

# Addressing the Gender-Science Stereotype: Effects of participation in a second-grade science outreach program on students' science identity and teachers' confidence

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## Introduction

### Research Questions

- RQ1)** Are elementary school boys and girls' identity affected by gender differences and liking of science after a Science Outreach Program (SciTrek)?
- RQ2)** Does teacher confidence, due to participation in SciTrek teacher training, impact their students' science identity scores; and is the impact different for girls or boys?
- RQ3)** Does teacher participation in SciTrek lead to their students' having a more complex understanding of what scientists do and their understanding of science and engineering practices?

### Prior Literature

- The gender-science stereotype is that a scientist is a Caucasian, middle-aged man, and there is evidence this stereotype persists throughout education and deters young girls from identifying with STEM and pursuing STEM courses and occupations since they feel as if they do not belong (Miller et al., 2018; Steinke et al., 2007).
- Science identity, defined as whether or not students see themselves engaging in the world scientifically and recognize themselves as scientists, develops as early as elementary school and is influenced by students' experiences in school and attitudes of important adults, such as teachers. (Brickhouse et al., 2000; Gunderson et al., 2011; Carlone, 2007). By the time children are nine, they adopt the same academic-gender stereotypes that are held by the adults they interact with (Steffens et al., 2010). The influence of important adults and the adoption of the gender-science stereotype causes girls' science identity to decrease as they age (Steinke et al., 2007).
- Teachers benefit from science outreach programs by introducing new and deeper science content and new ways to teach students (Laursen et al., 2017; Miranda et al., 2010). These improvements are viewed as benefits for themselves as professionals (Laursen et al., 2017), and also benefit students.
- Participation in science outreach programs has been shown to improve both students' attitudes and identities as scientists (Flick, 1990; Bodzin and Gehringer, 2001; Smith and Erb, 1986; Bradley and Farland-Smith, 2010).

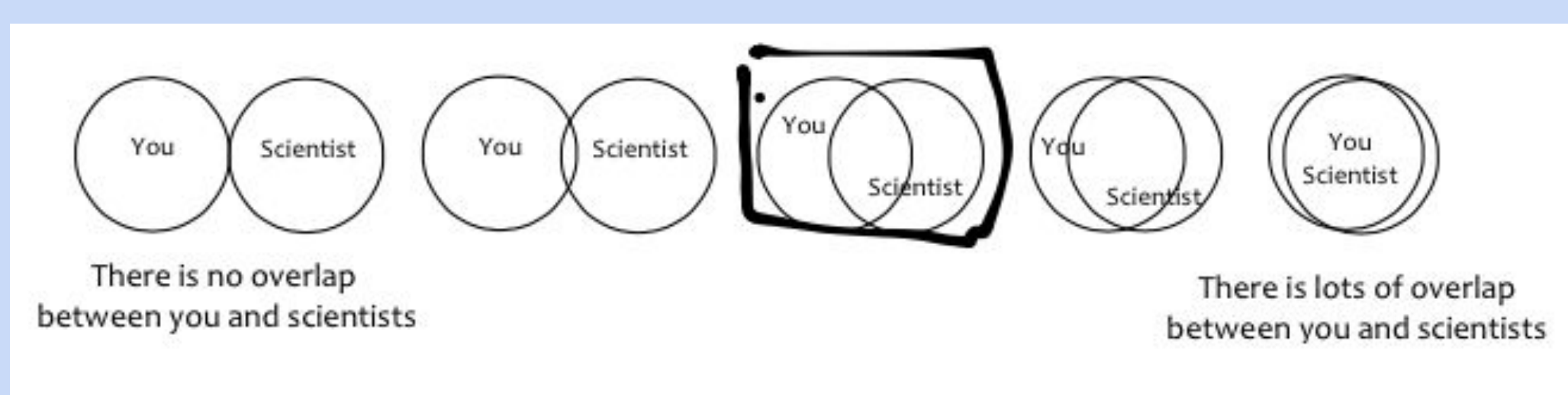
## Methods

- Second-grade classrooms who participated in SciTrek in surrounding public schools during 2018-2019 were used in this study.
- We recruited a total of 163 second-grade students and 14 second-grade teachers to participate. Demographic data could not be collected due to the elementary schools' privacy policies.

## Procedure

- Students were administered a series of assessments when SciTrek came to their classroom which assessed their perceived identity as a scientist, their understanding of what scientists do, and their performance on science and engineering practices. The data was analyzed using the pre and post program assessments.
- Students' perceived identity as a scientist was assessed using the Inclusion of Others in Self Scale that was modified to say "self" and "scientist" (Aron et al., 1992).
- Students' understanding of science was assessed by asking "What is one thing that scientists do, other than experiments?" in the Things Scientists Do (TSD) score. The data was coded by three independent coders to assess the complexity of students' answers.
- Students' understanding of science and engineering practices was assessed using performance assessments that were linked to SciTrek curriculum which was aligned with NGSS and SEP like practices by grade.
- Teachers completed pre and post program measures to gauge their attitudes towards, and comfort with teaching science (Slider scale 0-100 (not confident at all to very confident)).

