Composing Scientific Inquiry

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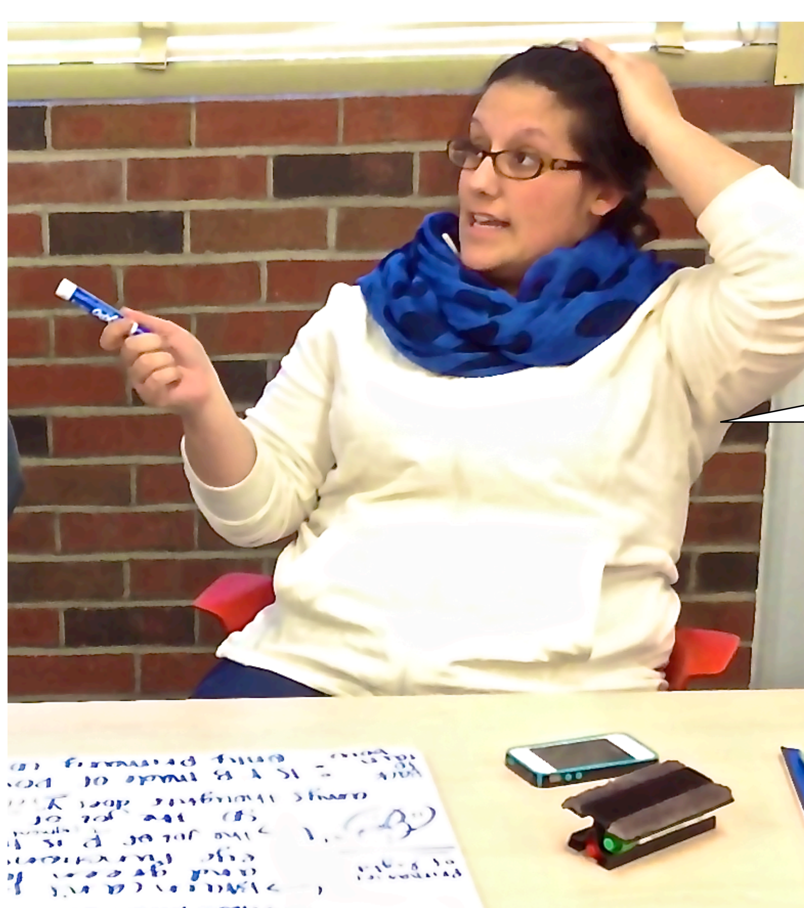
ABSTRACT. Faculty from science education and faculty from English (Composition & Literacy) collaborate in an upper-division science class for future teachers. We use a range of practices to support students' engagement with science writing. We pay particular attention to multimodal composing—informal science notebooks, diagrams on whiteboards, images shared on Tumblr—to model and reflect the composing practices of scientists. We offer evidence that 1) students engage in a rich, iterative process of constructing, critiquing and refining models and terminology in ways characteristic of scientific practice, and 2) students' multimodal compositions play a central role in the construction of these models. Of particular importance are structures that allow, and encourage, the use of student's own language for composing. Without the rigid, and often template-driven, lab report as a model, students make meaning in ways that resemble the "real" work of scientists.

ASSIGNMENT 1: Is every color in the rainbow?



... "While this may seem ridiculous, I would like to explore this inquiry through an exploration of technology screens. For example, a computer monitor or television can only depict the colors red, green, and blue in each pixel; however, we are clearly able to see each color on the monitor. This is created through proximity of pixels (like a painting by Seurat!) The rainbow may in fact be like a giant pointillism canvas filled with an infinite number of dots."

How would you respond?

- ✘ Cassandra's response to her homework assignment does not specifically address the question asked.
- ✘ The phrasing "while this may seem ridiculous…" and the exclamation point in her parenthetical comment are not typical of scientific texts.
- ✘ The ideas themselves are not normative descriptions of the colors in a rainbow - which are largely monochromatic and not a "pointillism" composition of wavelengths.

THIS! THIS IS A QUESTION! Your group started looking at iPhone screens today, right? I'd love to see you do more with this. Like: why red/green/blue? How does a TV screen show a rainbow if it's only using red/green/blue?

-Instructor feedback

Using a generic rubric - or even one specifically targeting this assignment - would lead an instructor to undervalue these ideas. However, allowing students the right to their own ideas as they construct scientific ideas (here, the questionable idea that the colors in a rainbow are a pointillism-like collection of colors that can be investigated using a pixelated screen) and engaging with those ideas in scientific ways, we find that students come to employ sophisticated writing practices in the service of scientific inquiry.

