

# Building young scientist confidence: Integrating peer-review and publication in science research projects

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## How does participating in the publication process impact young scientists?

### The Question

It has been known for many years that the way scientists approach “doing science” is not fully reflected in classroom practices or by the curriculum standards and assessments for K-12 science education (1, 2,3). Specifically, the role of disciplinary literacy skills (reading, writing, revising and using literature) within scientific inquiry are emphasized much differently in the scientific field compared to the classroom. For scientists, communicating one’s work is not just a critical output of their research, but an integral part of the entire process from initial observation to hypothesis development, design and revision of methodologies, results interpretation, and finally integration of conclusions into a larger knowledgebase (4, 5, 6). Thus, a gap exists between how disciplinary literacy *should* be part of learning and practicing science inquiry and how students are *typically* taught, and exposed to, disciplinary literacy practices. Currently, it’s not known how younger scientists perceive the role of disciplinary literacy practices, specifically the role of the primary literature, within science and how their views align with contemporary understandings of STEM disciplinary literacy and scientific inquiry. This study explores the experience and perceptions of students who have engaged in peer-review and publication of their STEM research projects through the Journal of Emerging Investigators. We hypothesize that after the publication experience, students will express more advanced ideas of disciplinary literacy practices and also express enhanced self-efficacy and confidence in pursuing research.

### Our Approach



**Figure 1. The Journal of Emerging Investigators (JEI) is a free open access journal open to middle and high school students to publish their work.** JEI connects middle and high school students with graduate students and post-doc scientists within their field who mentor each student through the publication process.

### Data Collection & Analysis

- Submission of Paper and Pre-Survey
  - Starting in Fall 2020, any student who submitted a paper to JEI was asked to complete a voluntary presurvey regarding science inquiry, STEM efficacy, confidence and identity.
- Peer-review, revision and resubmission
  - Student papers were sent to 3-4 graduate students for review. Students were provided the constructive feedback and asked to revise the paper prior to publication.
- Student paper is published, Post-survey submission
  - Students were emailed their final paper proofs before online publication and asked to complete the voluntary post-survey, which was nearly identical to the pre-survey.

### Discussion & Conclusions

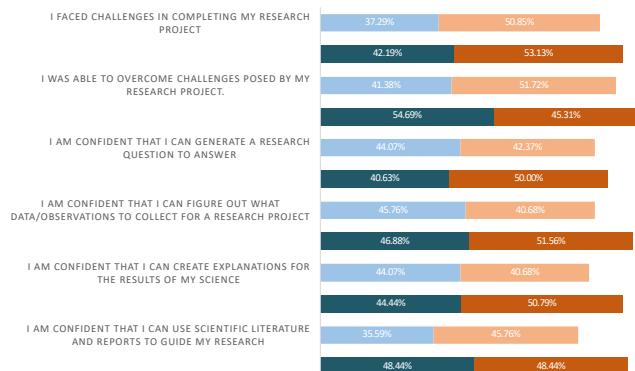
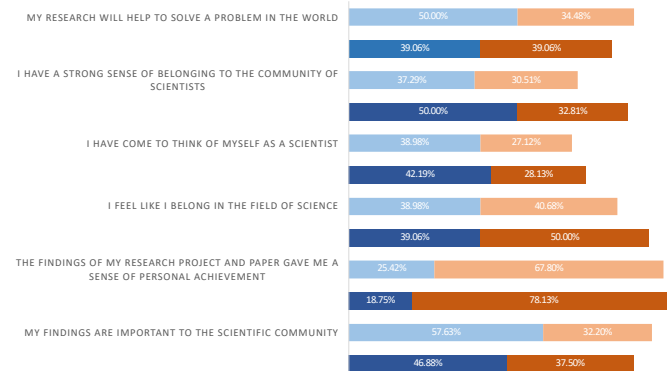
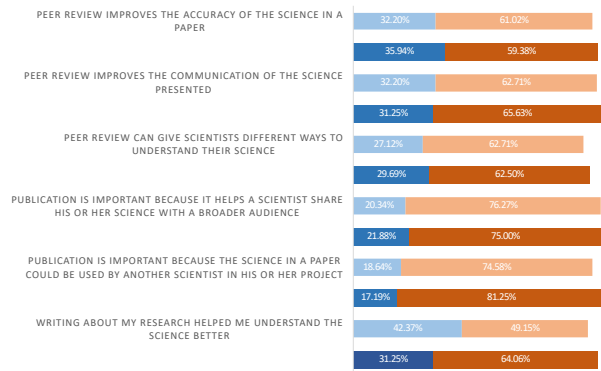
The dimension of “Disciplinary Literacy within Science Inquiry” shows the least gains in the post-survey responses. Our past work concurs with the survey results and suggests that students view the publication process as a personal outcomes more so than an integrated part of doing science. Although, students do acknowledge that writing helped them understand their research better. Students report greater gains in all “Identity in STEM” statements, except the two statements regarding the impact or importance of their research. Considering our past data, this may be because the peer-review process encourages students to make careful conclusions that are supported by evidence, which may lead students to better understand the limitations of their work. Across all dimensions, there were greatest gains in confidence and self-efficacy following the peer-review and publication process. Research has shown that confidence and identity is associated with continued interest and retention in STEM, thus these results are promising regarding long-term value of engaging in publication of research projects (7,8).

Although preliminary, these results could inform the how and why disciplinary literacy practices should be incorporated in the STEM classroom.

#### Future Directions

We are continuing to collect survey results for the next year and we will analyze questions within each dimension to understand changes more clearly. We also plan to examine demographics, type of research, and type of mentor to determine if any of these variables impact potential learning gains.

**Findings:** For each statement, the % of students who agreed or strongly agreed to the statement is shown. Lighter bars represent pre-survey responses (n=59); darker-shaded bars represent post-survey responses (n=64).



