 1

Cost of Corrections and an Educational Connection
McG (64A), Ingrid (64A), and Sofia (64A)

It seems like there would not be a connection between spending on education and cost of corrections and public safety, but they are closer than you might think. Our graphs show the amount spent in these two areas has increased together. In our project, we will talk more about our graphs and make suggestions for future budgets.

Our graph demonstrates that the state spending on E12 education and on corrections and public safety have both been increasing in a pretty consistent way, although E12 spending has been growing more rapidly than cost of corrections and public safety. This shows that state priorities are focused on education. This pays off, considering 98% of Minnesotans students are high school graduates. However, the cost to educate one student for a year is $12,248, which is much less than the cost to house one inmate for a year, which is $44,509. This means if the number of prisoners and the number of students were equal, we would be spending more on corrections and public safety than we would on E12 education. You could say that this goes against the flow, but actually since the number of prisoners in Minnesota is significantly smaller than the number of students in Minnesota, the money goes in cost of corrections and public safety is distributed across fewer people.

Our graph shows that both the spending on E12 education and on public safety and corrections have both been increasing steadily, and E12 spending has been growing more quickly.

Group 3

Relation Between Endangered Wildlife Populations and Man Made Enclosures (Zoos) Cost
Anishka Altman (67B) and Sarah Lipkin (66B)

In 1973 the grey wolf population decreased from the wild and the only way we got from this species is to see them from Canada for short visits. The wolf population started to decrease when the human population started to increase and two species began competing for the food and territory. Another difficulty the grey wolves have faced is that people have cut off large areas of forests allowing the species to decrease. When the bobcats started to grow in large numbers, the wolf population was forced to retreat and this without proof if it was the true attacker. The bay from the attack was not seen if the attacker was really a wolf or not.

Although the wolf and moose populations have been decreasing since the 1900's, zoos and wildlife organizations work hard to keep that population from hitting rock bottom. Although the wolf and moose populations have been decreasing since the 1900's, zoos and wildlife organizations work hard to keep that population from hitting rock bottom. Although the wolf and moose populations have been decreasing since the 1900's, zoos and wildlife organizations work hard to keep that population from hitting rock bottom. Although the wolf and moose populations have been decreasing since the 1900's, zoos and wildlife organizations work hard to keep that population from hitting rock bottom.

With our data it is clear that while rare are doing well with their spending in keeping the wolf population up, they are not doing as well with regards to the moose population, which has continued to grow. Even though the data is not conclusive that rare is not doing as well as it is, the data shows that rare is not doing as well as it could be, which is why rare has decided to do something to help the moose population.

A plausible solution for the declining moose population would be to have moose hunting and issue a certain number of moose in reserves that resemble their natural habitats. Also with the moose that are taken into the reserves we can study some of the diseases and bugs that are also threatening the moose population and find cures. To keep the wolf population from falling even further the state of Minnesota should continue working with zoos and other facilities like that will not only keep their population at a constant but will also increase the number of wolves they will hunt in the state of Minnesota.
Teacher 9, Geometry, N=28, F=14, M=14

The teacher began with a Do Now (see student notebook below), then presented a problem of figuring out the height of a lamp post by measuring shadows and known heights – triangulation – using pictures of an actual scene with overlays of the triangles and data. Students were all engaged in the whole class discussion. Then they worked in groups (turning to those near them) on the problem. All the SciGirls strategies were used in this class except role models and creativity.
Teacher 10, Woods 3, N=14, F=2, M=12

As a whole class, the teacher reminded the students of the deadlines for completion of their projects and showcasing them at a community wide event. He asked if anyone had any issues or questions. A few students asked questions, then they moved into the shop. Students had chosen something to build, created plans that had to be approved, then were building them. Every few days they do a video blog showing their progress like is now being used in real building projects. They also do quizzes and modules on specific topics that help with their projects. The main goal is to have students be able to conceptualize, plan, and manage a project. The teacher has an advisory board from industry that keeps the program focused on the latest trends, tools, and needs. This project uses all the SciGirls strategies, including role models since the teacher worked in industry, and other students who had completed Woods 3 projects had them on display.
Teacher 11
This is the lesson the teacher would have used if the schedule had not changed. It has many SciGirls elements.

How do the educators think the changes they made affected their female students?

