The role of affect in stabilizing inquiry

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ABSTRACT

We explore the role of affect in a group of fifth graders' inquiry: Having learned that when objects are heated their molecules spread apart, students struggle to explain why water expands when it freezes. We track the role of affect through a series of mounting tensions and the release of those tensions as students come up with alternate explanations. We argue that affect was central to the stability of students' framing their activity as theoretical inquiry to address an inconsistency.

Why might inquiry & affect be related?

Inquiry

- Includes generating questions, assessing and refining ideas, reconciling inconsistencies, supporting claims with evidence, etc. (e.g., Driver, et al, 2000; Engle & Conant, 2002; Ford, 2008; Hammer, 1997; Kuhn, 1991)
- All are intellectually and emotionally challenging, require perseverance, and pose potential risks of tensions in the classroom.

Affect

- As learners grapple with ideas that intrigue them, they activate affective resources such as excitement, anticipation, ambiguity, curiosity, fascination.
- Evidence from cognitive psychology, neuroscience, and education, suggest that emotions and rational thinking are closely intertwined rather than antagonistic. (e.g., Damasio 1994; Pintrich et al, 2003)

Why do learners come to invest in the pursuit?
What stabilizes students' engagement in inquiry?

Introduction

To understand how students come to engage in inquiry practices, researchers have applied the lens of *framing* (Goffman, 1974), as the individual's or group's sense of "what is it that's going on here."

While considerable work has explored conceptual and epistemological aspects of students' framing in inquiry (e.g., Engle, 2006; Ford & Wargo, 2012; Scherr & Hammer, 2009), there has been little attention to the role of affect.

This poster presents a case study of student inquiry showing affective aspects of the dynamics in their framing of what it taking place, in particular with respect to identifying and struggling to reconcile an inconsistency in their understanding.

Video Analysis of Classroom Interactions

Previous research has mostly studied affect using surveys and questionnaires (e.g., Glynn & Koballa, 2006; Pekrun, et al., 2011). While valuable, this approach does not provide data concerning moment-to-moment dynamics within the classroom.

Here, we use video analysis to explore the role of affect as it plays out moment-to-moment in classroom interactions (Goodwin, 2007; Jordan & Henderson, 1995; Derry, et al, 2010).

We analyze the 22-minute video for productive scientific engagement with a lens on verbal and non-verbal markers of students' affective displays.

Analysis of affect: A multimodal approach

Emotion is organized through stances embedded within the flow of ongoing activity (M.H. Goodwin et al., in press). We adopt a multi-modal approach (Stivers & Sidnell, 2005) to identify verbal or non-verbal markers of affect in action. We identified the following markers in the data:

Explicit discursive markers:	e.g., "YAY!"; "That would be awesome"
Paralinguistic markers:	e.g., raised/lowered voice, overlapping oppositional speech, excited exclamations, questioning tone, cut-offs
Physical displays:	e.g., vivid gestures, forceful hand movement, facial expressions revealing wonderment, puzzlement, frustration, oppositional body positioning, standing and sitting up desk, moving around

Part 1- Conceptual Model & Inconsistency

Molecules spread apart when temperature increases ⟷ Water expands when it freezes

Have you noticed, if you put the water bottle in the freezer, how it just-gets-expanding

So wouldn't packed together mean smaller?

DC (off camera): NO! Packing together means…

As Jared points out the puzzling inconsistency of ice expanding, DC interrupts him in an oppositional speech with a strongly pronounced "NO!" This marks the tension that is beginning to build up as students come up with alternate explanations to resolve this inconsistency.

Part 2- First attempt to resolve inconsistency

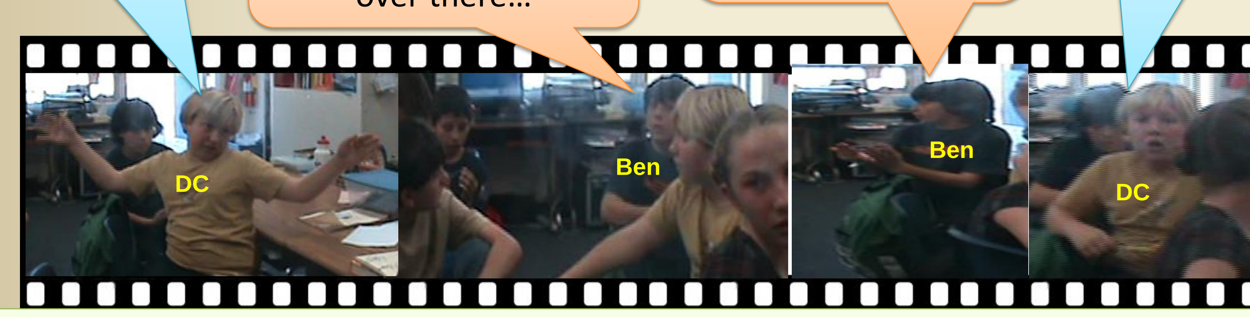
When molecules pack together, they form a larger unit ⟷ Forming a larger unit does not mean taking up more space

Say, we just huddle in a giant ball of circle, we would be a giant

if we were all packed together like on the rug over there…

… we would be big, but we wouldn't have to make the classroom expand!?

