



Participating in the scientific publication process:
Exploring students' perceptions of scientific inquiry and
identity

Sarah Fankhauser, PhD.

Assistant Professor of Biology
Oxford College of Emory University

and

Gwendolynne Reid, Ph.D,
Gwendolyn Mirzoyan, Clara Meaders, Ph.D, and Olivia Ho-Shing, Ph.D.

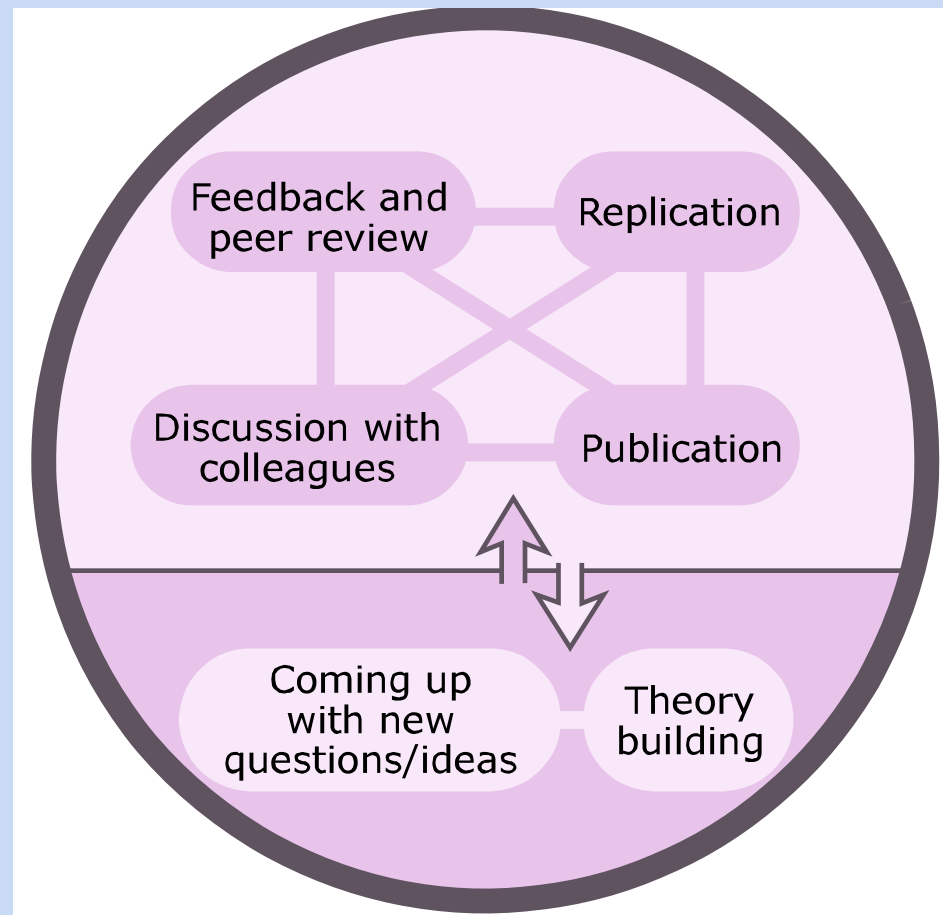
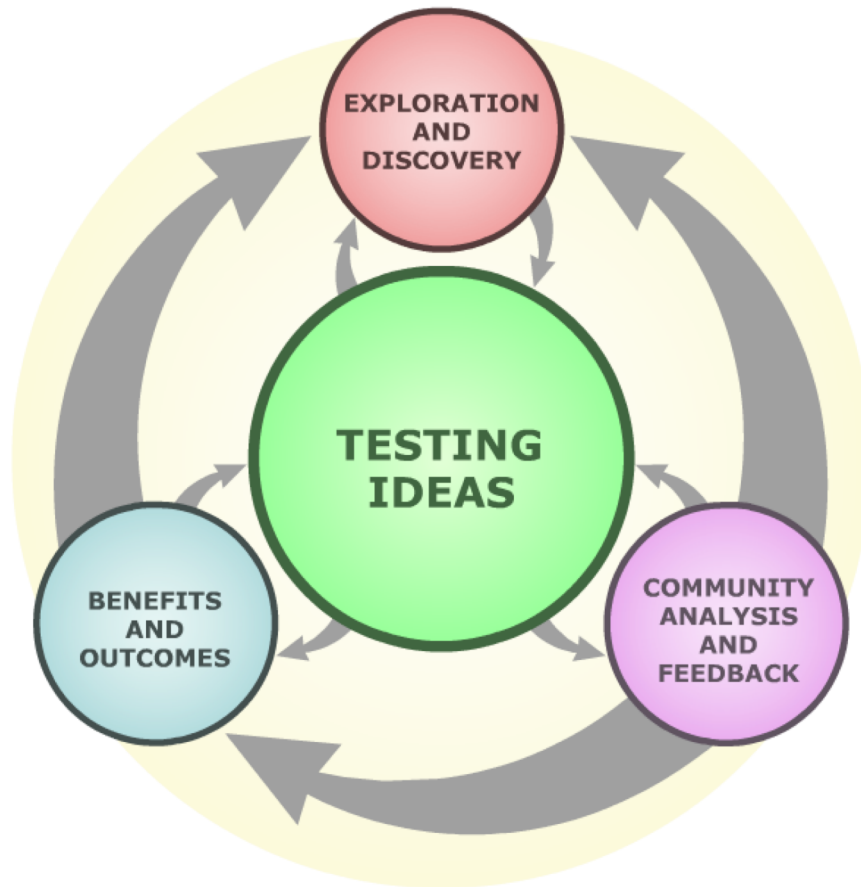


