TPT SciGirls ITEST

Evaluation Year 3

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I. Purpose and Background

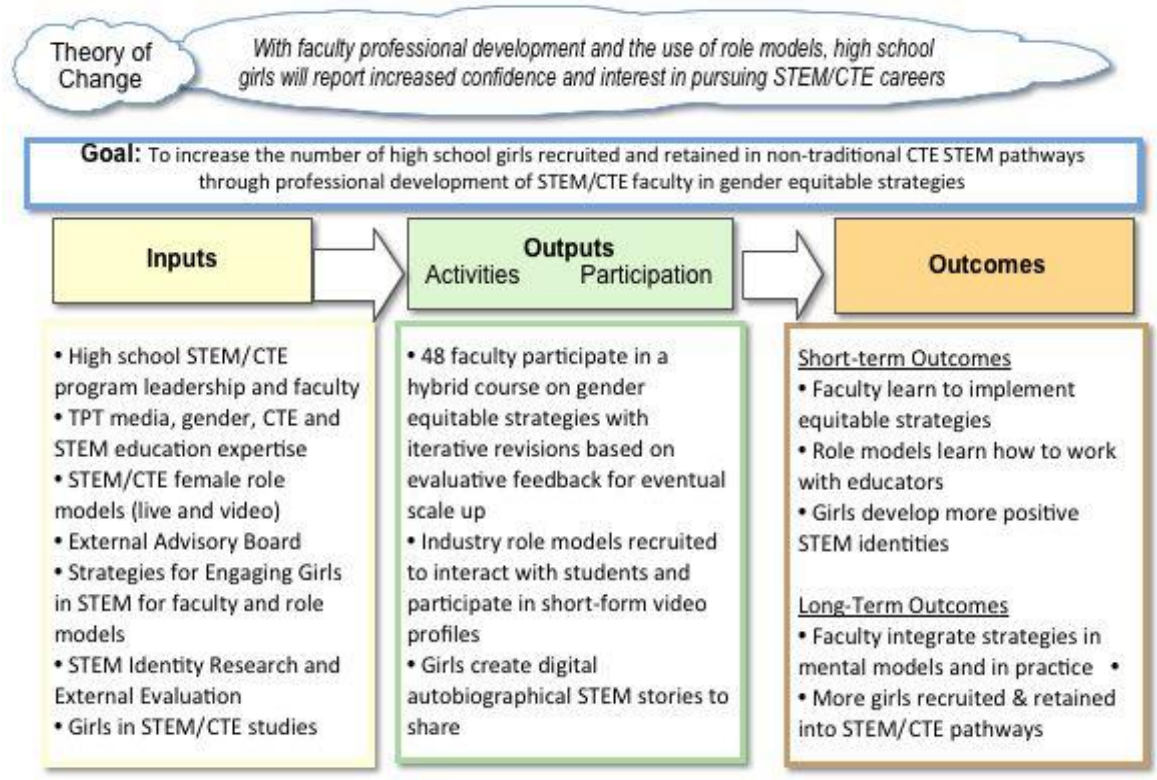
This external evaluation is designed to examine the nature and effects of professional development and implementation of gender equitable teaching strategies in high school classrooms. In Year 1, the evaluation examined: 1) the professional development course, 2) the effect of the professional development and implementation on the seven participating teachers and, 3) the effect of the role model training. The Year 2 report examined: 1) changes made in the course and, 2) the effect on the 11 teachers involved in the professional development. The Year 3 report reports on the effects of the revised course on 26 teachers and counselors.

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 Scalice, 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 so are not reported here. This report is about the evaluation of the effects of the PD on the teachers and counselors.



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 questions for Year 3 are:

Formative Study Questions

- *What are components of effective PD for CTE/STEM faculty?*

Summative Study Questions

- *What is the effect of the PD on teachers?*
- *What is the effect of the PD on counselors?*
- *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 data sources for the evaluation questions for Year 3 were:

Evaluation Question	Data Source
What are components of effective PD for CTE/STEM faculty?	Curriculum committee design and syllabus for the PD course based on feedback from Year 2 Educator evaluation of the course elements in post PD survey and interviews
What is the effect of the PD on educators?	End of PD survey before/after retrospective responses and "takeaways"
To what extent and under what conditions do educators' implement what they learned?	Lessons or activities described in post PD survey Interviews (N=24) Observations (N=23)
How do the educators think the changes they made affected their female students?	Portfolio reflections and evidence Interviews

Quantitative data from the surveys were analyzed using basic statistics for pre/post gains. Qualitative data were 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). Case studies (N=24) were created from the post PD survey, educator portfolios, interviews and observations (Davey, 1991; Yin, 2009).

III. Findings

The findings are presented in six sections: A) Participant information, B) Components of effective PD, C) Effect of PD on educators, D) Effect of PD on counselors, E) Implementation by educators, F) Effects on Students perceived by educators.

III.A. Who Participated?

Y3 Participants	In Person	Online
Teachers who enrolled	17	13
Teachers who started	16	13
Teachers who finished	15	7
Counselors who enrolled	3	4
Counselors who started	3	5
Counselors who finished	2	2
Teachers who received grad credit	8	2
Counselors who received grad credit	0	0

Participants Years 1-3

	# Districts	# Schools	# Teachers	# Counselors
Year 1	3	3	5	2
Year 2	2	3	11	0
Year 3	8	12	23	4

Year 1 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 Educators

Shakopee High School Teacher CTE (Woodworking)	
Central High School Teachers Science (Chemistry) Science (Biology, Physical Science) Science (Chemistry) Science (Chemistry) Science (Physics)	Open World Learning (6-12) Math (Algebra 2, Pre-Algebra) Science (Biology, Env Sci, Life Science) Math (Algebra 1, AP Calc) AP Computer Science Science, Not sure what classes, Leah?

Year 3 Educators

Hudson High School CTE Coordinator, 9-12 Intro Eng Design (PLTW), Automotive I, II, Small Engines, Basic Metals, 9-12 CTE, 9-12 Counselor	Burnsville High School Math - 10th grade (Algebra 2), Physics (12th grade, algebra based), Astronomy, 11-12 grade Chemistry, Grade 11 Media Production. Multimedia Animation. Web Design - 9-12 grade
Rosemount STEM teacher	Cretin-Derham Hall Science and Engineering
Duluth Schools CTE Supervisor	Eagan High School Math, 8th/10th grade
Avalon High School Special Education/STEM Special Education/STEM	Washington Tech Algebra and Geometry, 8th, 9th Geometry, 10th
Eastview High School IT Exploration, 10th-12th Earth and Physical Science & AVID, 9th	Tartan High School AP Calculus,CIS Multivariable Calculus, 11-12 AP Statistics, 12th Physics, 12th

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

The SciGirls hypothesis is that girls will develop more positive STEM/CTE identities and interests when their teachers and counselors employ research-based, gender-equitable and culturally responsive teaching practices enhanced with female STEM role models. The professional development was originally developed and has been refined by a team of professors and specialists in gender equitable teaching strategies to prepare teachers to have classrooms that are inviting to girls.

The course was offered online only and face-to-face with an online portfolio component. Participants received a stipend and, in addition, could receive continuing education units or graduate credit (new in Year 3). The face-to-face course was held on Wednesdays from 3-8 pm at Twin Cities Public Television every other week for 12 weeks from September to December 2017 and included dinner.

The Years 1 and 2 evaluations showed that the educators were familiar with many of the SciGirls strategies and wished to deepen their practice in a few of the areas, continue to get ideas in all areas (from peers and the facilitators), and use role models. Very few were using role models. Based on this feedback, the course was revised to begin with a needs assessment on the strategies, data collection on female enrollment in their school's STEM classes, an individual focus on enhancing one or more strategies in their practice, and individualized assignments for reflecting and providing evidence of the effects of their activities on their students in an online

portfolio. The course materials were the same as Year 2, but the order was changed to begin with Cultural Awareness and Relevant Learning. More emphasis was placed on developing a growth mindset in students as part of the SciGirls strategy, "thoughtful and respectful communication." Some short video overviews of strategies were created by the face-to-face facilitator and the cultural awareness specialist. Because the participants were doing individual reflections, the individual module surveys were dropped. The end of PD survey was used to ask about the effects and takeaways from each module and satisfaction data with the PD. Data from the portfolios, PD survey, interviews and observations were used to create a case study of each teacher and counselor that completed the survey and was interviewed (N=24).