**Figure 2. Disciplinary Literacy within Science Inquiry.** Of the six statements, a greater proportion of students respond “strongly agree” in the post-survey compared to the pre-survey in 4 of the statements. This demonstrates a positive trend in better understanding the role of disciplinary literacy.

**Figure 3. Identity in STEM.** Overall, students demonstrate increased perceptions of belonging and identity after the peer-review and publication process. However, post-survey responses indicate that students have lower perceptions of the significance or importance of their research projects.

**Figure 4. Confidence and Self-Efficacy in STEM.** Across all statements, a greater proportion of students agree or strongly agree in the post-survey compared to the pre-survey. These responses indicate a trend in greater confidence and self-efficacy following the peer-review and publication process.

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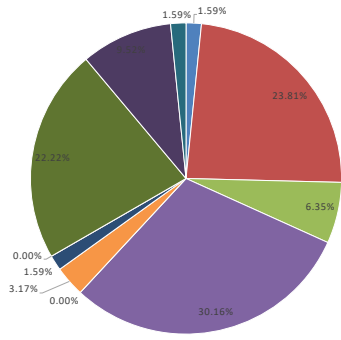
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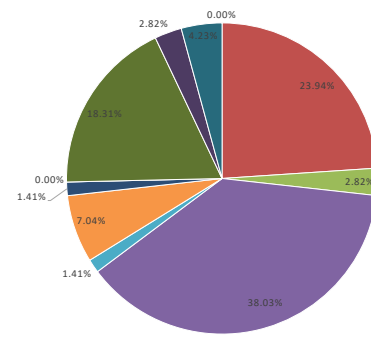
# Demographics

Pre-Survey



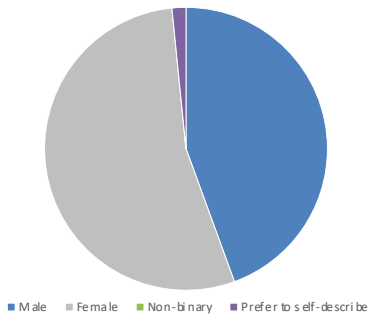
- American Indian or Alaska Native
- South Asian or Indian
- Black or African American
- Other, please specify
- East Asian
- Middle Eastern
- Native Hawaiian or Pacific Islander
- Prefer not to answer
- Southeast Asian
- Latinx
- White

Post-Survey

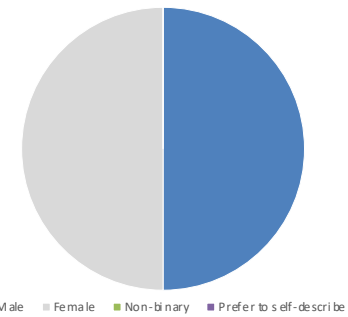


- American Indian or Alaska Native
- South Asian or Indian
- Black or African American
- Other, please specify
- East Asian
- Middle Eastern
- Native Hawaiian or Pacific Islander
- Prefer not to answer
- Southeast Asian
- Latinx
- White

## Race

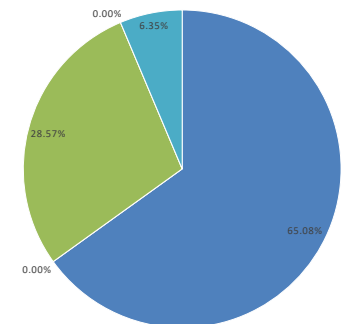


- Male
- Female
- Non-binary
- Prefer to self-describe

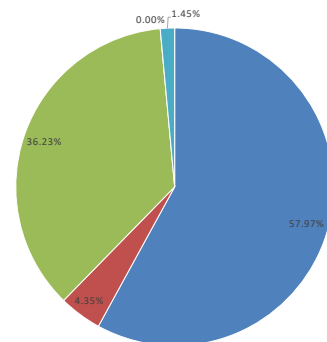


- Male
- Female
- Non-binary
- Prefer to self-describe

## Gender Identity



- public school
- charter school
- private school
- home school
- other, please specify below



- public school
- charter school
- private school
- home school
- other, please specify below

## Location of Research

# Confidence, Identity and Self-Efficacy in STEM

## Post-survey comments from student authors

JEI has been a great experience that made me even more enthusiastic about research, so my decision to continue research in college has been strongly influenced by this opportunity.

I think JEI has encouraged me to continue scientific research and try to publish my work more often

I think submitting my paper to JEI has made me more motivated to pursue science.

I plan to be a veterinarian and a researcher. Yes JEI has influenced my plans because it has made me realize how important research is to me.

I was wondering if I should do research after I graduate college and JEI gave me more confidence in thinking I could do this.

Absolutely. I plan on going into biomedical engineering, and this research project was what skyrocketed my interest in the field. Going through the publishing process showed me that this is what I really want to do, and that it can benefit other people in the scientific community too.

Writing this paper and submitting it to JEI has helped me feel more confident in my abilities as a scientist.

I would like to study social and political sciences. I have always been fascinated by history. I believe that the experience that I gained from JEI will give me more confidence to possibly pursue scientific research at the university.

I would like to pursue a degree in astrophysics. JEI has helped me gain confidence in my research and explore a lot more deeper into my field than before. I am interested in doing research in the future so JEI gave me the ability to explore the process of research and publication as a high schooler.

Yes, I was skeptical to study a science degree but after this experience, I completely fell in love with it

Yes, it has! My confidence in doing academic research before was extremely low. It seemed like such an unreachable goal. But publishing my work in JEI has boosted that confidence immensely. The research I conducted was primarily independent and having other scientists approve it has made me confident in pursuing academia, doing independent research and taking risks!

JEI helped me develop the confidence I need to succeed as a researcher.