Examining how pre-college students participate in research in informal settings:

- Perhaps a common goal: to authentically replicate and engage students in science research.
- Yet, even in these authentic settings, the “authenticity” of science may not be comprehensive, or inclusive of key pieces. Thus students do not develop an understanding of how *to do* science (Sadler et al., 2010)
- Particularly, engaging students in writing and communication practices is not a common endeavor.



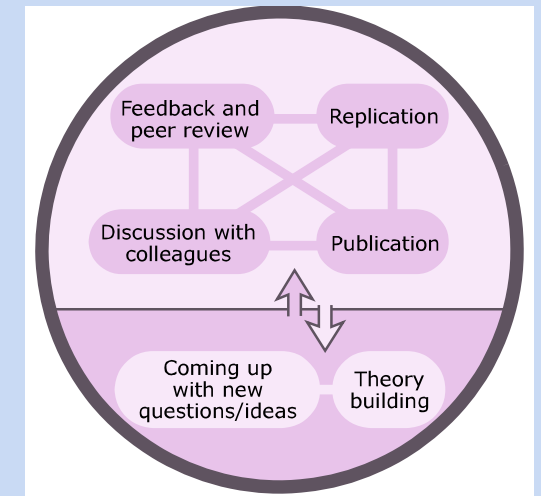
Engaging students in STEM disciplinary literacy: A key part of science inquiry





STEM Disciplinary Literacy within Scientific Inquiry

- A scientist **is required to use literature from other scientists, and thus the ideas, methods, and conclusions of other scientists**. Therefore, it is not surprising that the average scientist reads 333 pieces of literature per year, with over 40% of these readings comprised of the primary literature (Tenopir & King, 2004).
- Schwab advocated for the use of original scientific papers as curriculum materials in the 1960s, explaining that **“They afford the most authentic, unretouched specimens of enquiry which we can obtain”** (1962, p. 73).
- **Yet, pre-college students rarely read or publish primary literature, even though they are “doing science”**
 - Lack of primary resources accessible to students.
 - Lack of teacher/mentor awareness and comfort with primary literature.
 - Lack of time to devote to authentic literacy sources (Moje, 2008; O’Brien, Stewart, & Moje, 1995; Pearson, Moje, & Greenleaf, 2010).
- However, excluding the primary literature process within inquiry may undermine how students understand scientific knowledge construction.





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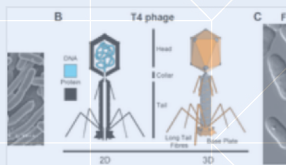
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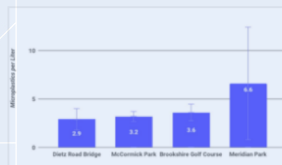
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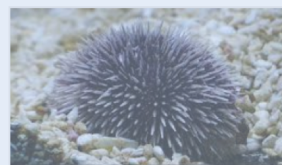
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Scientific journals written by and for K-12 students audiences may provide more accessible bridges to the primary literature for both students and teachers, much as undergraduate journals have done so in college settings (Stone et al., 2016; Tatalovic, 2008; Walkington, 2012).

