

Teacher Learning through Expansive & Connective Sensemaking

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Motivation

Preservice secondary science teachers often experience science courses that are narrow and marginalizing^{1,2}. With these experiences, how can they go on to teach science in inclusive and affirming ways?

The overarching goal of this project is to design & study a content-focused PST education course to promote expansive & connective sensemaking.

Design commitment 1: Fostering expansiveness



We launched the first inquiry unit with the question: *Are all the colors in the rainbow?*¹⁶

Drew on not just chemistry & physics, but art, visual perception, photography, & computer science.

Rather than a set procedure, used different materials to think *with*.



The second unit asked: *Why are some plant stems & leaves red/purple?*¹⁷

We combined FastPlant experiments & field work to study anthocyanin expression in plants.

Resisted stance of detached omniscience, instead developed relationships to plants, took perspective of pollinators & predators, & connected to family/home.



Design commitment 2: Connecting to identity & historicity



Foregrounding students' own identities, histories, and cultures in our sensemaking¹⁸

Activities to deepen connections between sensemaking and sociohistorical contexts¹⁹

Readings on dominant narratives of science & school

Reflections on their sensemaking in relation to dominant narratives

Expansive & Connective Sensemaking

Pursuing coherent, causal, explanations of the natural world in ways that support heterogeneity & make connections to identity and historicity^{3,4}

Expansive

- Acknowledging multiple ways of *knowing*^{5,6}
- Using diverse forms of *communication*^{7,8}
- Enacting varied ways of *relating* to each other & phenomena^{9,10}

Connective

- Reflecting on our (and future students') *identities* in science^{11,12}
- Considering how *histories* shape our scientific present¹³
- Imagining how science relates to our *futures*¹⁴

Summary of Findings

Student	Background	Project Description	Slide	Expansive			Connective		
				Know	Comm	Relate	Ident	Hist	Future
Ally	Japanese-American woman sophomore chemistry PST	Made Japanese silk flowers to show <i>crafting</i> in modeling							
Beth	White woman, Masters environmental science PST	Made <i>nature guide</i> for local park to meet plants in different environments							
Dal	Korean man, junior chemistry & ed studies	Presented on mask pollution to <i>think creatively</i> about solutions							
Janelle	Black woman, Masters international ed	Considered how our work has been <i>culturally relevant</i> and where to push further							
Jeremy	White man, physics teacher, PhD student	Critiqued curiosity & objectivity in science; proposed <i>kinship</i> as model							
Kendra	White woman, nutrition teacher, Masters health science PST	Presented on <i>photography</i> to see phenomena in new ways							
Li	Chinese man, senior CS & ed studies	Made NetLogo highlighting <i>thinking with programming</i>							
Min	Chinese woman, senior CS & ed studies	Developed <i>logical, question-oriented</i> planting guide							
Nick	White man, Masters chemistry PST	Elaborated on <i>drawings</i> as a way to share thinking with others							
Scott	White man, sophomore physics PST	Made a yearbook to <i>synthesize</i> the class's work							

Study Overview

Modeling in Secondary Science is a 3-credit course that meets for 3 hours weekly for 14 weeks. Students were asked to:

- Develop & pursue questions about phenomena
- Share thinking in weekly science journals
- Comment on weekly readings
- Write reflections on their engagement

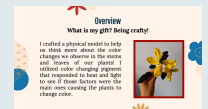
We analyzed students' final gift projects for evidence of engaging in expansive & connective sensemaking. The project is inspired by the quote¹⁵:



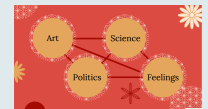
"Isn't that the purpose of education, to find your gifts and how they can do good in the world?" (p. 239)

Focal Case: Ally

To show her gift of crafting, Ally used Japanese silk flower technique to model color in FastPlants.



She connected her crafting to her family's histories, namely how Japanese Americans used crafting to cope with incarceration camps.



She linked these histories to science, arguing the need to how science is linked to art, feelings, & politics.

Sensemaking

Explored mechanisms of color change using photochromic and thermochromic pigments on the leaves. Compared the patterns of color change, raising questions about the link between light & heat.

Expansive

Knowing: Elevated Japanese cultural & material practices

Communicating: Engaged in familial story-telling as part of communicating science

Relating: Challenged science as neutral or acultural

Connective

Identity: Connected to family's practices, stories, & perspectives

History: Re-animated cultural and intellectual traditions to be part of her scientific present

Futures: Reimagines science to include art, feelings, & politics

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QR code for citations



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