Professional Development Evaluation

The end of PD survey asked educators to evaluate the fall professional development. The results for educators and counselors are presented separately below.

PD Evaluation by Teachers

The educators rated the course highly: overall (8.4/10), 12-week length (8.6), sessions every two weeks (8.6), topics (8.5), assignments (7.0), size (8.8), and feedback from professor (8.4). They rated the face-to-face version higher than the online (face-to-face=7.5, online only=3.6).

N=23	Mean
Length - 12 weeks	8.4
Sessions every two weeks	8.6
Topics in the course	8.5
Assignments	7.0
Size of the class	8.8
Feedback from professor	8.4
Face-to-face classes with online assignments	7.5
Online only format	3.6
Overall	8.4

Would you recommend the SciGirls PD to others?

F2F educators = 93% Yes (13/14, 1 maybe)
Online only educators = 71% (5/7)

For the onsite, what would you say? What advice would you give them on how to be successful?

- *YES! It was definitely a worth-while experience that has positively impacted my classroom with many small, easily implemented ideas!*
- *Yes, more for Science teachers than Math though.*
- *Yes, be willing to try new things, be open to changing your practice!*
- *Yes, dive in. It can be a lot of work but it is good work.*
- *Yes, there are many wonderful resources and ideas to implement. It's good to share and be able to discuss 'failures' with each other to get encouragement.*
- *Yes, I would say that I found the experience to be a grounding in equity principles. Being open to learning new ways of doing things is the best strategy for success.*
- *Yes, this course gave me great connection to other educator and role models in STEM.*

- *Yes, my advice would be to not procrastinate and truly try to implement the ideas. The more you try, the more you'll be able to engage with the course.*
- *Yes, I would tell them to make sure they are present at each class period, and to challenge themselves in each cycle, so they would see self growth.*
- *Yes, I learned a lot and felt very supported through the experience. This is something that will make me a better teacher.*
- *Maybe. I would encourage them to sign up with someone who teaches the same course, though, to get the most out of the course.*
- *Yes, I would recommend it, but my advice would be to do it during a time when they feel like they have been teaching the same course for a while and want a challenge and new perspective. It was hard to balance the work load of teaching a new subject with all these new ideas.*
- *Yes, after looking back on the experience it really makes you think and look back to what you are doing.*
- *Yes, be open to learning from the other course participants--they have great ideas.*
- *Yes, it provided me new ways of thinking about teaching STEM courses and provided me with a ton of resources. Keep an open mind!*
- *Yes, I would say it was a worthwhile professional development that I will absolutely continue to use this week, next week, think about over the summer, and use next year.*
- *Yes, take the course with someone else from your building to give opportunities to continue the work beyond the class meetings.*

For the online – what would you say?

- *Yes. It gives teachers some new strategies to try to make learning interesting and different. Follow the syllabus and email the professor if you get lost.*
- *Yes, maintain an open mind and resist negativity that may be present around you.*
- *Yes. I would recommend that teachers do the work on a consistent and regular basis.*
- *Yes, it was a good experience and made you think on a different level.*
- *Yes. The class presents the need to understand and shows research-based strategies that help girls overcome the stigma of not being able to pursue science.*
- *No, I would have rather been in a big group setting where I could have had better conversations.*
- *I would say take the face to face. It sounded like there was less paperwork.*

For the teachers who took the face-to-face course, the most consistently reported advantage was being able to converse with their fellow educators. If you took the face-to-face class with some online, what do you think were the biggest advantages of that format? Disadvantages?

- *One of the biggest advantages was the time to converse with our peers about what we were trying in our classrooms. One of the disadvantages is that sometimes I felt like we did not have enough time to cover all of the materials.*
- *Class discussion.*
- *It was wonderful to have the chance to work with and discuss with other educators. I got a lot out of sharing ideas with one another and helping think through in class situations and planning.*
- *Being able to bounce ideas off of other educators was extremely helpful.*

- *I needed the face-to face to stay motivated.*
- *The greatest advantage is the opportunity to discuss ideas and strategies in real time with your peers. The disadvantage is the scheduled time commitment.*
- *I work best with face to face because I enjoyed the time to personally reflect and talking with other teachers and counselors help me get creative on how I could implement others teacher's strategies my class.*
- *The biggest advantage was having the chance to discuss with other educators and share ideas. It was helpful to have a week off between classes to really try implementing and documenting the strategies.*
- *I always feel face to face discussion is more productive than online discussion, so I appreciated the face to face aspect of the work. I felt the class times were beneficial and enjoyable, and the work done in between was intentional and helpful. I was stretched in new ways. I always felt that being a woman in STEM was enough to encourage other women in STEM - but now I have tools to help encourage more effectively. As for a disadvantage - It is tough to get information from so many different people/sources...I was frequently confused on what we needed to do or where we needed to find information.*
- *The in-class discussions and the availability of the instructor and employees to answer questions.*
- *I liked being able to discuss face to face with peers. The three-hour classes got long and we didn't really spend three hours learning.*
- *I loved getting together with colleagues, chatting over food, engaging in discussion and activities in person.*
- *Sharing with each other during our meetings. We also tried out some of the activities with each other.*
- *Meeting other educators; that was the most important advantages; being able to share ideas with one another. Disadvantages was the time commitment. It was challenging to designate 3+ hours of time.*
- *Meetings with colleagues: monthly at TPT and online with the Facebook group*
- *The conversations with other educators, which were difficult to continue online with people I don't have a strong relationship with, were the most valuable part of the course for me.*
- *If I did, it would be nice for the human factor and the opportunity to directly engage in discussion.*

For the teachers who took the online course, the biggest advantage was flexibility – being able to work at their own pace. If you took the online course, what do you think were the biggest advantages of that format? Disadvantages?

- *The biggest advantage was being able to work at your own pace. The biggest disadvantage was not interacting with others in real time. Also, the website platform was not user friendly, there were too many ways to access information and reaching information through one channel would not be consistent with reaching it from another channel.*
- *How to follow the syllabus, but it was convenient.*
- *I can do it on my own time. It was hard.*

- *It was hard to navigate the website and the due dates were off. It something was to be turned to today. That starts at midnight and you don't have all day to turn it in. Advantages: Very comprehensive.*
- *The online format afforded me the opportunity to participate distantly - with my teaching schedule, class schedule, and family responsibilities.*
- *Just staying involved. it was difficult to know exactly what was expected and getting emails from all kinds of different people was also confusing.*
- *I tried to go online to read and gain access to as much as I could with the materials, wish I would have used more.*

When asked if they would take an online only course, 43% of the teachers said yes because it was worthwhile content and gave them flexibility; 57% said no because they don't like online, finding it hard to stay motivated.

Yes=43%

- *Yes, if that person is comfortable with online coursework and posting.*
- *Yes - Important to learn intrinsic biases and work to eliminate them. Also learn about the resources available.*
- *Yes, spend some time getting used to the website as it is challenging to find what you are looking for consistently.*
- *Yes, it is a learning experience and it will give you some more things to try in class.*
- *Yes, IF they had previously taken and been successful in an online course. I know it is not a format that suits me.*
- *Yes, the online course is great for intrinsically motivated and organized teachers.*
- *Yes, any connection with a community of learners that asks questions and gets you thinking is best for students - stay out of the rut.*
- *Yes, it was a good experience and made you think on a different level.*
- *Yes, online allows the opportunity to be more flexible in completing what is needed.*

No=57%

- *No - So much was gained from the face to face contact. I know I would have not had the same experience in an online-only format.*
- *No, I'm not sure how the connection with other teachers would be replicated.*
- *No, I don't typically enjoy online only courses.*
- *No, I found so much value in hearing from others face to face. I am not sure it would have the same impact.*
- *No, meeting the other educators and talking F2F with them was so important.*
- *Straight online learning is hard for me - I feel like you lose a lot without the face-to-face component. So, I would definitely encourage face to face over online only.*
- *I personally enjoy face to face. It makes it more real for me.*
- *No, I like face to face. More accountability and personal.*
- *Not sure because I didn't experience it online only. I'd be willing to try, but I know it's hard to stay motivated and held accountable with everything online.*
- *Probably not - I got the most out of the class sessions.*
- *No (2)*

Teachers made comments about the course.

