



**Multimedia Educative Curriculum Materials for Supporting Teachers' PCK of Scientific Argumentation**

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## Educative Curriculum

- Recent reform documents (NRC, 2012) and standards (NGSS Lead States, 2013) advocate for a new vision of proficiency in science in which students engage in science practices.
- Teachers can have different views of what counts as the science practices (McNeill et. al., 2013) and can lack depth of knowledge needed to integrate science practices into classroom instruction (Pruitt, 2014).
- Educative (i.e. support teacher learning) curriculum materials offer one potential avenue for supporting students in science practices (Davis & Krajcik, 2005; Davis, et. al, 2014).

## Educative Curriculum

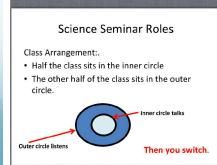
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**Multimedia Educative Curriculum Materials (MECM)**

- materials offer one potential avenue for supporting students in science practices (Davis & Krajcik, 2005; Davis, et. al, 2014).

## Example: The Science Seminar

- Student-driven evidence-based discussion focused on a science question like, "How will the Indian Plate be different in 50 million years?"



### Purpose of a Science Seminar

**Goal:** To work together to build shared understanding about a question, and consider what is the best argument to answer that question.

Students run the conversation:

- Use evidence.
- Listen to one another.
- Respond to one another.
- Agree/disagree, giving reasons why.

Regents of the University of California, 2012

## Two different enactments: Ms. Richardson

- Ms. Richardson: ok. Marcus.
- Marcus: Um, I disagree with Ian and Jose. I see what they are saying. Um. Ian's theory it is still going to the Eurasian plate, because that entire area is still the Eurasian plate.
- Tony: But it's also colliding with the – what plate is that?
- Several students go over to point to map Tony is holding.
- Ms. Richardson: So you're talking about the countries of South Asia and Indonesia. You're saying that forms a different plate?
- Tony: Yeah. And it is also colliding with the Indian plate.
- Ian: Well, I (inaudible) cause – yes it is going to collide, but right here there's many – there's lots of spreading zone. It is going to get lots of crust – lots of new crust to make the plate bigger
- Eduardo: It is also a subduction zone.
- Ian: Yeah, but look – the subduction zone has like  $\frac{1}{4}$  of the subduction zone and like 1, 2, 3, 4, 5, 6, 7, 8 – eight spreading zone
- Eduardo: But it is really small.
- Ian: Yeah but they have 8 that's  $\frac{1}{4}$ .
- Ms. Richardson: Is there anybody else who would like to join in the conversation with agreeing or disagreeing with um - the ideas that have been presented, or providing more evidence or new evidence? Bill?

McNeill, Gonzalez-Howard, Katsh-Singer, Price & Loper, 2013

## Two different enactments: Ms. Brennan

- Ms. Brennan: Elena why don't you come on up. Ok. And you guys be attentive. Guys this is a little bit different than a presentation where someone – this is, this is um a give and take where you are going to be um listening. The inner circle as well is going to be able to – um as they come up – when they come up they will give their evidence for their part, but we can't clap between speakers. Your engaged and listening. It is like as if you were a grown-up and you were going to a workshop. That is exactly what it is like. Ok. Elena.
- Elena: Well, I thought that the um Indian plate would get bigger over 50 million year period because of spreading zones which could easily spread the plates apart and make them wider.
- Ms. Brennan: Ok. Alright. (Elena sits down). Ok. I am going to need um – why don't you go ahead. Once this starts, why don't you come on up. Jordan why don't you come next. (Jordan stands up). And I am just going to move this right over here so you guys can go in and out (Teacher moves iPad). Ok.
- Jordan: I thought that um that the Himalayans would get taller, because when the plates like started crashing into each other – this one is going in this direction (Jordan points to the map) and it should make it bigger.
- Ms. Brennan: Ok. (Jordan sits down). Thank you very much. Another person. Come on up.

McNeill, Gonzalez-Howard, Katsh-Singer, Price & Loper, 2013

## MECM Design Principles

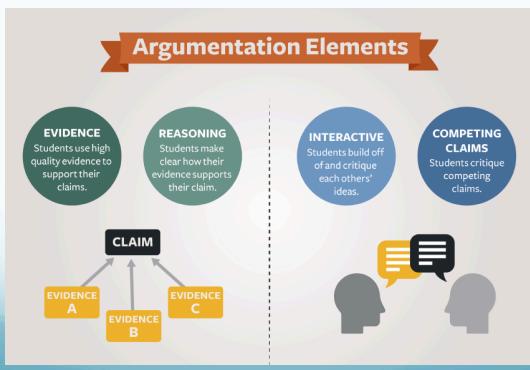
1. Target **challenge areas** in enacting curriculum focused on scientific argumentation (Alozie, Moje & Krajcik, 2010; McNeill et al., 2013; McNeill & Pimentel, 2010)
2. Use **multimedia representations of practice** that illustrate scientific argumentation in real classrooms (Lieberman & Mace, 2010; van den Berg, Wallace & Pedretti, 2008)
3. Support **active learning** by encouraging teacher reflection and connections (U.S. Department of Education, 2009; Dede, Ketelhut, Whitehouse, Breit, & McCloskey, 2009)



## Four Conceptions (McNeill et al., in press)

	Conception	Title
Structure	Conception 1A: Evidence	Teachers evaluate and support students' use of high-quality evidence to justify their claims.
	Conception 1B: Reasoning	Teachers evaluate and support students' use of scientific ideas or principles to explain the link between the evidence and their claim.
Dialogic Interactions	Conception 2A: Student Interactions	Teachers evaluate and support students in building off of and critiquing each others' ideas.
	Conception 2B: Competing Claims	Teachers evaluate and support students in critiquing competing claims.

