Discerning students' epistemological understanding of argument through an analysis of their classroom talk and action

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However, all opinions are strictly our own.

talk overview

- In the context of a complex educational intervention…
- We tried to support students in a particular epistemic form of argumentation…
  - [We know quite a bit about how well this was accomplished.]
  - What did Ss actually do?
  - And, what did they say they were doing?

- What meaning did students make of the instruction?
- What does this say about students developing epistemologies?
- How might this approach uniquely inform instruction?

scaffolding argumentation in the science classroom

Context

- Pedagogical opportunities associated with argumentation (Bell, 1997; Herrenkohl & Guerra, 1998, 2001; Magnusson & Palincsar, 2003; Sandoval, 2004; Brem, Russell & Weems, 2001; Stevens, Wineburg, Herrenkohl & Bell, in press)
- Widespread absence of argumentation in the science curriculum (Driver, Newton, Osborne, 2000)

Study

- Analysis build upon six design experiment iterations focused on scaffolding argumentation in a middle school science classroom (Bell, 2004 presents an overview of all six; Bell, Davis & Linn, 1995; Bell, 1997, 1998, 2002; Bell & Linn, 2000; Bell & Winn, 2000)

pursuing etic and emic views around the conditions that support learning

- Design experimentation typically works from a specific theoretical projection of learning (by necessity)
- This standard approach misses member-derived (emic) accounts of the instructional experience (Bell, 2004)
- Perhaps much could be learned—about learning and conditions for learning—by juxtaposing etic and emic views (cf. Cronbach, 1975)
  - Particular way of going after the intended versus received curriculum
- Study is a secondary analysis of design experimentation data that pursues an emic view of this argumentation / debate instruction

playing different accounts of disciplinary epistemology off each other

- *Nature of Science view*: privileges meta, reflective discourse (the philosophical in Ss talk)
- *Epistemology-in-Action view*: privileges situated action (epistemic practice, inquiry of Ss)
  - Particular instance of the *say* / *do* behavioral distinction
  - Positions are not mutually exclusive—except as practiced it seems
  - We don't really know which epistemologies serve Ss well

- Need epistemology research that carefully juxtaposes what Ss say 'about science' and how they 'do science' to inform development of a generative theory
- Study juxtaposes member-grounded accounts of situated debate activity with Ss written responses on an epistemology assessment

The Intervention: The "How Far Does Light Go?" Debate Project

- A comparison of two theories:
  - Light dies out as you move farther from a light source.
  - Light goes forever until absorbed.

- Student activities:
  - Analyze, categorize, and create evidence
  - Create argument involving evidence and claims
  - Present and discuss their argument in class

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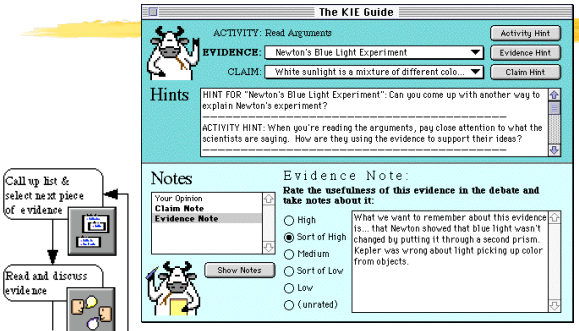
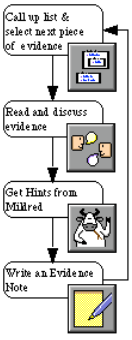
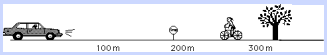
Research Context

- 8th grade physical science class
- Semester-long curriculum sequence focused on heat, temperature, & light
- Veteran classroom teacher (over 30 years experience)
- Students work in pairs with computers / probes
- Computer as Learning Partner and Knowledge Integration Environment projects