- *It was great!*
- *I think everything was delivered fine. The Facebook thing was sometimes a nuisance - but that's personal preference.*
- *It was accessible.*
- *I had a great experience - I hope more can be exposed to this great experience!*

Teachers were asked for suggestions to improve the course.

- *More PR about it. I only found out because my coworkers are awesome but prior I had never heard of it.*
- *Too much just science focus...*
- *Make assignments clear - make sure online and in person components are connected so that there is clarity between the two.*
- *A weekend meeting time may be more convenient.*
- *Keeping it centrally located in the Twin Cities is nice but going to different locations might get more teachers from other surrounding communities more involved.*
- *Have one of the classroom instructors actually do the grading for the grad credit, instead of having someone score something separately.*
- *In the way of accessibility - the role model videos are wonderful. If there was a way to introduce them in a smaller workshop format, I think many people may benefit.*
- *I think it would have been better to require 1-3 days of face-to-face learning before school started to learn about the web platform and begin learning/planning strategies. It is very difficult to both learn about then implement strategies on the fly during the school year, especially when we were required to work on specific strategies during specific 2-week periods. Implementation would have been much easier if we had more freedom to implement strategies during times in the curriculum where we saw a natural fit.*
- *Improve communication. It was too often but not specific enough. The particular challenge was with St. Kate's.*
- *Encourage content-specific collaboration if possible.*
- *I would make it last longer over the course of a whole semester or whole year with sessions more spread out, once a month or so. I feel like the changes and goals were big ones that needed more time to try to incorporate. I also lost hold of a lot of the inspiration once the in-class stopped.*
- *Offering the sessions on Saturdays instead of in the evening. It made for very long days.*
- *The timing at the beginning of the school year was really tough. It was super stressful.*
- *It would be nice to have a big meeting at the beginning of the class. This way all the participants would understand what the class is about, format, and expectations.*
- *Encourage word of mouth, offer Saturday events that past/present teachers can go to and 'bring a friend.'*
- *Just clearer expectations and assignments for the online version.*
- *It was a good course. Starting the very beginning of the school year is a bit hectic and feels rushed. I would start course a bit later in the school year.*

PD Evaluation by Counselors

Three of the five counselors would recommend the course to others for its content. The counselors rated the course highly: overall (7.1/10), 12-week length (7.7), topics (7.9), assignments (7.6), size (7.7), and feedback from professor (8.4). They rated the online version higher than the face-to-face version (face-to-face=4.7, online only=5.1).

N=5	Mean
Length - 12 weeks	7.7
Topics in the course	7.9
Assignments	7.6
Size of the class	7.2
Feedback from professor	7.7
Face-to-face classes with online assignments	4.7
Online only format	5.1
Overall	7.1

Would you recommend it to others? Yes=3, No=1, No response (1) What would you say? What advice would you give them on how to be successful?

- *Yes. It was a great opportunity to collaborate with other schools and identify areas of growth within your own school and courses. To be successful, try each of the strategies at least 2 times to see some change.*
- *YES YES YES! This was a practice changing experience.*
- *Yes. Any purposeful efforts to increase girls' engagement in STEM I would recommend to other educators.*
- *Yes, make sure you can tie the work in SciGirls to things you would like to do in the classroom.*

If you took the online course, what do you think were the biggest advantages of that format? Disadvantages?

- *I normally love online learning, but this one did not work for me. I am not sure why but it just wasn't a fit.*
- *The interface was a bit confusing. It was nice to be able to work from home.*
- *D2L felt a bit cumbersome to use.*
- *Very clunky and hard to track. Voice concerns already so no need to go into it deeper.*

If you took the face-to-face class with some online, what do you think were the biggest advantages of that format? Disadvantages?

- *Advantages- Great conversations and activities. Disadvantages- None*
- *The opportunity to have all information delivered at one time, face to face conversations. with others, the opportunity to share 'just in time.'*
- *Connecting with other educators interested in equity.*

If it were offered in the online format only, would you recommend it to others? Yes=0 No=2, NR=3 What would you say?

- *No... change the format or platform.*

- *No, the face-to-face connections were a critical portion for me.*

What comments or suggestions do you have to improve the course and make it accessible to more educators?

- *Making sure people can collaborate with others in their discipline.*
- *Keep it going!*
- *More readings regarding challenges faced by women of color in STEM.*
- *Work with district leaders to recruit teachers.*

III.C. *What is the effect of the PD on teachers?*

The teachers reported increases in their use of all the SciGirls strategies from before their PD experience to after with statistically significant changes in all areas ($p<0.01$). They reported the greatest increase in their use of role models followed by strategies for cultural awareness and relevant learning and critical thinking.

Use of SciGirls Strategies Before and After PD

N=25	Before	After	Change
Strategies for culturally awareness and relevant learning	5.6	7.7*	2.1
Role Models	2.7	6.8*	4.1
Student-Focused Instruction	5.1	7.0*	1.9
Thoughtful Respectful Communication	7.1	8.5*	1.4
Promoting Student Creativity	6.1	7.8*	1.7
Promoting Critical Thinking	5.3	7.3*	2.0

***Indicates a significant difference between values ($p<0.01$)**

Use of Practices Within Module

This section provides the data from the End of PD Survey on Cultural awareness and relevant learning, role models, student-focused instruction, creative thinking, and critical thinking from the teachers.

Cultural Awareness and Relevant Learning

How often did you use each of the following strategies for thoughtful, respectful communication to promote a growth mindset before this course? How much do you plan to use these strategies in the future? 1-10, 1=never, 10=all the time.

N=25	Now	Future	Change
Consciously planning for diverse students to be included	5.2	7.4*	2.2
Active teaching methods to engage diverse students each other	6.1	8.0*	1.9
Plan ways to make the content accessible	6.8	8.2*	1.4
Give students time to relate to content from cultural perspectives	3.8	6.3*	2.5
Accommodate different learning styles	6.4	7.9*	1.5
Provide an atmosphere where students value other's perspectives	6.7	8.7*	2.0
Teach listening skills explicitly	4.6	7.1*	2.5

***Indicates a significant difference between values ($p<0.01$)**

What was your biggest takeaway from the discussion, readings, and reflection on how to make your classes more culturally relevant?

- *One of the biggest takeaways on how to make your classes more culturally relevant was providing an atmosphere in which students' value each other's perspectives.*
- *Being aware.*
- *Students will engage and value the classwork more if it is culturally relevant.*
- *That as teachers we can make a lot of assumptions that are not necessarily true and can also be offensive.*
- *Knowing that I have intrinsic biases that I need to become fully aware of and be put aside in order to reach ALL students.*
- *I really liked getting the books about women in Science. I am able to use the small articles to engage and add interest to many different topics I cover in my class.*
- *I had never working on explicit listening skills, so this has been useful for me.*
- *I'm already doing what I need to do. I can continue to find more timely and relevant resources to incorporate into my curriculum.*
- *I used video clips of how other cultural groups have made different contributions to astronomy.*
- *Hearing how other teachers are doing this, sharing perspectives and ideas. Realizing that culture is far bigger than just race.*
- *Creating ways for students to make work meaningful to them. I still struggle with multiple, useful examples, but I have become intentional on seeking out places in conversation that I can help students recognize ways a topic is culturally relevant.*
- *If a student's cultural background isn't validated in the classroom, they will not necessarily feel valued in the classroom and will often have a lower engagement level with peers and content.*
- *That culturally relevant teaching practices are just best practices. Previously, I struggled to define what this means in math.*
- *I think the biggest takeaway was to be intentional about the strategies being used, make them aligned to the learning outcomes, and be conscientious about the people presenting information and how they present information.*
- *Just to be aware that culture is important and try to incorporate it any way that I can.*
- *From this course and another PD, I am currently in, I really want to focus on providing and creating an atmosphere where students value each other's perspectives. I think I have allowed students' perceived status to get in the way of good collaboration and culture in the room. It's clear who the students' think are the smart ones and not smart ones, and this hinders students from being vulnerable and open to each other in class. I did find ways to value and praise more types of smartness in class.*
- *My School is not very diverse so it is hard to associate with that.*
- *I need to explicitly teach the soft skills too.*
- *I realize that this is something that I need to keep working on. I need to make sure that I am aware of all my students' cultural backgrounds and how they are different than my own.*
- *Good to have discussions with students.*

- *It's important to provide students options and/or prepare a diverse array of lessons and activities. Role models can play an important part in helping students see themselves as scientists.*
- *Strategies for classroom conversation - helping the conversations stay on task but also stay engaging within the groups.*
- *Ways to adjust my classroom to make big differences for every learner in there.*
- *Need to teach students how to listen to each other's ideas, not just expect them to be able to do it.*
- *Finding specific female role models. Choice. Continued affirmation that anyone (girls) can do science. Encouragement.*

Role Models

How often did you use each of the following strategies for thoughtful, respectful communication to promote a growth mindset before this course? How much do you plan to use these strategies in the future? 1-10, 1=never, 10=all the time.