## Four Conceptions (McNeill et al., in press)



## MECM Curricular Elements

Embedded within 3 middle school earth science units (~60 lessons) educative supports targeting scientific argumentation:

- 28 Videos
- 24 Interactive Reflection
- 3 podcasts
- 4 Slideshows
- 21 Right hand notes (i.e. text boxes)
- 4 Graphics
- 7 Student Work Examples
- 1 Rubric
- 1 Argumentation article

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1. Target challenge areas  
2. Use multimedia representations of practice  
3. Support active learning

## 4 Video Categories Embedded in Lessons

3 Rationale    6 Approach    5 Activities    10 Strategies







### Approach Video

#### Rocks Introduction

#### Argumentation Toolkit Overview



**Recommended Video:** Approach: Argumentation Toolkit Overview



**Video Reflection Question:** What questions do you have about scientific argumentation?

### Rationale Video

#### Rocks Session 1.3

#### Argumentation as Part of Science



**Recommended Video:** Argumentation as a Part of Science



**Video Reflection Question:** How do you think incorporating argumentation might help you address standards with your students?

### Activity Video

#### Rocks Session 2.1

#### Evidence Card Sort



**Session Prep**

**Recommended Video:** Activity: Evidence Card Sort



**Summary Card**

**Video Reflection Question:** What ideas do you have for encouraging your students to discuss during card sorts?

**Strategy Video**  
Rocks Session 2.10  
**Stepping Back During Science Seminars**

Recommended Video: *Strategy: Stepping Back During Science Seminars*



Allow for Long, Productive Silences

07:25 HD

**Summary Card**

**Video Reflection**  
**Question:** How difficult will it be for you to step back?

## Argumentation Toolkit

Home Rocks Currents Space The Argumentation Toolkit

**Building A Culture Of Argumentation**

Here you'll find an organized collection of all of the argumentation resources included in this curriculum.

The Argumentation Toolkit



**Toolkit Video Category Overviews**

 <b>Rationale</b> VIDEO	 <b>Approach</b> VIDEO	 <b>Activity</b> VIDEO	 <b>Strategy</b> VIDEO	 <b>Long</b> VIDEOS
Conveys a rationale for argumentation including to enhance deeper learning for all students, to provide connections to science, and to alignment with NGSS.	Introduces 4 conceptions of argumentation and common student challenges associated with them.	Explains the main argumentation activities step by step. Provides teachers with an authentic view of students doing the activity in the classroom.	Provides deeper dives into student interactions and teacher moves around specific argumentation activities and addresses challenges.	Include long unedited video recordings of student interactions that highlight different aspects of argumentation.

## Interactive Reflection – Text

Rocks Session 2.11

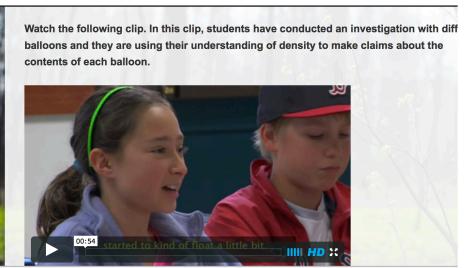
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 Sec Arg (25)  
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**How would you rate your first Science Seminar?**

Excellent. It was almost entirely student-led; students discussed evidence and used reasoning; students made and respectfully critiqued arguments; many different students participated.  
 Good. It was mostly student-led; students discussed evidence and provided some reasoning; for the most part students made and respectfully critiqued arguments; a number of students participated.  
 Just okay. I had to jump in a lot, and it was not mostly student-led; students discussed evidence, but I often had to direct them to the evidence; there was not a lot of reasoning; only some students made and respectfully critiqued arguments; only a few students participated.  
 Not good at all. I had to jump in all the time—it was not mostly student-led; students barely discussed evidence—I usually had to direct them to the evidence; there was almost no reasoning; almost

## Interactive Reflection – Analyze Video

### Currents Session 1.6



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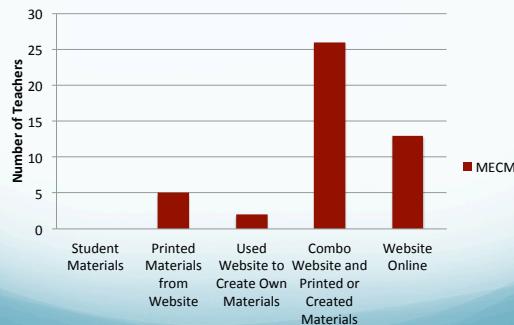
[The Argumentation Toolkit](#)