Educators reported changes in their awareness of what they were doing and how it was affecting the girls in their classes. This awareness led to making changes to engage the girls more.
and help them feel comfortable in class. For example, one teacher reported moving girl groups to the front of the class to “let them know I cared about them” which resulted in them paying attention and participating more. Another teacher realized that some girls seem to feel they can’t be smart and pretty at the same time so they don’t engage as much or sign up for advanced science classes. She has talked more about her own culture as a female growing up in India where that distinction did not exist, and brought other role models into the class live and via videos. She has seen the girls pay attention to this message but feels it is too early to tell what the overall effect will be.

One science teacher assigned students to research a scientist and present about him or her to the class. He noticed that girls assigned a female scientist did a better job than boys assigned a female scientist, “They really seemed to identify with them. They even got mad when a woman was not given credit for her work. They were also very surprised at how few women become scientists.”

Two teachers in one school observed each other’s classes for gender participation and found they called on the girls at least as much or more than the male students in beginning science classes. This is in part because they have very active females in these physical science classes. They are not sure why but suspect that boys are pushed to go into biology (as the more difficult class), whereas girls might not be pushed in the same way so there ends up being a larger number of motivated girls than boys in physical science classes. They plan to look into this with guidance and observe each other for the types of questions asked by gender. This peer observation is accepted in lieu of principals observing teachers in this school.

One teacher reported working on helping the girls in his classes to see themselves as science students through noticing when they were “doing” science and commenting positively to build their sense of identity within the field. He wants them to feel like, “I can do this” as opposed to “that’s not me.” For the labor and trade union field trip, he showed role model videos on the trades ahead of time and actively recruited girls to go. More girls than boys ended up going.

IV. Conclusions and Options for the Future

Educator Formative Results

To what extent are educators already using SciGirls strategies?

Most of the (9/11) educators participating in year 2 had education and experience in teaching students from under-represented groups in formal and out-of-school environments. They reported their use of six of the seven SciGirls strategies from 6.2 out of 10 with a lower rating for using role models (4.9). The professional development facilitator confirmed their understanding of many of the concepts in the course, describing them as a “sophisticated group” so she ran it as a discussion forum of their previous practice and their needs.

What are the components of effective professional development for SciGirls strategies?

Based on feedback from the year 1 participants and reflection by the course team and TPT, revisions were made to the schedule for the professional development to make it more effective.
The seminars were held every week over 12 weeks rather than weekly for six weeks to allow more time for trying out ideas in between face-to-face meetings. Seminars were moved from Monday to Wednesday evenings to allow educators to plan over the weekend to try things the next week. The online platform for the course was changed from Desire2Learn to a weebly with SeeSaw for interaction.

One module was used in each two-week period. Educators completed a survey after each face-to-face session. Results showed that they enjoyed the class discussion, intended to use some of what they learned, and had insights into their current practice. The change in platform resulted in more participation in between face-to-face sessions than in year 1. Three of the 11 educators complained about having to learn new tech tools. The schedule was rated positively. As discussed, most of the participants had experience with the SciGirls strategies except using role models, so while they appreciated the discussions in the face-to-face seminars, they would have liked to have learned practical methods for engaging girls beyond what they were already doing.

**Educator Summative Results**

*What is the effect of the PD on educators’ understanding, confidence, mental models, and intent to use the SciGirls strategies?*

The educators reported feeling more confident using each of the strategies, having insights into ways to support girls in class, and intent to try new things to engage them more. They reported their mental models of how to teach girls had shifted to being more focused, supportive, and explicit as a result of the course.

When they were observed in the late spring, they were each using strategies they learned in the class, such as ways to call on every student every class, structure groups to encourage girls, and have personal interactions that develop girls’ science identities.

*To what extent and under what conditions do educators’ implement what they learned?*

Observations and interviews with each of the 11 teachers occurred during the week of April 17, 2017. In the observed classes, most teachers were using at least one method for each of the SciGirls Seven. Teachers used methods of collaboration such as think, pair, share, lab groups with roles, hands-on activities in groups, and discussion groups for test prep. They engaged students in making connections with the content through analogies and examples. They set expectations for the class and checked on participation with individuals and groups. Each teacher reported having had role models through video or in person, and having emphasized women in science in other ways.

Educators created public service announcements they could use with their students, providing further evidence of their implementation. Posts in the SeeSaw space about their students’ work, useful resources they use, and things they were trying show they were implementing ideas as they learned them.