The instructor's comments above do not attempt to "fix" Cassandra's writing or ideas. Instead, the instructor shows enthusiasm for this student's ideas, attending to the nascent attempts to model color. The comment shows that the idea is indeed not ridiculous at all. She recognizes that the idea is one that the students have already (since submitting the assignment) begun to pursue and the questions that their pursuit raises. When the instructor's notion of the ideal text takes precedent in the comments on writing, this "[tends] to show students that the teacher's agenda is more important than their own, that what they wanted to say is less relevant than the teacher's impression of what they should have said." Instead, students ideas here are taken up as a serious attempt at making meaning, and over time, the ideas will be generative for the whole class as they come to understand color, light, and the eye.

As we move on to consider the structures in the eye - many months after Cassandra's original conjecture - class debate considers how it is that images appear in focus. The debate concerns the following question: does each "SeuratSpot" reflect a ray in one direction, (and a collection of spots send rays in multiple directions), or does each SeuratSpot diffusely reflect light in all directions?

Kait: But you have multiple light rays coming off from the same SeuratSpot.

Amy: ...but they're not actually coming off of like, the exact same spot. Because a light ray can't, like, break. So it's like two light rays that are really really close to each other...

Trevor: That's the problem though - because it's one *single* spot and it's got light rays going in all those directions. It's not a bunch of little spots sending out a bunch of light rays.

Kait: It's the same exact spot.

Amy: But light doesn't do that.

A COMPOSITION FRAMEWORK FOR TEACHING SCIENCE WRITING

"Since teachers do not grant student writers the authority that ordinarily justifies serious reading, **they tend to undervalue student efforts to communicate what they have to say in the way they wish to say it.** Yet it is precisely the chance to accomplish one's own purposes by controlling one's own choices that creates incentive to write. **Denying students control of what they want to say must surely reduce incentive [to write] and also, presumably, the likelihood of improvement.** Regardless of what we know about students' authority, therefore, **we lose more than we gain by preempting their control and allowing our own Ideal Texts to dictate choices that properly belong to the writers."**

- Brannon & Knoblauch
"On Students' Rights to Their Own Text: A Model of Teacher Response."
College Composition and Communication 33 (May 1982): 157-66.

In our next unit on light, beginning with the pinhole camera, the idea of pointillism continues to be a productive way of modeling images, and other students begin adopting Cassandra's language.

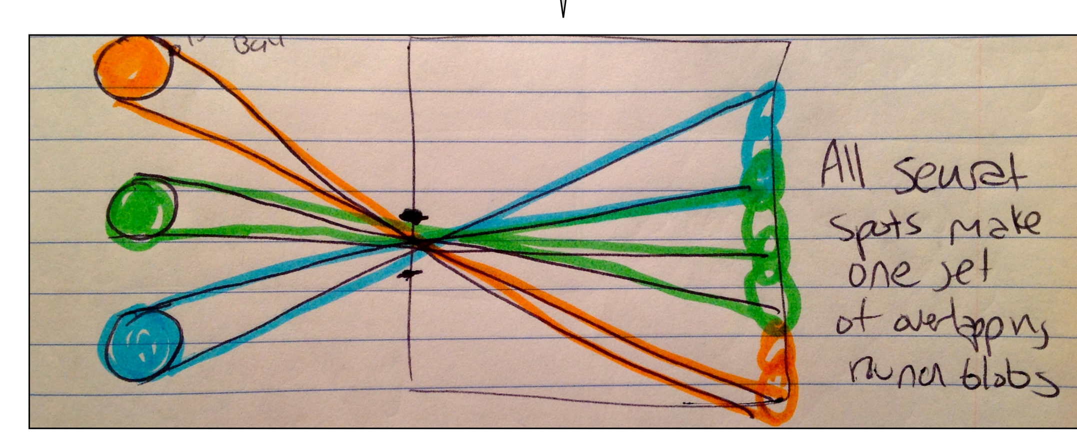


FIGURE 1. Image from a student's notebook adopting Cassandra's pointillism ontology of images.