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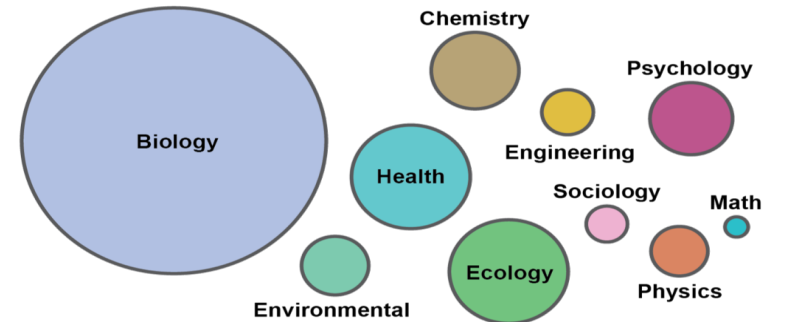
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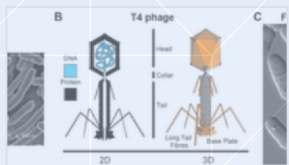
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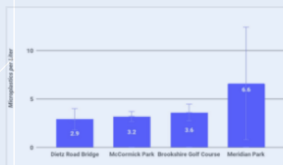
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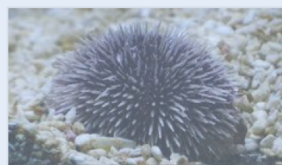
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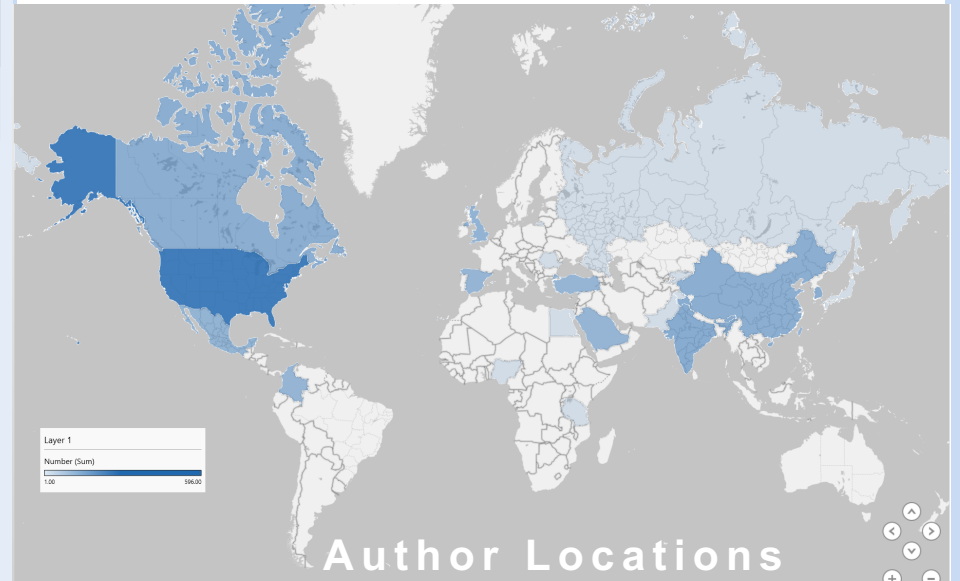
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Featured Scientists





How *JEI* Started

Like any other research project, *The Journal of Emerging Investigators* started *with an observation*. At the end of several local science fairs in the Boston area, all of the hard work of the students -- all the data and the conclusions -- often went into the trash once the science fair concluded. It was disappointing to say the least, but it led to a simple question: *how could we keep the work of these young scientists alive past science fair and share it more broadly?*



Supporting Manuscript Development

Online Writing Guides & Models

Senior Author

Parts of a Scientific Manuscript

The manuscript must contain:

- Title Page
- Summary
- Introduction
- Results
- Data Figures
- Discussion
- Materials and Methods
- References

For detailed descriptions of each of these elements, see below.