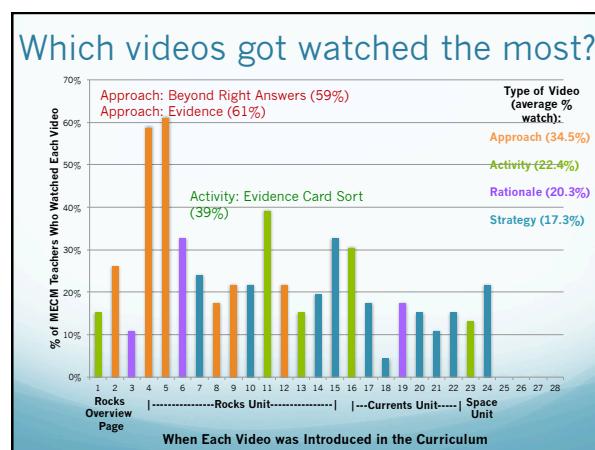
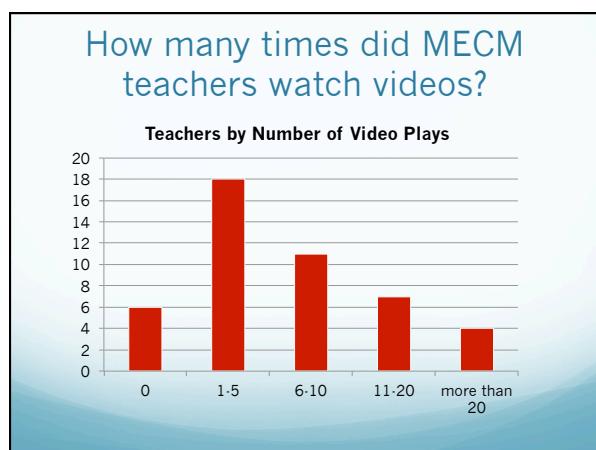
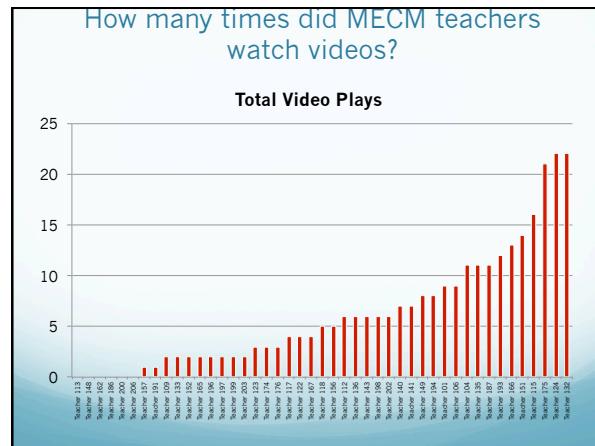
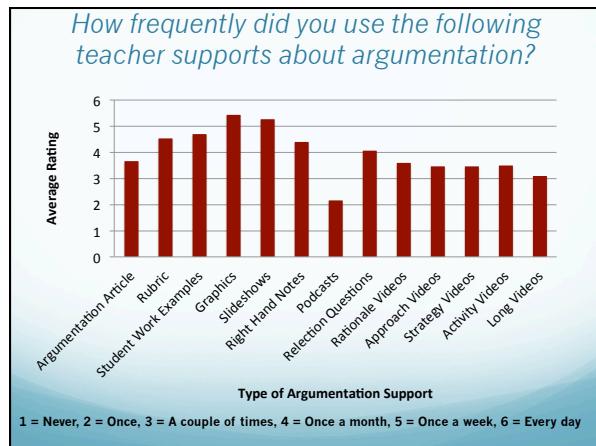


## Teacher Page Views (n = 46)



## Teacher Use of Curriculum (n =46)





## Argumentation Toolkit

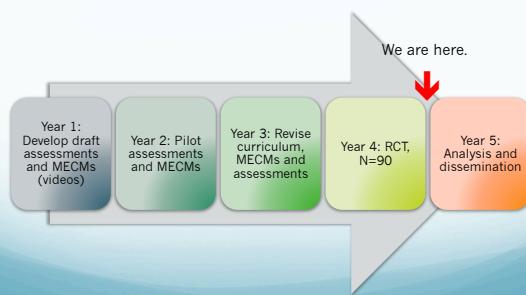


Website:

[www.argumentationtoolkit.org](http://www.argumentationtoolkit.org)

## Other Data

### Multimedia Educative Curriculum Materials (MECM) Project Timeline



## Research Design

### RCT 2014-15 (n=90)

- All teachers received a digital teacher's guide and all student materials
- Treatment teachers received additional MECMs (videos, interactive elements)
- No requirements: use materials as you would normally use them.
- Data Collection
  - Pre- and post-assessment of PCK for argumentation and beliefs about argumentation
  - Back-end data collection on teachers' use of digital curriculum and access of videos.