N=25	Before	After	Gain
Gender equity in STEM (stereotypes, growth mindset, identity)	4.0	7.7*	3.7
Biases that push women out of STEM	2.8	6.2*	3.4
Brain differences between genders	3.0	5.3*	2.3
Sources for role model videos	1.8	7.3*	5.5
Sources for in person role models	2.0	6.6*	4.6
Strategies for using role models in class	2.0	7.1*	5.1
How girls can be role models for each other	2.8	7.0*	4.2

*Indicates a significant difference between values ($p<0.01$)

What was your biggest takeaway from the discussion, readings, and reflection on how to use role models in your classes?

- *There were two big takeaways I had on how to use role models in my classes: one is how to utilize the role model videos as a support piece when talking about STEM careers for ALL of my students. The other was how to effectively bring in and utilize role models as guest speakers and resources for my students.*
- *FabFems.*
- *It is especially important for young women to see role models that look like them! Students are more engaged when they have a visitor in class!*
- *That is can be easier than perceived. It doesn't have to always be a visitor to the class. It can be videos and just incorporating women into your discussions and informational lectures.*
- *As a CTE teacher - having role models was not a new concept. Making them gender specific was. I will make more of an effort to include female role models in my curriculum*
- *I loved the FabFems website. I was able to get two guest speakers from the area. My classes loved the ladies from FabFems. I will definitely use this resource again.*
- *I learned about how important role models are for young women and developed several strategies to incorporate them into my lessons.*

- *As a CTE teacher I have always implemented role model behavior and using business professionals in the classroom. After the class I will be more purposeful in including more female role models.*
- *How willing and accessible role models can be! I had many positive experiences and will continue to use these strategies!*
- *I had never worked with role models in my class. By taking this class, I was required to take a leap and introduce role models. I worked with some of my colleagues, who were also in the SciGirls class, to put on a panel discussion. The outcome was amazing - we are planning to do it each year. I also used videos in my class - I loved hearing students react to the work these women were doing. I feel it opened up doors for them to consider various career choices.*
- *That females are more likely to remain in a STEM program or career if they have a connection with a female role model.*
- *How meaningful role models can actually be. Bringing in a panel of role models was a moving experience for me. It was wonderful to hear the girls' conversations and take-aways.*
- *There are a large number of role models to use and a variety of ways to include them. I just need to be intentional about looking for relevant opportunities to include them.*
- *It is very helpful for the girls to see women in science.*
- *In my four years of teaching I have never brought a role model or guest speaker into my classroom except for my mom teaching an origami lesson for fun one time. I enjoyed having the role model in person and want to find my fluid ways to incorporate them. I think the videos were great for students to explore different ideas and see role models. I need to keep exploring these strategies.*
- *Providing role models for my classes male or female is very important to students*
- *I didn't realize how important role models that my students can relate to were for their self-image.*
- *I realize the importance of role models to my students. They have to realize that people like them can and are being successful in the STEM field. I struggle with fitting role models into my every day classroom but with my Women in STEM club, we have had many different types of role models come in and speak. I have also found that I don't have to devote a whole day's lesson to a role model but sharing different methods, such as a bell ringer or offering additional readings to students to learn about people who are in the STEM field. I am also working on a database of my former students who are going into STEM fields so they can share their stories.*
- *When we watched the video, the students didn't talk about who the video was about but more about the task or job that they were doing.*
- *It's important to choose a diverse group of role models to help all students see themselves reflected in professional scientist roles. Give students an opportunity to engage in discourse and/or interview role models.*
- *How important the other voices are to students - in person is even better. I love the realization that girls need to see themselves in the career and can often fulfill this by just hearing stories from other women in math and science.*
- *I have never done role models so everything was a great takeaway for me.*
- *Role models need to be used in a way that emphasizes their humanity and their struggles*

- *I wasn't being purposeful in choosing female role models if I had a role model coming into the classroom. I am now.*

Student-Focused Activities

How often did you use each of the following strategies for thoughtful, respectful communication to promote a growth mindset before this course? How much do you plan to use these strategies in the future? 1-10, 1=never, 10=all the time.

N=25	Now	Future	Gain
Student-generated learning strategies	4.0	6.3*	2.3
Start class with a mind warm up	5.5	7.3*	1.8
Use movement to get students focused	5.3	7.6*	2.3
Teach students how to collaborate before expecting success	4.8	8.1*	3.1
Use quick-writes when you want quiet time and student reflection	3.4	5.7*	2.3
Run a tight ship when giving instructions	6.2	7.6*	1.4
Use fairness cup to keep students thinking	3.9	5.5*	1.6
Use signaling to allow everyone to answer your question	5.0	7.2*	2.2
Use minimal supervision tasks to cut dead time in regular routines	5.1	7.0*	1.9
Mix up your teaching style	5.9	7.6*	1.7
Create teamwork tactics that emphasize accountability	4.9	7.5*	2.6
Direct instruction	5.6	5.8*	0.2

***Indicates a significant difference between values ($p<0.01$)**

What was your biggest takeaway from the discussion, readings, and reflection on how you can have more student-focused activities in your classes?

- *One of the biggest takeaways I had on having more student-focused activities is to teach students how to collaborate before expecting success. I received an awesome resource from a peer that I was able to hand out to students and that outlined respectful and accountable talking within a group. I really noticed a difference in discussion groups.*
- *Don't have to know everything.*
- *Helpful ideas for group work and accountability.*
- *The part about teaching students how to work collaboratively before expecting success.*
- *This is an area that I need to improve in my teaching. I think I am doing these things but am finding that I need to break my lessons down even more to make them more manageable for the students. This is going to take me some time...*
- *I am going to try and make my questioning tactics friendlier for girls to answer. I had noticed I let the boys often dominate the question answer periods in class. So, know I pay closer attention to the girls getting opportunities to answer as well.*
- *Quick writes have been a great addition to my routines.*
- *Giving students more control in their learning opportunities.*
- *I love seeing my students' creativity. When I have provided more student focused-activities I am able to see how each student learns and can assess them on tasks that they are engaged with, which provides more insight into what they have learned compared to traditional tests.*
- *Planning is so important for success - this isn't something you can 'wing.'*

- *I was challenged to be intentional in my grouping strategies. When I tried different grouping strategies, I was encouraged seeing the impact the grouping strategies had on the students.*
- *Control the content learned or the product of learning, but not both. This guarantees student choice no matter what the assignment.*
- *It's so fun to see what students design and create from PBL. It's a way to build relationships as well as engage!*
- *Make sure to use a variety of strategies in instruction and make sure the strategies fit the outcomes.*
- *I already do a lot of student focused activities, but I think I got out of it how to make them more accountable. Not so needy.*
- *I really want to work on teamwork tactics to emphasize accountability.*
- *Some students have great ideas, but sometimes it doesn't pertain to the curriculum.*
- *Giving explicit instructions first and using many of the same basic routines minimizes off task behaviors.*
- *Before this class, I was already doing quite a bit of student-focused activities in my chemistry class. I teach AVID and many of these techniques are in our AVID curriculum so I transfer them to my chemistry class. I also try to have multiple different learning styles in every lesson. I find this is the best way for students to learn.*
- *By giving very clear and exact expectations the students will understand what you want.*
- *Student-focused activities improve student learning and motivate students to participate.*
- *intentionally planning the different learning strategies used each week so that I don't fall back into old habits of just lecturing.*
- *The effect it can have on their learning and ownership of the class.*
- *I need to work on teaching effective collaboration skills.*
- *I have been trying to move the classroom towards 'student centered' vs. lecture…it's improving and getting better.*

Growth Mindset

How often did you use each of the following strategies for thoughtful, respectful communication to promote a growth mindset before this course? How much do you plan to use these strategies in the future? 1-10, 1=never, 10=all the time.