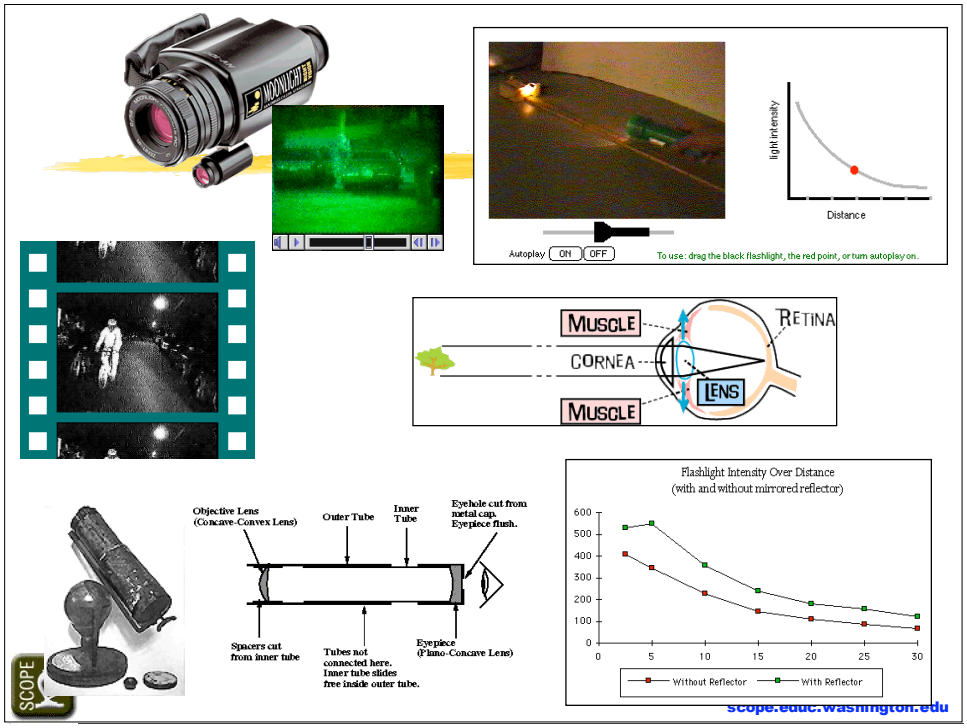


A car approaches a bike rider at night, 250m away. Its headlights are "dimmed". The bike rider sees the headlights of the car.

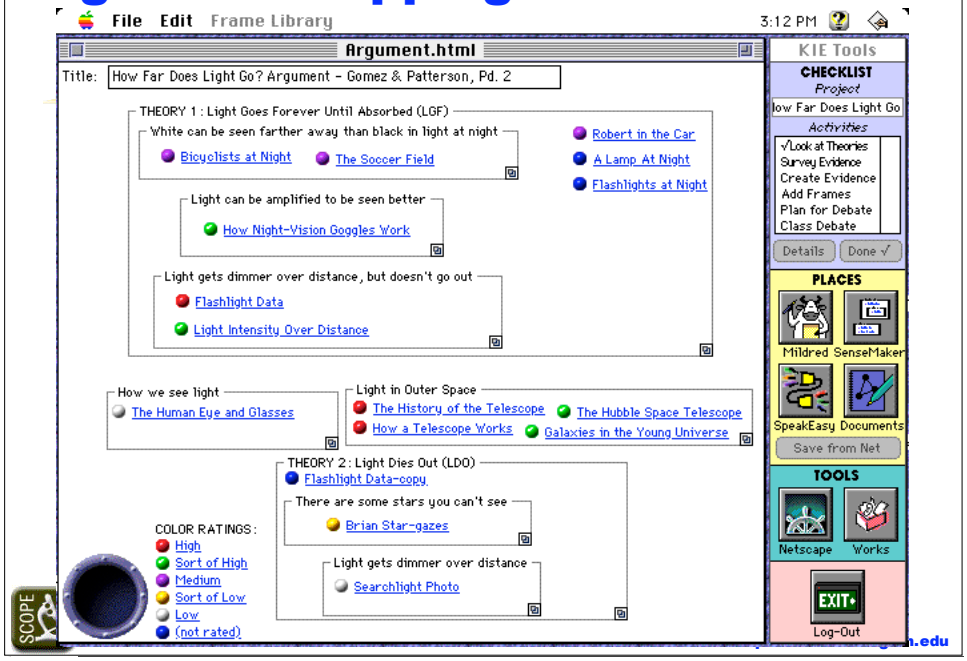


a. How far does the car's light travel? (circle one)
- The light will not reach the stop sign
- To the stop sign, but not beyond
- To the bike rider, but not beyond
- To the tree, but not beyond
- Beyond the tree

b. What is the most important reason for your answer?