We would just be expanding ourselves.



While DC argues that packing together creates a larger unit, Ben questions this reasoning establishing a conceptual and affective dissonance. DC is perplexed as he realizes the shortcoming of his explanation.

Part 3- Second attempt and tension build-up

A pool of liquid water is more expanded than an ice cube ⟷ Ice is larger as molecules pack together making a big unit when water freezes

A pool of water is expanded more than an ice cube, isn't it?

When it's freezing, the molecules are coming closer and closer together,…

…they get bigger because they merge and make one big one that turns into ice

Yeah! I agree with you!

While Jared suggests that liquid water is more expanded than ice, Ben reiterates DC's model who explicitly expresses his agreement. Tension is building up as students take up oppositional stances with respect to various conceptual and epistemological elements of the argumentation.

Part 4- Tension build-up: Challenges to second attempt

Ice expands because it is a solid ⟷ The account does not provide a mechanistic explanation

But how does it exPAND?

It expands… 'cause it's a solid.

'Cause … when they're merging together, and then they can get bigger because they're already one…

Solids can get bigger!

But then HOW does it exPAND like what you're saying!?

Jack's anxiety is building up as he finds DC's account lacking a mechanistic explanation. He twists his body to face DC directly, opposing his explanation with the use of the word "but" twice to convey disagreement. DC responds in a defensive tone and forceful body movement.

Part 5- Third attempt and tension resolution

Ben suddenly experiences an "aha-moment." He reasons that air pockets form between water molecules making the volume of ice increase.

I need two pieces of paper!

Pretend there's a metaphorical water bottle around this

molecules, when they merge together…, they make something big like that,

… then they expand like that

maybe this kinda explains it that little water in there kind of- or that air

YEY!!!

Ben abruptly stands up to demonstrate his new idea interrupting the conversation. Ben and DC rejoice for the teacher's comment: they sit up on their desk, smiling and cheering. This marks the beginning of tension release in the classroom.

Part 6- Tension resolution: Pursuing the model further

Students became enthusiastic to pursue Ben's model, offering supporting evidence and models, and suggesting experiments.

So the molecules come together, and spread apart like that… That's why, in ice cubes, there are little pockets of air.

You know when you put your cup of water, and put ice cubes in it and they crack? That's the air pockets opening.

If you had this flat piece of paper, this is a puddle. When it's trying to compact there's still air inside, so …it just freezes right there because it can't go all the way

We can do an experiment! Do we have any magnifying glasses?

The class experiences a moment of resolution. Jared, who originally opposed Ben's reasoning, now takes up his model to resolve his own struggle. The excitement for Ben's model is portrayed by the bubbling of ideas, the overlapping talk, and students moving all around.

Background on Research Context:

This data is from a 3-year **learning progressions for scientific inquiry**, to promote "responsive teaching" by training and supporting 3rd to 6th grade science teachers in attending and responding to students' reasoning.

Summary of results

In this episode, we see students taking up disciplinary practices of science that reflect their framing of the activity as theoretical inquiry: they initiate ideas, problematize arguments, generate thought experiments, suggest models, and offer evidence to support claims.

As students strove to explain the puzzling phenomena of ice expanding, they oriented to inconsistencies within and across each others' stances causing a build up of tensions that were at once conceptual, epistemological, and affective.

Main Claims

We argue that affect played a central role in instigating and stabilizing students' generative engagement in this episode of theoretical inquiry. Students' puzzlement over the discrepancy, their frustration and desire to reconcile it, created a generative tension in the classroom that became the main driver of the inquiry.

These affective dynamics were closely entangled with the conceptual and epistemological substance of the pursuit. We propose the notion of ***disciplinary motivation*** to describe **affect that inheres in the substance and practices of science.**

Significance and implications

Our perspective on disciplinary affect entails repositioning affect within the practices of science.

This implies that part of recognizing and cultivating the beginnings of science in students' thinking involves attention to their *affect in the doing of science*, rendering ***disciplinary motivation*** a central instructional goal in science education.