N=25	Now	Future	Gain
Keep an inclusive environment	7.0	8.4*	1.4
Keep Discussion positive and constructive	7.5	8.7*	2.2
Encourage participants	7.6	8.8*	1.2
Allow students to introduce themselves	6.5	7.8*	1.3
Set clear expectations and intentions amongst participants	6.8	8.2*	1.4
Use inclusive language	7.8	8.8*	1.0
Ask for clarification about a student's intent or question	7.1	8.5*	1.4
Treat participants with respect and consideration	8.8	9.4*	0.6
Develop an awareness of barriers (cultural, social, experiential)	6.3	8.3*	2.0
Provide time for students to gather their thoughts and contribute	6.0	8.0*	2.0
Provide opportunities for pairing and sharing	6.7	8.4*	1.7

*Indicates a significant difference between values ($p<0.01$)

What was your biggest takeaway from the discussion, readings, and reflection on how you can promote thoughtful respectful communication and a growth mindset in your classes?

- *One of the biggest takeaways I had on promoting thoughtful respectful communication and a growth mindset is to teach students how to collaborate before expecting success. I received an awesome resource from a peer that I was able to hand out to students and that outlined respectful and accountable talking within a group. I really noticed a difference in discussion groups. I also really felt more confident about encouraging students in the growth mindset area.*
- *Give time for students to respond.*
- *The importance of working through struggles - smart = continuing to work!*
- *How I respond to students' questions, my body language when speaking to different students, etc. are all part of having a growth mindset and communicating respectfully. Learning how to respond when student's responses are incorrect is difficult and it is something I need to continue to work at.*
- *Being in a new environment, I am seeing that I need to allow for more of these types of discussions across the classroom. It happens one on one with me and individual students, but I am not fostering enough of it among them peer to peer.*
- *I changed the set-up of my classroom desks to allow more pair-share opportunities in class. Students seem to discuss more.*
- *I was reminded that I need to set expectations about group discourse multiple times during the term.*
- *The student still has the choice to grow or not. We continue to encourage the mindset.*
- *I use pair-share a lot now. I use colored popsicle sticks to vote on physical and chemical changes.*
- *Setting up the class culture and expectations up front is very important.*
- *I learned ways to use language that led toward growth mindset, over a fixed mindset. By trying out various strategies, I have become much more intentional in the way I address students when they are working through a difficult task.*
- *Being intentional about teaching respectful behavior is going to be key to changing culture.*
- *My biggest takeaway was with Growth Mindset and how powerful it is for girls.*
- *It is similar to the previous answer, be intentional about using a variety of strategies and make sure they fit the learning outcomes.*
- *Just get the kids to share their ideas more and critique each other's ideas in a positive way.*
- *This has been an area of strength and focus for me in my teaching that I want to continue to grow in. My takeaway was strategies for inclusive language and environment. How am I providing opportunities for students to feel included in the class?*
- *I am a "go-go-go" type person I have learned that sometimes it is a good idea just to sit and reflect.*
- *I need to ensure that everyone gets an opportunity to speak and be heard during class.*
- *I try to make an environment as inclusive as possible. While I know there is always areas that I can work, I have gotten feedback from students that state they really like that about my class.*
- *By the students having clear instructions they will know what to have a discussion on and will stay on task.*

- *Students need guidance and training as they develop interpersonal communication skills.*
- *My own modeling of the thoughtful respectful communication is just as important as students practicing*
- *I think the most helpful thing was just taking the time to reflect on respectful communication and growth mindset.*
- *This need to be explicitly taught; students often do not realize the ways their communication may be disrespectful to a peer.*
- *I was purposeful in addressing females of different cultures in class, being careful about respecting cultural norms (American Indian, Muslim, etc.) and tried to include inclusive cultural components in various parts of curriculum. For example, I found it super interesting that dyes, dice etc., originated in India....lots of discussion and fun.*

Creative Thinking

How often did you use each of the following strategies for thoughtful, respectful communication to promote a growth mindset before this course? How much do you plan to use these strategies in the future? 1-10, 1=never, 10=all the time.

	Now	Future	Change
Have students ask the questions	4.8	6.9*	2.1
Have students answer questions instead of you answering them	5.9	7.8*	1.9
Foster intellectual curiosity	6.0	8.0*	2.0
Encourage (and giving time) for students to embrace messiness	5.9	7.7*	1.8
Build a community of learners	6.6	8.4*	1.8
Provide an atmosphere in which creative effort is valued	6.8	8.4*	1.6
Allow time for students to ask questions	6.8	8.0*	1.2
Teach creative skills explicitly	4.6	6.7*	2.1
Expose students to creative work	5.2	7.0*	1.8
Praise students for creative ideas and questions	6.5	8.5*	2.0
Permit failure and help students learn from it	7.0	8.6*	1.6

***Indicates a significant difference between values ($p<0.01$)**

What was your biggest takeaway from the discussion, readings, and reflection on how you can promote student creativity?

- *I believe that my classroom has become a lot more creative in general. Students are excited about trying new things and have seemingly not been deterred from ideas just because they might fail.*
- *My focus for a peer leader visit was on questioning and she showed me I don't give enough wait time.*
- *Allowing students to show their creativity in their own way*
- *Simple things such and taking more pictures of student work to display and/or use as examples when introducing a project. Also, making note of student work that is different or creative such as how a student answered a question or completed a left side activity in their science notebook.*
- *My classes are naturally designed for creativity. Motivation is more of the issue as opposed to promoting creativity.*

- *I started using Epic FAILs (First, Attempt, In Learning) and celebrating it, Now, kids yell out "EPIC FAIL."*
- *I need to give more time for students to ask their own questions and find their own solutions.*
- *Many students will rise to the occasion and want chances to express themselves creatively!*
- *One of my cycles focused on creative work. It stretched my comforts, but I found that students benefited from the experience. As a result, I am more comfortable using creative strategies.*
- *While I am good at permitting failure and helping students learn, I need to be more intentional with encouragement in general.*
- *How powerful language can be in promoting creative problem solving. Additionally, rewarding multiple and creative methods more so than just a right answer.*
- *Kids need time to process, but it is hard when giving them time sometimes leads to chaos.*
- *The idea that I can TEACH creativity was huge for me. I limit myself in thinking that I am not very creative, so I need to have a growth mindset about that in myself so that I can support students in their own creativity.*
- *In some of my classes students can be very creative and in other it is very technical and it has to be a certain way, finding a balance of both is hard to do some times.*
- *I need to provide more options for student creation of conjectures.*
- *This is an area that I need to improve on. I struggle with promoting creativity in my classroom because I struggle with seeing that in chemistry. But I also realize that if students aren't creative then how is anything new going to be discovered.*
- *Teach the students to ask many questions.*
- *Student creativity can be encouraged through many different types of activities and opportunities with different time requirements.*
- *the culture around mistakes is key... I love the brain science connections! Communicating the reasons why with students helps with the buy-in as well because they are so used to mistakes being a bad thing and also something to avoid*
- *The creative aspects of science are rarely visible to students*
- *Failure is how we learn. It's ok to fail. Failure is the first attempt at learning. Tried to stress this more.*

Critical Thinking

How often did you use each of the following strategies for promoting critical thinking BEFORE this course? How much do you plan to use these strategies in the FUTURE? 1-10, 1=never, 10=all the time

	Now	Future	Change
Having students analyze case studies	1.6	3.3*	1.6
Provide rigorous feedback on critical thinking	4.2	6.7*	2.5
Expect high intellectual engagement	6.2	7.9*	1.7
Use discrepant events to provoke thinking	3.7	5.5*	1.8
Structure student group work so they push each other's thinking	5.1	7.3*	2.2
Provide an atmosphere in which critical thinking is valued	6.3	8.3*	2.0
Allow time for struggling with issues & doing critical thinking	5.5	7.7*	2.2

Teach critical thinking skills explicitly	4.9	7.5*	2.6
Expose students to intellectually rigorous work	5.9	8.2*	2.3
Praise students for critical thinking and questioning	6.3	8.4*	2.1
Encourage students to constantly improve their thinking	6.8	8.5*	1.7
Use problem-based learning	5.8	7.9*	2.1

***Indicates a significant difference between values ($p<0.01$)**

What was your biggest takeaway from the discussion, readings, and reflection on how you can promote critical thinking?