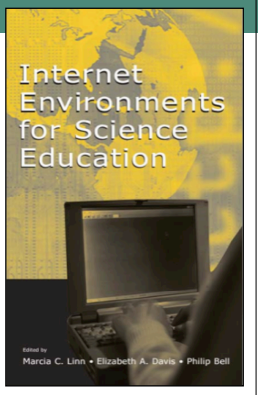
Argument Mapping Tool

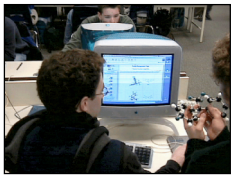


Theory (etic) derived findings about supportive conditions for learning through debate

DESIGN PRINCIPLES:

1. The role of the teacher during a classroom debate should be to moderate equitable interactions, to model appropriate question-asking, to probe theoretical positions of the debate in equal measure, and to serve as a translator between students—all in the fewest turns of talk as possible.
2. When engaged in a collaboratively focused debate discussion, students can safely share, explore, test, refine, and integrate their scientific ideas.
3. The media representation of scientific evidence significantly influences the interpretation of that evidence by students.
4. **Make Evidence Collections Visible**—When students attend to evidence in their argumentation, they tend to fixate on individual pieces. Argument representations promote student consideration of a corpus of evidence during argument construction.
5. **Shared Corpus of Evidence**—Engaging classes of students with a common corpus of evidence will allow the teacher to more quickly refine usable pedagogical content knowledge and instructional strategies related to the topic. It will also help establish an increased degree of common ground during classroom discussions.
6. Students created more elaborated arguments when an activity structure was promoted whereby the use of the knowledge representation tool was integrated into their interpretation and theorizing about evidence.
7. **Theory-Evidence Coordination**—Left to their own accord, middle school students rarely incorporate instances of evidence into their arguments about science. Argument representations should promote theory and evidence presence, distinction and coordination.
8. **Causal Theorizing**—Students produce arguments that predominantly include causal conjectures connecting empirical evidence and theoretical conclusions when they are supported in a process of authoring prompted explanations. Such theorizing is further supported when it become the focus of community discussion in the classroom.
9. Introducing argumentation through the exploration of a historical debate between scientists allows students to understand aspects of scientific argumentation, the creativity involved with theorizing and coordinating with evidence, as well as how individual ideas can shape one's interpretations of evidence and constructed arguments.
10. Represent student thinking and topical perspectives. Promote the use of the argument representation as a blended representational medium that depicts: (a) students thinking and theorizing about the controversial topic (based on their prior and evolving understanding), and (b) different perspectives associated with the controversy.
11. Compared to allowing students to refine their initial position in a debate, students engaged in a perspective-taking activity structure theorize more in their argument maps and evidence explanations and develop a more integrated understanding of the subject matter in the process.
12. Debate Infrastructure—Use argument map representations comparatively during whole-class debate presentations to promote accountability to the body of evidence under consideration.





research approach & context

- Focus: member-derived (emic) meanings
  - Discern (and infer) the epistemic games that particular students play as indicated through their talk and action
  - Coordinate with their meta talk about argumentation in the classroom and in science
- *Data:*
  - ≈ 2 hours of classroom debate (≈1500 lines of transcript)
  - handwritten responses on epistemology questions pre / post
- *Methods:* video interaction analysis, student cases
- 3 cases that vary in terms of intended / received, emic / etic

Epistemic case: Andrew

- Not a typically successful student in science
- What did Andrew *do*?
  - Andrew systematically and competently engaged in the pedagogically desired epistemic game during the debate (received ≈ intended)
  - The coordination of theory and evidence was a working assumption. He regularly sought to validate his / other's claims put into discussion. He regularly challenged ideas through sustained interrogation.

Andrew pushes on both theoretical sides of the debate in public debate

- Segment 1

Devi	Andrew?
Andrew	um (you) keep on saying that you can't see light with your eyes but the light is still there. How, how do you know that the light is still there?