When asked what effect the course had on their practice, most of them led with something like, “It’s made me more aware of that I do and what I need to do for girls.” Because of this shift in their thinking, they continue to observe, try things, and notice the effects. This result is more
general than adopting specific methods, but at the same time more generative because they have a framework for continuing to evolve their methods.

**How do the educators think the changes they made affected their female students?**
The educators all felt they had made changes in their classes that positively affected their female students on a day-to-day basis. They were quick to point out that long-term effects were difficult to predict, but certainly seeing girls more engaged, or doing better work are positive indicators of potential effects on girls’ involvement in STEM. They had each looked closely at the way they structured group work to more supportive and encouraging to girls. They were all more consciously offering encouragement and positive feedback orally and in feedback on assignments to help girls feel like they belonged and could be successful. They all used role models and saw that all their students, especially the girls, were interested in them and benefitted by learning about a career and seeing that a woman could be successful.

**Options for the Future**
The data from the two cohorts of teachers in 2015 and 2016 indicate that teachers with different levels of experience sign up for, and benefit from professional development in gender equitable strategies. Not only do these teachers have different levels of experience and expertise in the strategies outline in the SciGirls Seven, they also teach in very different environments and levels of students. To accommodate this range, their feedback provides some directions for the future.

*Teachers recognize that most girls are not as engaged in STEM/CTE as boys*
The teachers were very clear about how girls are not as engaged in STEM/CTE as the boys. They were aware of societal and school policy issues that contribute to this. They were also aware of some of the areas that could potentially make a difference, such as counseling more girls to take these classes, providing more encouragement and reinforcement that they can succeed, and providing them with role models. While aware of the factors and needs, they did not feel they were adequately addressing the issue.

*Teachers want to build on their own experience*
In both years, some of the teachers felt the material was already familiar to them. At the same time, they wanted ideas for their own classrooms, such as how to meet standards and course requirements and allow time for creativity, or how to “mix up” lessons so girls were more engaged more of the time.

*Teachers want to focus on their own classrooms*
Learning how to navigate new technologies that they probably will not use with their students was frustrating for many of the teachers. While a Weebly and SeeSaw were substituted for D2L from the first year, some teachers were still not sure how to post. Some resented doing “homework” that seemed more like make work to them.

*Teachers appreciate and learn from the expertise of others*
In both years, educators appreciated the discussions in the face-to-face sessions, the research articles, and practical suggestions from the facilitator and other participants. They want new
information that gives them ideas for what they can do in their own classrooms. They want to be able to reflect on what they are doing and ask questions with problems or concerns they have, such as, *How do I assign roles in a group if I also want them all to do all the parts?* They want a more individualized approach than is currently offered in class assignments so they can focus on their own work.

**Teachers report the main effect of the course was making them more aware of what they are doing to support girls in their classes**

Each of the teachers talked about this in his/her own way – from noticing how girls react to boys in a group or how they want to be right so are reluctant to try things to systematically building girls’ STEM identities with positive comments and seeing themselves as advocates for girls in their classes, encouraging them in every way possible. They all moved from being aware of the issue to more explicitly addressing it.

**Course Design Features**

Whether an all online course or a continuing hybrid course is offered in the future, several options are suggested by the data.

1. Use an andragogical approach to instruction or class time that recognize and build on the professional experience and expertise of the educators. Activities could include analyzing classroom lessons (video) for use of SciGirls strategies, comparing approaches through case studies using different gender equitable strategies, redesigning lessons to be more gender equitable, designing their own lessons for critique by a partner or the facilitator.

2. Instead of individual assignments related to the modules, have educators identify what they would like to work on related to girls during the 12 weeks, develop an action research plan, work with a coach, and have a peer partner to share their data, insights and issues with, culminating in a paper on what they learned, what they changed in their own practice, the effects they achieved and why they think these changes occurred.

3. Increase the richness and variety of resources for teachers to use in their action research with video on each SciGirls strategy, methods, and examples. Make these with students in mind so teachers can use them directly with students on topics such as: Why work in a group? What makes an effective group? How to involve everyone and help them feel comfortable in a group? Where does a sense of identity in an area come from? Can it be developed? If so, how? These videos could have accompanying questions to think about or activities for both teachers and students. These learning objects would then support the educators in becoming more explicit in their expectations and methods in their classes. The assignments could be given to girls to do individually or in groups to further develop their confidence and skills and let them know the teacher understands the issues they are facing.

Below is an overview of one way these options might be used in a course design in the future.
References