- *One of the biggest takeaways on promoting critical thinking I have is utilizing scaffolding to really help students be successful and have the skills they need to think critically about things.*
- *Allow them to challenge themselves.*
- *Cultivating curiosity.*
- *Changing the way I respond to student's questions can help promote critical thinking skills. Also, altering daily work so it is in the form of analyzing models, graphs, etc. can get to the same information while promoting critical thinking skills.*
- *With our information overload in society - I see this as the biggest challenge. Motivating the students to take ownership of their own perspective and the importance of sharing it.*
- *I plan on using the Engineering and design loop to promote problem-based learning. I will be trying out different methods for grouping student to help student push each other's critical thinking.*
- *I have tried to incorporate more problem-based learning and to explicitly teach the critical thinking skills that can be used.*
- *I like to use real life examples to enhance discussions and learning of content.*
- *I was struck by how hard this is for students, but also how important it is. We must keep trying!*
- *I was able to tie critical thinking to growth mindset to help students push to the next level.*
- *While I always want to provide constructive feedback, it often gets pushed to the back burner due to the time it takes outside of class. Often this is the feedback students value most and I need to treat it as such.*
- *That this is something I do very easily in TOK and considering how I can increase these methods and skills in my math and programming classes.*
- *Critical thinking is a process that takes time and patience.*
- *I used to do a lot more problem-solving activities, but I don't do them often enough anymore. I need to teach and allow students to practice more critical thinking.*
- *It is hard and it always will be hard to make students think really deep about a subject especially if they are not interested in the subject.*
- *I need to give students more time to develop rigorous problem solving.*
- *Critical thinking is important for students to be able to do but I have to be better at teaching the skill. This forces students to think beyond the right answer, which is so important. I need to find ways to do this in my class more.*
- *Problem-Based learning is a fantastic way to learn because it takes multiple ways to learn to solve a problem.*

- *I need to spend more time thoughtfully grading student work to provide feedback to better encourage critical thinking. Additionally, my team of teachers and I need to integrate newer and more diverse activities, such as CER and POE.*
- *Struggling is a necessary space to work through to learn.*
- *Ideas on how to make critical thinking an active thing in my classroom and how to be uncomfortable with it.*
- *Groups can be structured to support critical thinking.*
- *Tried to use more discrepant events-especially as strong hooks and relevance to my teaching. Also, mindful of wait time, allowing the student to figure it out-if couldn't figure it out, return to the student later to clarify for understanding.*

III.D. ***What is the effect of the PD on counselors?***

The counselors participating in the SciGirls program were asked about their use of SciGirls strategies before and after their SciGirls experience. In all areas, the counselors reported increases in their use of all the strategies: cultural awareness (6.3 before, 8.6 in future), relevant learning experiences (6.6, 9.3), role models (5.3, 8.7), student-focused instruction (7.3, 9.0), growth mindset (6.6, 8.9), creativity (6.7, 8.9), and critical thinking (7.0, 9.0). Statistical significance was not calculated due to the small number of participants (5).

Use this question to tell us the extent of the effect on your practice. Rate your use each of the following strategies before this course and how much you plan to use each strategy in the future? 1-10, 1=never, 10=all the time

N=5	Before	Future	Change
Cultural Awareness	6.3	8.6	2.3
Relevant Learning Experiences	6.6	9.3	2.7
Role Models	5.3	8.7	3.4
Student-Focused Instruction	7.3	9.0	1.7
Thoughtful, Respectful Communication and Growth Mindset	6.6	8.9	2.3
Promoting Student Creativity	6.7	8.9	2.2
Promoting Critical Thinking	7.0	9.0	2.0

What was your biggest takeaway from the discussion, readings, and reflection on each strategy?
Cultural Awareness

- *How to make your activities more culturally relevant.*
- *Being reminded of our own biases and stepping back.*
- *Be cognizant of actions and words as bias is easily created.*
- *I believe that finding ways to make learning more equitable and attainable for all students needs to be the driving force in education. My biggest takeaway here was looking at the possibilities of rewording aspects of the class to make it more culturally appealing to groups.*
- *The readings could be improved.*
- *Listen to students and take their feedback seriously.*

- *Great examples and ideas. Mostly dealing with creating the connections with diverse cultural examples and promoting those in the classroom.*
- *It is crucial for students to see their personal culture as respected and valued in the classroom.*

Role Models

- *I love that there are people willing to come in and talk to students and to also have them be engaging. One of the hardest things is to find a good speaker.*
- *Provide an arc for presentations to guide their involvement; the structure will provide the opportunity to gain what is needed in a common format.*
- *Frequent and often. . . That is my biggest takeaway. We need to provide exposure to people who can relate. You have to be able to see yourself in the career in order to pursue it.*
- *Role model visits are really valuable. We knew this, but it was a good reminder that it is worth the extra logistics and planning.*
- *Use them - frequently - and in many modalities.*
- *Biggest take away. This was also the primary focus of my work during this process. Creating a diverse data base of role models, speakers, instructors that could be utilized by CTE and STEM programs throughout the district.*
- *Role models must be portrayed as fully human to be most effective.*

Student-Focused Activities

- *Allowing students to control their own experiences.*
- *Group girls with girls!*
- *This was one of my strongest areas to start with. . . So, for me the takeaway was affirmation that my philosophy and practice is on the right path.*
- *Our school is very student-centered. It was insightful to hear the questions that students had for our role model visit. They get right to what is real in ways adults often don't.*
- *Reinforce the already existing student-focused curriculum at our school.*
- *Was already well-versed in this aspect.*
- *Students need to be engaged and thinking deeply in order to learn.*

Thoughtful, Respectful Communication and Promoting a Growth Mindset

- *Providing a safe place for all learners and giving girls the opportunity to grow without penalty.*
- *Listen intently and be open to ideas.*
- *I found this to be interesting. I became much more aware of my praise, push and practice with my staff and how to model it for them to start attempting it with their students.*
- *Our students are great at this. We also discuss the cultural biases of growth mindset.*
- *Create safe spaces for girls, especially girls of color, to gather and discuss ideas.*
- *Some good additional ideas but nothing too groundbreaking if one is read up on recent best practices.*
- *This is an area I've taken for granted; I need to explicitly teach my students how to communicate effectively.*

Creative Thinking

- *Allowing more students to shine in a different way.*
- *Give alternative options that students may create their own.*
- *This again was a strong point and a focal point of my instructional practice. I maintain that today as an administrator. Students have to have time to play, fail, and explore the content, not just be told what to expect or what should happen.*
- *The role model videos helped expand their ideas about STEM and STEM careers.*
- *Encourage girls to expand their horizons and ask questions.*
- *Was already a strength of mine, but not a strength of the teachers. Started work on this but this is a much slower process.*
- *Science is a creative process and students need opportunities to engage in that.*

Critical Thinking

- *Answering a question with a question. It is a true strategy.*
- *Ask questions from a higher depth of knowledge.*
- *This ties to creativity and student-focused activities. When placed in those settings students are forced to think critically. My biggest takeaway would be sticking to my philosophy here and continuously promoting it to my teachers.*
- *Reading Braiding Sweetgrass and reading about businesses with women leaders both lent well to productive critical conversations.*
- *Reinforce the already existing critical thinking curriculum at our school.*
- *Same as Creative thinking - I believe they have to go hand-in-hand*
- *Traditional activities can often be re-worked to give students more opportunities for critical thinking.*

III.E. ***To what extent and under what conditions do educators' implement what they learned?***

The teachers and counselors did four reflection papers and a final reflection during the fall course. They were also interviewed (N=24) and most were observed (N=23). We were able to use these data to create 24 case studies.

Educators in the face-to-face course used the class to get ideas, plan, then reflect on the results in the next class. They found this the most valuable aspect of the course - the sharing of ideas, the feedback from each other, and the structure of going someplace to think. On those Wednesday evenings, they had no other responsibilities, so could take a "time out" to think about their practice.

This successful structure evolved from the first two years of evaluation. Meeting every week didn't allow time to reflect, plan, and experiment. Meeting on Mondays didn't work because most teachers do planning for the week on the weekend. In an online course, the educators were not as comfortable sharing and discussing their practice because they didn't know each other. Having assignments for each strategy was time-consuming and often unnecessary for strategies they were already using. A face-to-face class meeting every other week on Wednesday worked for all those who participated. The facilitator modeled approaches while used most of the time

for sharing and discussion. Individual reflections were posted online and were about what that educator was experimenting with to engage more girls and the evidence they had of its effects.