## Modification of Inclusion of Others in Self Scale



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Table 1: Correlations between Teacher Confidence and Students' Improved Approach to Problems

|  | Confidence in Knowledge | Confidence in Teaching Science Content | Confidence in Teaching Science Practices | Confidence in Teaching NGSS | Students' Improved Approach to Problems |
|--|-------------------------|--|--|-----------------------------|---|
| Confidence in Knowledge                  |                         |  |  |                             |   |
| Confidence in Teaching Science Content   | 0.93**                  |  |  |                             |   |
| Confidence in Teaching Science Practices | 0.79**                  | 0.82**                                 |  |                             |   |
| Confidence in Teaching NGSS              | 0.75**                  | 0.81**                                 | 0.86**                                   |                             |   |
| Students' Improved Approach to Problems  | -0.06                   | 0.24**                                 | 0.09                                     | 0.09                        |   |

Note: \*p < .01

Table 2: Linear Regression: Teacher Confidence and Gender on Assessment Difference (SEP like practices)

| Effect                | Estimate (Standardized B) | Unstandardized B | 95% CI Unstandardized B |      | p    |
|-----------------------|---------------------------|------------------|-------------------------|------|------|
|                       |                           |                  | LL                      | UL   |      |
| Teacher Confidence*** | 0.22                      | .39              | 0.14                    | 0.64 | 0.00 |
| Gender                | -.05                      | -2.49            | -10.30                  | 5.33 | .53  |

Note: R<sup>2</sup> = .05 (p < .01)  
\*\*\*p < .00

Significant correlations between teacher confidence and teachers perception of student's ability to solve problems (Table 1). Teacher confidence was a significant predictor of students' improvement on assessments (Table 2).

Table 3: Linear Regression: Teacher Confidence and Gender on Things Scientists Do (TSD)

| Effect             | Estimate (Standardized B) | Unstandardized B | 95% CI Unstandardized B |       | p    |
|--------------------|---------------------------|------------------|-------------------------|-------|------|
|                    |                           |                  | LL                      | UL    |      |
| Teacher Confidence | 0.08                      | 0.002            | -0.001                  | 0.006 | 0.25 |
| Gender             | 0.10                      | .08              | -.03                    | .19   | .16  |

Note: R<sup>2</sup> = .02 (p = .19)

Table 4: Linear Regression: Teacher Confidence and Gender on Post Science Identity

| Effect              | Estimate (Standardized B) | Unstandardized B | 95% CI Unstandardized B |      | p    |
|---------------------|---------------------------|------------------|-------------------------|------|------|
|                     |                           |                  | LL                      | UL   |      |
| Teacher Confidence* | .17                       | .02              | 0.003                   | 0.03 | 0.02 |
| Gender              | 0.06                      | 0.16             | -.23                    | .55  | .41  |

Note: R<sup>2</sup> = .03 (p < .05)  
\*p < .05

Teacher confidence was not a significant predictor of students' understanding of Things Scientists Do (Table 3).

Teacher confidence was a significant predictor of the students science identity score Science IOS (Table 4).

After participation in SciTrek, 65% of students reported liking science more! Student's liking of science post program was also a significant predictor of student's science identity (Table 5). Gender was not a significant predictor in the 2nd grade data for any outcomes.

Table 5: Linear Regression: Students' Liking Science and Gender on Post Science Identity

| Effect                      | Estimate (Standardized B) | Unstandardized B | 95% CI Unstandardized B |      | p    |
|-----------------------------|---------------------------|------------------|-------------------------|------|------|
|                             |                           |                  | LL                      | UL   |      |
| Student's Liking Science*** | .45                       | .86              | 0.61                    | 1.12 | 0.00 |
| Gender                      | -0.01                     | -0.02            | -.38                    | .34  | .93  |

Note: R<sup>2</sup> = .20 (p < .00)  
\*\*\*p < .00  
2<sup>nd</sup> grade students showed 65% liked science more and 35% liked it the same or the less after participation in the Sci Trek program.

## Discussion

- Gender was not a significant predictor in the 2nd grade data for any outcomes. However, gender effects in STEM are commonly reported throughout the literature. This suggests that gendered changes in science identity and performance are happening later than 2nd grade. Future research can look at data by grade to see if and when gender does significantly predict science identity. There is evidence that gender stereotypes are related to media exposure, which would be an important factor in future studies.
- Teacher confidence was an important factor, playing a role as a significant predictor in both student's improvement on NGSS SEP like practice assessments (post-pre program). Teacher confidence in teaching science was also significantly positively correlated with the perception that their students had improved in their approach to problem solving. This is important because frequently teachers who teach lower grades in elementary school do not report strong confidence in teaching science as science is not required part of curriculum in 2nd grade in CA.
- Teacher confidence was a significant predictor of child's science identity measured with the modified IOS scale shown in methods. This is a significant finding showing that the SciTrek teacher training is important as the teacher's rating of their own confidence teaching science predicts some of their student's science identity.
- 65% of students reported liking science more after the program, suggesting the program is successful at increasing student's interest in science. Further, the student's liking of science (post program) was also a significant predictor of science identity.
- The data suggest 1) SciTrek is a successful program at increasing students interest in science as well as their understanding of SEP like practices, 2) Teacher confidence is an important factor in the students performance on assessments of SEP like practices and student identity 3) students liking of science is another important factor in predicting students' science identity, 4) SciTrek's approach is pivotal science education since it has positive effects on students and teachers in 2nd grade.

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