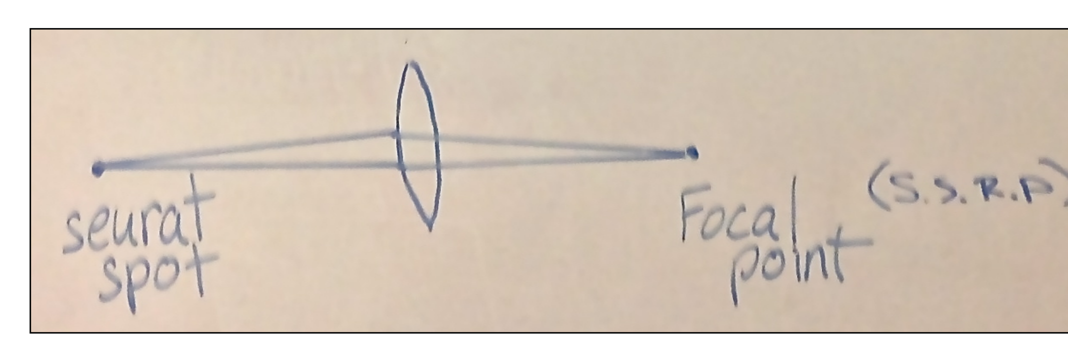


FIGURE 2. Image from a whiteboard representing a consensus model of 'focus' as related to SeuratSpots (SeuratSpot Reunification Point).

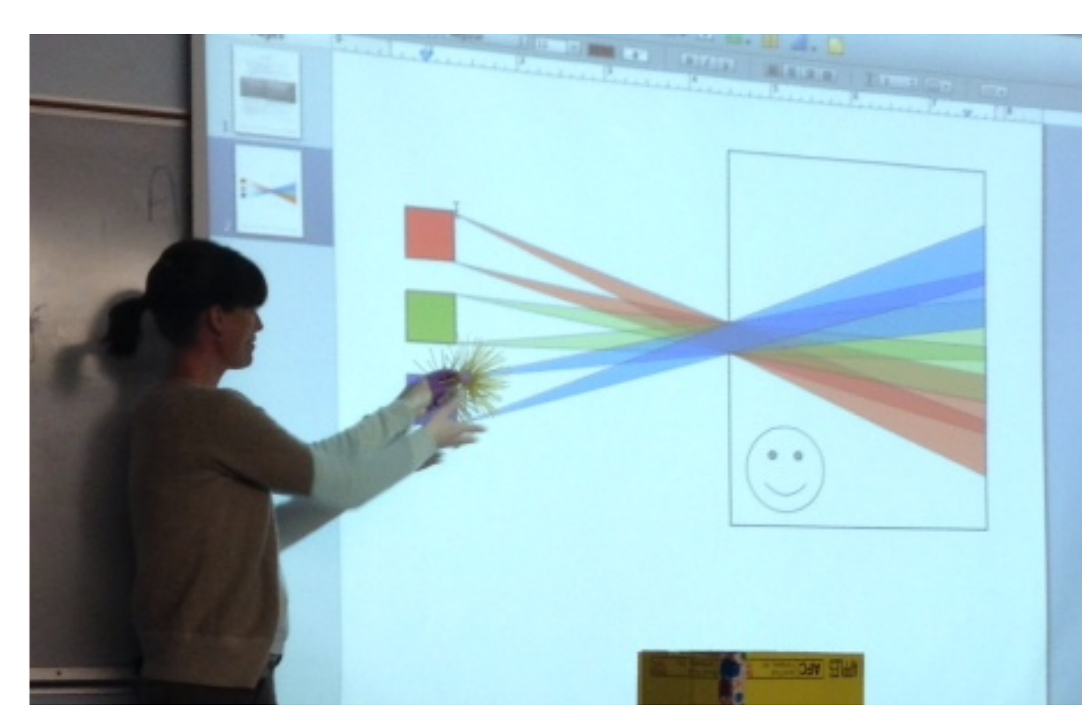


FIGURE 3. Instructor working with student-provided model showing the rays of light from a collection of SeuratSpots.

CHALLENGES FOR SCIENCE TEACHING & LEARNING

"SeuratSpots" is not a term or explanatory model used across scientific communities to understand focus; however, it is representative of the way scientists construct models to explain phenomena. Unlike science classes where students memorize terms or follow a lab report template, students in the *Scientific Inquiry* course take on the habits and ways of being scientists: they construct models and definitions to support the groups' understanding of an idea.

The challenge for science teaching is to see students' struggle with scientific ideas as worthy of pursuit, to see their meaning making as intentional, and to create a classroom space where students are allowed to try on the ways of being that are central to scientists.

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