Because the emphasis was on experimenting to see what would work, teachers were very invested in learning and getting results. They used the time with each other to talk about their prior experience, get ideas, think through what they might do, and then discussing how it went. The PD provided a support system for transforming their practice, but perhaps more importantly, it gave them a way to continue to try things. They became more aware of what the girls in their classes were doing, or not doing, how they reacted to success and failure, to getting stuck, to asking for help, how their culture also affected their interactions in the classroom, their confidence in STEM/CTE, and a host of other things. Their female students responded well to being "seen" and the positive support and encouragement that followed, which helped them do more. One teacher put it like this, "I'm a black female CTE teacher. Isn't that enough? Nope, it sure isn't. My girls needed to know that I have their backs, that I am here for them, that I believe in them and will help them succeed. I needed to be much bigger about all that than I was before."

As you read through the case studies, you will hear about their journey, in their own voices, into more girl-friendly territory. Some are wonderfully honest, others earnest, and some even surprised by what they learned and what they were able to do. When we asked them what they would remember about "that SciGirls thing" five years from now, many said it was a turning point in making them more conscious about what they could do to better educate the girls in their STEM/CTE classes. Another said it will have made her a better parent to a girl. They planned to continue to collect data, try things, and track results. Many were thinking beyond their own classes to the what they could do schoolwide. Others were recruiting girls for their classes, going to talk to those who could be taking their courses to let them know they could be successful. You will find the 24 case studies in the Appendix.

III.F. *How do the educators think the changes made affected the female students?*

The Year 3 PD began with data analysis on their own school's female STEM enrollment and a self-assessment of their use of the SciGirls strategies, followed by trying new things, and gauging the effects on girls in their classes. The 24 case studies describe these efforts and the effects the educators saw on the girls. Here are some examples of effects.

Students are excited to meet role models. They like reading the bios, have lots of questions about the careers, and talk about what they learned in personal terms - *I had no idea, I think I could do that, I thought I wouldn't like that, but now I think I might*. When a math teacher didn't have "role model Friday" the students asked for it. She was showing the short videos made by SciGirls and others on FabFems. Another teacher started a STEM girls club after school. They decided to watch four videos at each meeting for a while. They talked about similarities and differences in the careers and how they noticed that all the women found ways to balance their work and personal lives.

Several teachers noticed that students were not very productive in groups. They didn't know how to work together. They tracked when and how students were engaged, who was active, in what

ways, how they invited each other's contributions, and who was doing talking. One math teacher asked the language arts teacher for list of sentence stems for collaborating, taped them to the desks, and found that by mid-year, they were using them so consistently, she took them up. We observed them using the language when we visited in late April. For example,

- To state an opinion – I think…. In my opinion… From my point of view…
- To disagree – I don't quite agree. I see it differently. I have a different point of view. I disagree somewhat because …
- To offer a suggestion – Maybe we could… We might think about… You might consider…

Almost all the educators found that girls preferred to work together and were more productive when doing so. Having all boy groups caused some problems because some were less productive without the girls. This meant the teacher had to do more to help the boys improve their collaborative skills.

After listening to how her students talked when they were frustrated, one teacher wrote down their self-talk and created alternative messages on posters on the wall. Her data showed that students, especially the girls, replaced negative self-talk with those positive statements, and gained confidence in persevering and asking questions, which led to improved grades.

I made a mistake >	*Mistakes help me improve*
I'll never be as smart as her >	*I'm going to figure out what she does and try it*
I give up >	*I'll use some strategies I've learned*
I'm not good at this >	*What am I missing?*
I can't do math >	*I'm going to train my brain to do math*
This is too hard >	*This may take some time and effort*

Another teacher told how some of her physics girls came in all huffy one Monday morning because they were skyping with two girlfriends in another school and they didn't even get the basics – they were failing Physics. They said, "We had to explain "everything" to them. What are they teaching over there?" The teacher was so proud because they not only explained the concepts accurately to their friends, but they were very confident.

Many of the educators adapted projects to give students more choice. For example, 1) For practice calculating surface area and volume, student groups designed and built a tinfoil project that used 5 solids and 13 pieces altogether. They had to develop a plan, gather materials, do the calculations, build the thing, present their thinking and findings. In one class, there was a castle, a tin man, a rocket, a robot, a cat, and a house. Girls were often the ones who had lots of ideas and asked quiet students in the group what they thought, 2) For a 3D printing project, students could scan an object of their choosing instead of a given object. Girls were more engaged than in previous projects and worked harder at getting the printing done right.

To develop critical thinking in a math class, the teacher displayed the results of a review test with graphs, mean, median, mode, standard deviation, and gender performance data. She handed out the scored review tests - just the items, not a total, and asked them to figure out where they were on the curve and explain how they knew. All the students went to work summing their scores,

talking with their table groups about where their score fell on the graph, and asking questions about the graph. This was also a routine that made math relevant to their grades. In an architecture class, students were to design a house and had to justify their designs based on their interviews with at least one homeowner, and the building code and design principles to gain approval to "build" it on the computer. Students were observed "arguing" for facets of their design based on their own aesthetics, input from a homeowner, or the rubric.

Girls' behaviors and aspirations in STEM/CTE may also be related to their culture. With her "new eyes" one teacher noticed her African American girls wanted to be seen as hard and tough, not geeks, so they were sullen when she praised them. She saw their reaction, so started passing them notes, which made them giggle and smile, and try harder. Several asked her about advanced classes for next year. Through observation, another teacher figured out that one of her Somali girls who wasn't doing well in class couldn't see very well. Although she had glasses she wouldn't wear them for looking too smart and calling attention to herself. Her parents told her she had to wear them. She wouldn't. They finally got her contacts and her grades and confidence improved in all her classes!

In a statistics class, the teacher started relating the topics to jobs, including current student jobs, and/or sports. *They use this at the CDC. They use this to push ads. Starbucks uses this to determine what to offer. Coaches use this to plan workouts…* She noticed that they started making those same connections, or asking her, "Who uses this one? What for? Would I like that job?"

In a physics class, students were building musical instruments, choosing or composing a song, and performing for the class. They could choose an instrument they play, or something else. The teacher also had examples. Girls were very engaged, helping each other and excited about choosing a song. Several asked if they could work together to build their instruments, and also perform together. We observed the girls talking through their ideas, discussing the pros and cons, and sharing duties for getting materials and tools. It probably took more time to collaborate and rehearse, but they really enjoyed it, and benefitted from the discussion.

Each of the 24 case studies in the Appendix has a section on the perceived effects on students. Every educator in the project saw the positive effects of the strategies they tried.

IV. Conclusions

Formative Conclusions

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

The Year 3 revised Professional Development began with a needs assessment on the SciGirls strategies, data collection on female enrollment in their school's STEM classes, an individual focus on enhancing one or more strategies in their practice, and individual assignments to reflecting and providing evidence of the effects of their activities on their students in an online portfolio. The PD began with cultural relevance, followed by role models and the other strategies. More emphasis was placed on developing a growth mindset in students as part of the

SciGirls strategy, "thoughtful and respectful communication." Some short video overviews of strategies were created by the face-to-face facilitator and the cultural awareness specialist.

The face-to-face course was very well received, with 15/16 educators who began the class, finishing it. The online class had some technical and logistical difficulties and was not as interactive resulting in just seven of the thirteen finishing. The online only participants felt isolated and found it difficult to get and provide feedback with others they did not know. Most would recommend the SciGirls PD to other educators (93% F2F group, 71% online group).

The main benefit of the SciGirls strategies PD is the resources and support in reflecting on and improving one's own practice. The online participants liked flexibility and not having to go to a class due to family obligations and the location of the class relative to home and school, but they felt they missed out on the modeling of the strategies and the discussions, which is what the face-to-face participants felt was most beneficial about meeting.

Summative Conclusions

What is the effect of the PD on educators?

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 in 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 24 teachers were conducted in April 2018. In the observed classes, all the teachers were using at least one method for each of the SciGirls strategies. Most had used what they learned to improve the collaborative learning in their classes by grouping girls together, teaching communication strategies and critical thinking explicitly, and increasing the options in assignments so students were more engaged.

Counselors reported talking with girls in and out of STEM classes to try to figure out how to get enrollment up and were more actively and explicitly talking with girls about STEM/CTE classes and careers as real opportunities and very doable for them.

