

Lab Experiences and Students' Ideas About the Nature of Science

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What is IMPRESS?

Acronym:	Integrating Metacognitive Practices and Research to Ensure Student Success
Who it's for:	20 First Generation and Deaf/Hard of Hearing pre-college students at RIT

Assessing Students' Beliefs of Science

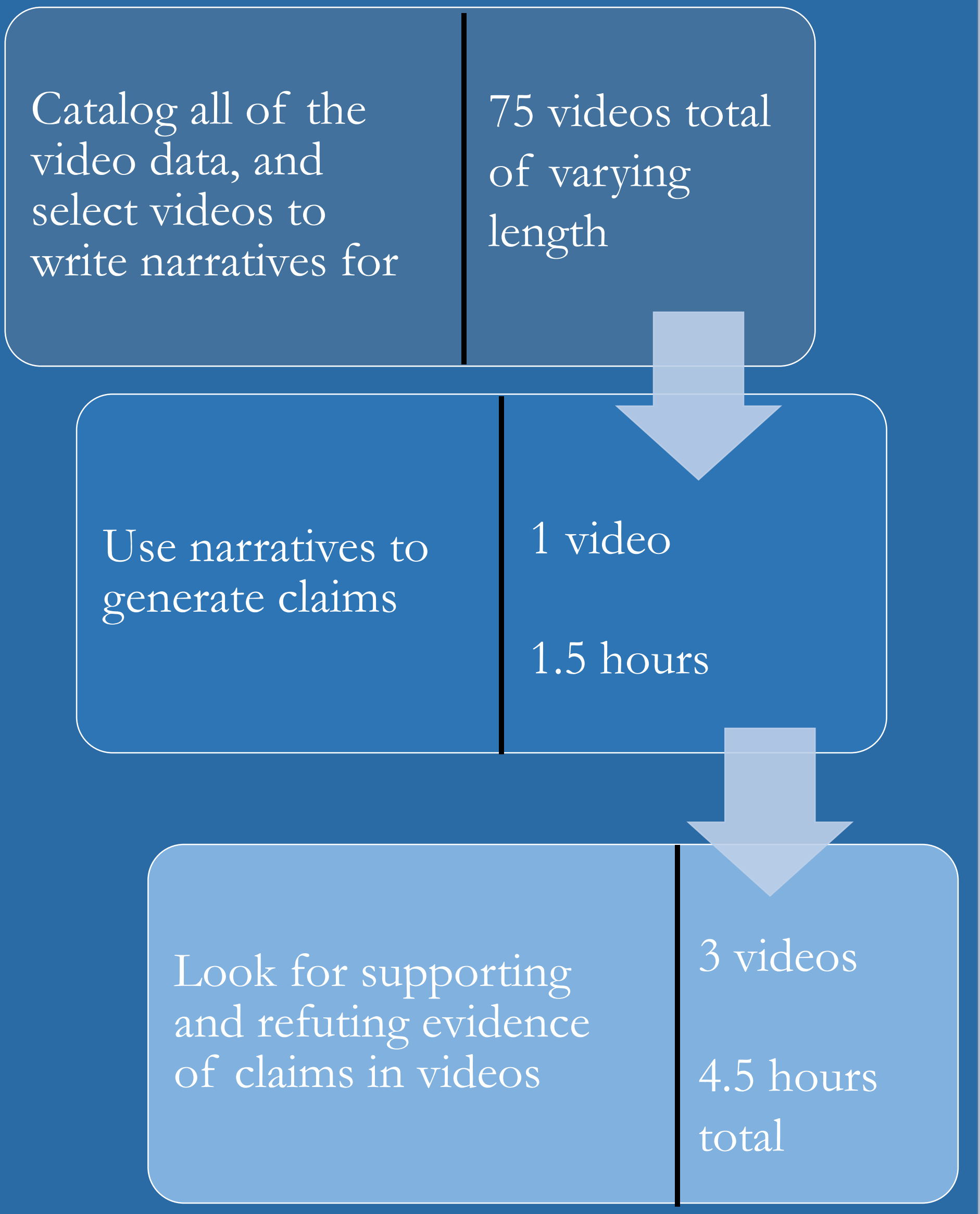
What are students unprofessed and implicit beliefs about science? We use video data of 4 students completing open ended experiments to analyze their words and actions.

Analyzing Student Talk About Science¹

B	• Brief: Short comments or questions
E	• Embedded: Part of a larger project
S	• Spontaneous: Unprompted
M	• Metacognitive: Reflective

BESM talk shown in bold

Methodology



You notice that you guys have a setup on your bench already for you: you've got a heat lamp, two bottles with thermometers in them, alright? You'll also notice you have some seltzer tablets... those seltzer tabs are gonna be a source of carbon dioxide.

So you're gonna drop those seltzer tabs in one of your bottles but not in the other. You're gonna turn on that light, and you're going to monitor the temperature in both bottles for about 20 to 25 minutes.

Do we want to control "night time" just to see a cooling temp? Or are we supposed to have the heat lamp on for the whole 20 minutes?

I think we're supposed to have the whole thing with heat.

Are we doing another 25 minutes with it being "night time"?

Are we still doing the whole "night and day" thing?

...

...so we'll just keep it on, I guess.

Resistance to Side Quests

- On the previous day, the group completed an experiment on how the atmosphere heats up and then cools down.
- When a student expressed interest in deviating from the day's given instructions, the group was not receptive to the idea.
- The long pause followed by another student suggesting to follow the instructions was confirmation of the group's unwillingness to complete a side quest.

You're going to try to figure out what's happening. Make a theory about what you think is happening in those bottles.

Well, carbon dioxide makes a difference... but I feel like it's more of a chemical reaction that's going on- um, that gave off the heat.

I keep coming back to that "molecules absorbing at different electromagnetic spectrums" idea, but I still have no idea if I'm right about that... Maybe carbon dioxide absorbs the visible light or ultraviolet light spectrum.

My head hurts

Later...

Would it be alright if we put water in the bin?

What for?

To put tablets in it... so we have carbon dioxide in that environment.

Is there another source that you could use for carbon dioxide?

Your breath.

Lack of Explicit Consensus

- The group had two competing theories for their observations. The theories are described by two students in panel 1.
- They never reach an explicit consensus at any point; nonetheless, they end up moving onto the model building stage anyway.
- In panel 2 they *implicitly* chose a theory by picking a model that didn't use the principles of a seltzer tablet and water reaction.

I want you to go back to your supplies and construct a representation of how that theory would affect the atmosphere.

We should do an experiment without more carbon and then with more carbon? You're thinking?

I don't really know if we're doing an experiment right now though. I thought we were just trying to figure out our model, you know?

Later...

What do we want our model to incorporate?

We want to incorporate the added CO₂... because that's what we did in the experiment.

Resistance to Side Quests

- When a side experiment is proposed to test a new idea, a student questions it because she doesn't think it's part of the modeling.
- The student with the idea didn't push back, and the other group members didn't object to continuing.

Lack of Explicit Consensus

- In panel 1, the prospects of a new theory are ignored, thus ignoring a chance to help establish one theory over another.
- Panel 2 shows that the group appeals to what they did in the experiment to guide modeling.

¹E. Sayre and P. Irving (2014)
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