Title Page

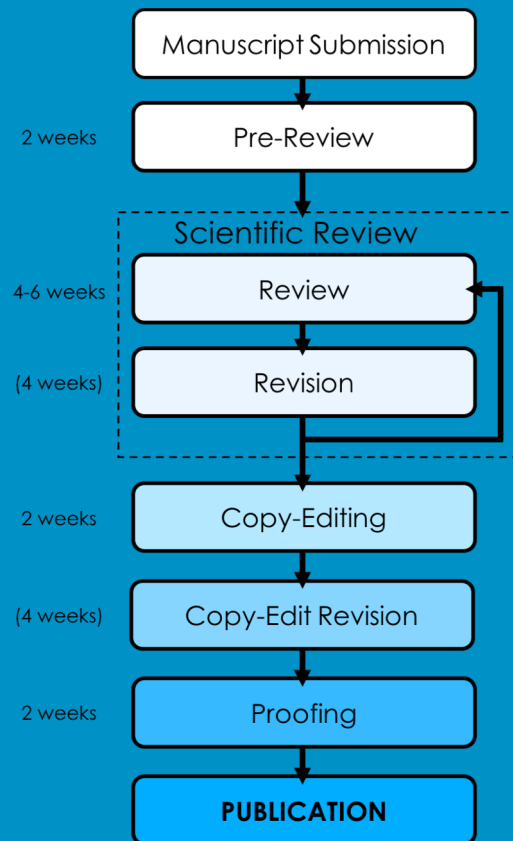
The title page should include a title which succinctly describes the content of the manuscript. This page should also have all of the authors listed in the order in which they contributed, with the teacher or college/university mentor listed last. Please also include the school of the students and the school or place where the research was performed. Here is a [Sample Title Page](#)

An adult mentor and co-author, such as a middle school teacher, high school teacher, college professor, or parent.



JEI's Publication Process

JEI guides students through several cycles of critique and revision with professional scientific mentors.



JEI's mentoring process:

1. Challenges students to think critically about their experiments and whether their conclusions are valid.
2. Teaches students effectively communicate their research to a broad audience through writing.
3. Provides supportive feedback from fellow students studying science at the graduate level.



Research Questions

1. What motivated student authors to write for JEI?
2. What are JEI student authors' perceptions of scientific publication?
3. What did student authors perceive as the outcome to their JEI publication?



Research Methodology

Retrospective discourse-based interviews (Odell et al, 1993) with twelve JEI authors.

Manuscripts, peer review comments, and editor communication used to elicit tacit knowledge.

Inductive coding using constant comparison (Glaser, 1965): open, focused, then axial coding (Saldaña, 2009).

95% Inter-rater reliability

Relevant Codes Identified

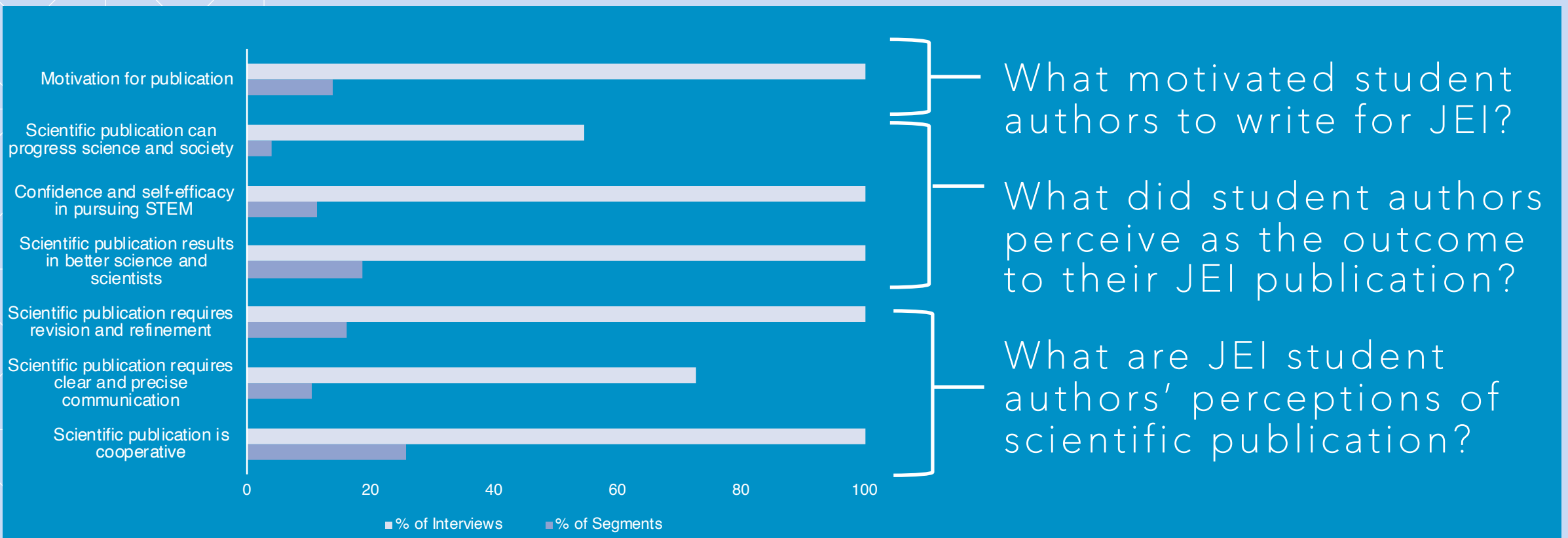


Figure 1. Frequency of codes from interview transcripts within all segments and interviews