Both teachers and counselors were using role model videos and planning live visits after learning how to find and use or host them or meeting them at the TPT event. In previous years, teachers made little use of role model resources. The PD was changed to provide more scaffolding through discussing how to use role models, showing videos, and communicating the strong expectation that the educators would use role models. Educators did things like have "role model Fridays" using videos, posting biographies of mathematicians or scientists from under-represented groups on a bulletin board to show anyone can have these careers, having a

role model visit with an individual class, or hosting a schoolwide, "Women in STEM" evening for families. Every educator saw very positive effects of these role model activities and plan to do more in the future.

The shift to educators doing the needs assessment and choosing a few areas to focus was very positive. They were more interested and engaged in thinking about their own practice and many described themselves as more "reflective" about their practice. Rather than doing assignments for a class, they were using the class to get better at teaching girls. The class gave them resources and ideas and a safe place to talk about what they were currently doing and how they would like to change it, and then to debrief on how it went. The emphasis on collecting evidence of the effects gave them the tools to be analytical rather than self-conscious about what worked and what didn't.

As in previous year, 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 to help girls feel they can do STEM/CTE now and as a career." Because of this shift in their thinking and the tools and resources from the course, they planned to continue to observe, try things, notice the effects, and improve. The result was more pervasive than adopting specific methods. The course contributed to their "growth mindset" for gender equitable teaching with a framework, tools, resources and network to continue to evolve their practice.

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

All the educators reported that the changes they had made as a result of the PD had affected the girls in their classes or school. They all had more ideas for things they could do. They all were committed to increasing female enrollment in their STEM/CTE classes and helping girls to see themselves as capable in those fields.

They observed very clear results from their efforts. Girls were more communicative, engaged, and excited. They saw more confidence and interest in girls. The female teachers who already thought they were role models, found that girls began to see them that way and reach out for more information and guidance.

Educators who started Girls STEM clubs were pleasantly surprised at how much girls valued the opportunity to learn more about careers and "talk STEM." Several CTE educators implemented a "professional behavior" expectation that they saw made girls more comfortable and more creative options for projects that girls were excited about.

Overall

The data from this third cohort of educators shows that a viable model for PD for gender equitable strategies has been developed and successfully implemented in a face-to-face format. There is good evidence that the PD engages educators in transforming their practice to be more girl-friendly and that they get measurable results with their girls.

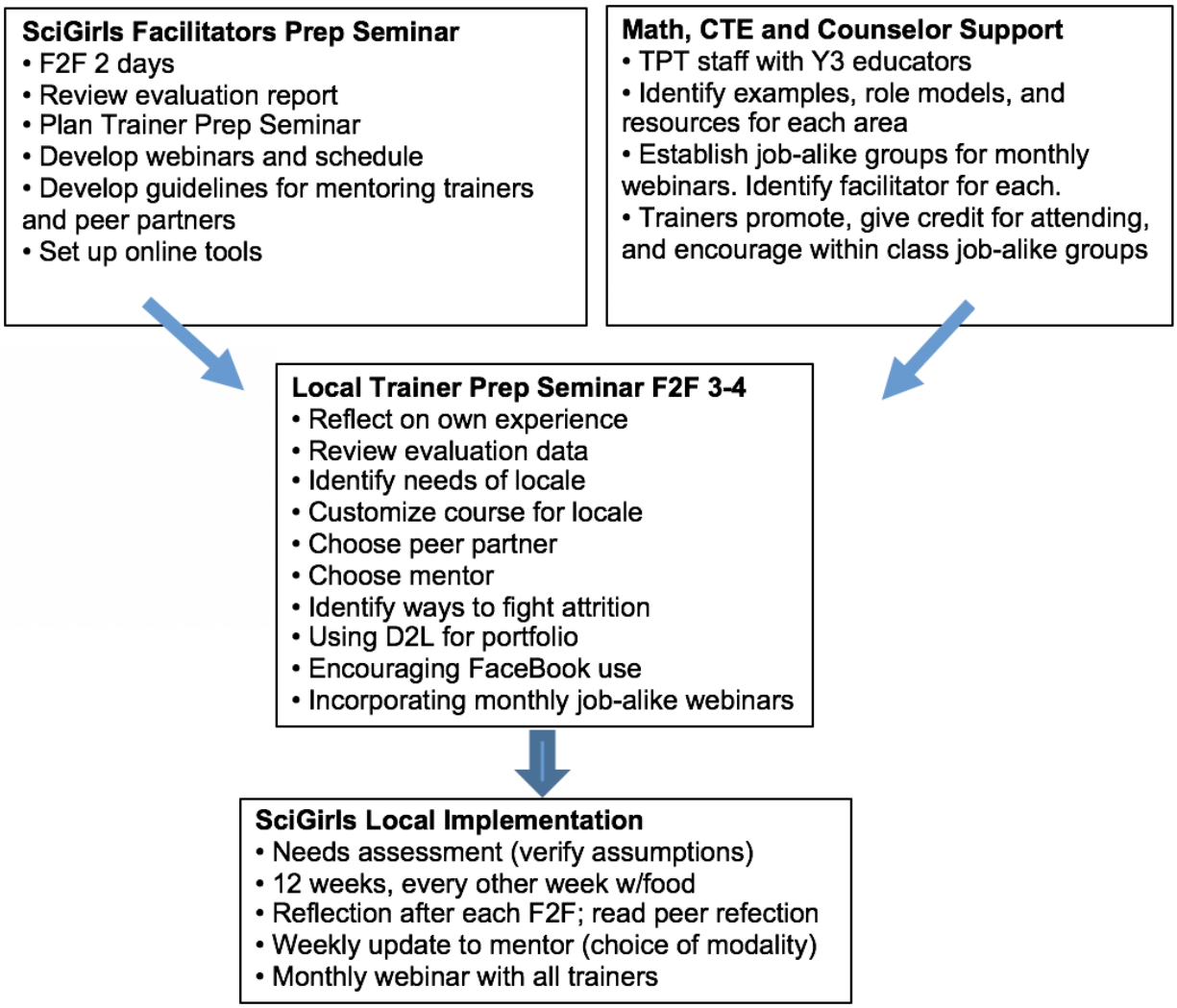
It is recommended that TPT develop a train-the-trainer model for this SciGirls PD. Ideally trainers would be drawn from the third cohort face-to-face participants since they have

experienced it. They should receive initial training in conducting the PD and customizing it for their locale. They should choose a mentor from the current project facilitators (their lifeline), team up with a fellow trainer for peer feedback, and attend monthly online meetings to discuss their challenges in the same style as the class (idea generation, planning, reflection, and debriefing).

More examples of gender equitable activities in math and career/technical education need to be available for these additional courses. Educators from Year 3 could be recorded describing a lesson or modeling it. The current F2F course uses predominantly science lessons.

Just as educators need to support different cultural perspectives, this Train the Trainer phase needs to support communication among job-alike participants. Having project-wide job alike sessions in which current math and CTE teachers and counselors offer resources, ideas, and lessons, followed by discussion and support from each other is critical. All three of these groups wanted what they saw the science teachers getting in the class – the opportunity to see lessons, read research, and hear ideas specific to their work.

Below is an overview of how a **Train-the-Trainer model** could build on the success of the SciGirls TPT ITEST work.


SciGirls Facilitators Prep Seminar
• F2F 2 days
• Review evaluation report
• Plan Trainer Prep Seminar
• Develop webinars and schedule
• Develop guidelines for mentoring trainers and peer partners
• Set up online tools
Math, CTE and Counselor Support
• TPT staff with Y3 educators
• Identify examples, role models, and resources for each area
• Establish job-alike groups for monthly webinars. Identify facilitator for each.
• Trainers promote, give credit for attending, and encourage within class job-alike groups
Local Trainer Prep Seminar F2F 3-4
• Reflect on own experience
• Review evaluation data
• Identify needs of locale
• Customize course for locale
• Choose peer partner
• Choose mentor
• Identify ways to fight attrition
• Using D2L for portfolio
• Encouraging FaceBook use
• Incorporating monthly job-alike webinars
SciGirls Local Implementation
• Needs assessment (verify assumptions)
• 12 weeks, every other week w/food
• Reflection after each F2F; read peer refection
• Weekly update to mentor (choice of modality)
• Monthly webinar with all trainers

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Appendix – Case Studies (see separate document)