- Segment 2

Emma	well we have to use a telescope because we can't see it without the telescope (exaggerated cadence)
Sarita	yeah.
Emma	(laughs).
Andrew	so there is light.
Emma	but.
Andrew	light doesn't die out.
Emma	it fades you can't see it.
Andrew	but there is light.

Pushing on both sides is in keeping with intended instruction

Andrew fits a pattern: instruction that leverages personal agency in learning strongly engages some students otherwise disinterested in science (cf. Heath; Lee; Shear, Bell & Linn)

Epistemic case: Andrew
What did he *say*?

	Is debate useful in the classroom?	*How can debate be useful in science?*
Pre	No – Spending time debating is useless, because you should be concentrating on doing work. If you have a problem, as(k) the teacher.	Scientist can express their opinions and thought by using evidence and examples to support them. This could show who's right or wrong. The right theory could be usefull.
Post	The purpose of doing this project was to let us debate each other. Experience what the scientists are like when they debate each other. We were to learn how to use the evidence to support our theory and to answer questions from classmates.	Debate can be useful, because you can understand what other people thinks. To express your own idea, using evidence to support it. That's where the new ideas come from.

'Say' does track *'do'* for Andrew about debate

Comes to understand possible role of debate in science class
- understanding 'the other'
- learn from evidence/theory coord
- uptake of 'doing what scientists do'

Epistemic case: Cindy
Understanding student silence

- A very quiet student in science class; arrived mid-semester
- What did Cindy *do?*
  - Cindy says almost nothing throughout the debate presentation. Instead, she seems to let her partner do all of the talking.
  - However, she is actively directing his responses in subtle ways throughout through gestures and quiet whispers.
  - During the Q&A segment, her partner responds to a question from a classmate. When he's finished Cindy whispers a response, which extends his answer. He strongly says to her, "Tell it." She then repeats what she had whispered so the whole class can hear. This is just about the only time she talks in the debate.
- Quiet students are often thought to be not understanding the focus of instruction, but that is often not the case.

Epistemic case: Cindy
What does she *say*?

- On the post-debate epistemology test…
  - *Question (paraphrase): How can debate be useful in the classroom?* Cindy's response mirrors aspects of the designers' intent (e.g., get students to deeply consider different theories "and have us find supporting evidence for both") (received ≈ intended)
  - *Question (paraphrase): How can debate be useful in science?* When different people believe different things they can debate it out, and come to our conclusion. Like Gallileo (sp?) I think it was, was trying to prove that a grape would fall at the same rate as an orange because the King (or someone like that) had made a book. Saying things like — since a grape is 1/10 the size of an orange it should fall 1/10 as fast, but never proved it. So Gallileo debated it with him…(of course the King was stubborn and ignored him but if he hadn't he could have changed his way of thinking).
- Cindy demonstrates a unique facet of epistemological sophistication in writing, but it is not mirrored in action (say ≠ do)

Epistemic case: Arnold & Liz
Playing an unintended epistemic game

- Arnold (ESL) and Liz were both adequately achieving students, considered by the teacher to be typical students
- Arnold makes a single, off-hand statement in the midst of a swirling debate conversation that seems to reveal that they were playing an unintended epistemic game during the entire unit (received ≠ intended)

Epistemic case: Arnold & Liz
Playing an unintended epistemic game

Interpretation

- Statement not caught in the moment
- Argument maps were foreign representations, not domestic (Hall); received ≠ intended
- Hypothesize that the "even-handed" seed argument led to their evidence balancing game
- One small design choice likely had a dramatic consequence on student's epistemic game

Klani Ok, um, you have um soccer field, flashlight data, and bicycles at night inside um light goes on forever until its absorbed, which is inside irrelevant (coughing) and so how come you didn't put those three inside the theory that light goes on forever?
Liz (laughs)
Arnold ehhh (pause) sort of messed up on that.
Liz ~~yeah, that's all.~~
Arnold we just didn't want to put too much in one box (so) we tried to.

Conclusions & Next steps

- Plan to coordinate these emic accounts with prior theoretically-derived analyses of learning
- Emic-focused method worked relatively well to bring new accounts of the enactment into view—with educational design implications
- It was a reasonable approach to help resolve the insider / outsider problem with interventionist research (i.e., Cronbach was right)