Student Motivation

Making a Difference

Jane: We started thinking about the idea of a [mammal species] safety corridor, and really we wanted to do more than just, you know, raise money and stuff like that. We wanted to do stuff that would really matter in the scientific field. (Jane, with co-author Michael)

Ishita: I travel to India a lot and when I go there, every time I go I get sick because we're just not used to the water, the food, and everything. So last time that I went I took these probiotic pills with me, and I still got sick. So that was kind of the motivation behind it. I wanted to see if there were some combination that I could test to see whether that would be more beneficial in actually protecting you.



Student Motivation

Gaining Legitimacy

Noah: Publishing it makes another level of *legitimacy* to your work.

Jane: Personally, I wanted our idea to really get out there. I thought that if we could reach people in their language, you know, like scientific papers, that would really help. And I think that when you have it written on paper, and it's very like facts oriented, then *people will take you more seriously*. So you get a lot more respect and a lot more—I'm not sure if publicity is the word—but a lot more awareness.



Perceptions of scientific publication

Scientific publication requires revision and refinement

Michael: We had always known the stages, like, first you plan, then you make it into a paper, then you submit it, and then it comes back and you review it, and then you change some things, and then you submit it again and it comes back, and then you change some things, and then it probably gets admitted. But I really hadn't known that there would be that many things to change.

Ishita: Going through a publication process makes you look at every published paper differently now. I can look at another paper and I'm like, oh, wow, they went through these revisions too."



Perceptions of scientific publication

Scientific publication is a cooperative endeavor

Ishita: The most helpful thing would be, like, how much they [reviewers] guided you through every step of the way, by whether it'd be doing your revisions, or, they were really thorough about telling you what to change. Or getting back to you or seeing what the next step will be.

Michelle: I was surprised in a good way how much they... how in-depth the comments were. And so, I was really happy that they, you know, took the time to read the entire article and took the time to give thorough comments... I enjoyed learning new things from them.



Outcome of scientific publication

Scientific publication results in better science and scientists

Jane: We got really great feedback, but it informed us to go back into our code and to tweak it a bit, and I was worried it would change all of our results and we would have to pretty much change our entire paper. But after doing so, I just think it made our paper so much more stronger.

Vivek: And it [review comments] had a lot of science comments on the biomarker that I had and that actually taught me a lot more about it, my own research."



Outcome of scientific publication

Scientific publication can progress science and society

Vivek: The publishing aspect is really important because not only will it show other people what I've done, but it can also inspire them or it can also encourage them to think more about what I did. And then might even lead to them doing their own investigation.

Jane: Going through this process, I realized kids like us, they can completely change the way people think with just a computer simulation and a paper.



Outcome of scientific publication

Confidence and self-efficacy in pursuing STEM

Michelle: [it] boosted my confidence . . . now, I still like to read scientific papers, mostly submitted by [organization], and I read them differently now. I can look at the graphs and understand them a lot better than I have before, and I like seeing how other people approach their problems and then relating it to our paper. I think it's really really cool.

Michael: Yeah I always used to think, oh, I'll be a scientist when I go to college ... but now I'm thinking I'm a scientist now once I published a paper.



Conclusions

- **Motivation:** In seeking self-sponsored writing opportunities, the desire to learn and act figure prominently. For minors, who generally struggle with a sense of powerless, *learning to write scientifically is a way to develop agency and social power.*
- **Process of Publication:** Students recognize the *revisionist nature of publication,* yet view the reviewers as supportive and collaborative partners who ultimately help them improve the science.
- **Outcome of Publication:** Students ultimately hold *underdeveloped views on the role of primary literature in science publication.* Primarily, students view publication as “knowledge transmission” vs part of “knowledge construction”. This could be connected to their original motivation to create change.



Implications for practitioners and mentors

- Given our results, we suggest that the *value and use of primary literature should be emphasized at all stages of the student research process.*
- More resources should be created to *engage students in these disciplinary literacy practices.*

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