The Process of Change
Examining teacher growth in orchestrating dialogic science discussions

Sherice N. Clarke
Overview of talk

What is dialogic instruction and why does it matter?

Critical case study of teacher growth

Designing for teacher growth
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Mr. Anderson: So what are these circles that are halfway shaded in?

Dontae: The females that are affected.

Kendra: The girls that got it.

Elijah: The girls that carry it.

Cassandra: The girls that carry it but don't have it.

Mr. Anderson: The girls, do they have the disease?

Kendra: Yes.

Ashley: No, they just carry it.

Jamisha: No, they just carry it and pass it on.
Dialogic Teaching

Talk as a form of learning
Talk to socialize scientific habits of mind
Evidence on dialogic teaching

Steep increases in student achievement (Bill, Leer, Reams & Resnick, 1992; Chapin & O’Connor, 2004)

Steepest increases in achievement for ELLs (Matsumura & Garnier, 2015)

Retention for up to 3 years (Adey & Shayer, 1993, 2001; Shayer, 1999; Topping & Trickey, 2007a, 2007b)

Transfer across domains for up to 3 years (Bill, Leer, Reams & Resnick, 1992; Adey & Shayer, 1993, 2001; Shayer, 1999; Chapin & O’Connor, 2004)

Students perform better on non-verbal reasoning tests e.g., Ravens (Mercer, Wegerif & Dawes, 1999)

Reasoning itself improves (Kuhn & Zillmer, 2015; Lin et al, 2012)
Where can we find dialogic teaching?

(Pauli & Reusser, 2015; Kelly, 2007; 2008; McNeill & Pimentell, 2010)
How can science teachers be supported to use dialogic class discussions to support students’ robust learning?
How can science teachers be supported to use dialogic class discussions to support students’ robust learning in high need settings?
Evidence from PD studies

Teachers can grow in their orchestration of dialogic class discussions
- e.g., @ EARLI 2017: Alexander; Wilkinson & Reznitskaya; Howe, Hennessey and colleagues and @ BERA 2017

It takes time to see evidence of growth in dialogic teaching
- E.g., Clarke et al, 2013; Clarke & Resnick, in preparation; Osborne et al, 2013; Alexander, EARLI 2017

Teachers gain declarative knowledge in "talk moves" from PD
- E.g., McNeill et al, 2013; Clarke & Resnick, in preparation

Challenges in recognizing and knowing how to respond to student reasoning
- E.g., McNeill et al, 2013
Overview of talk

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Critical Case Study

**Critical case** (Yin, 2014) to examine the nature of teacher growth in dialogic teaching from a case of pedagogical change

Mr. Nelson
- 9th Grade biology teacher
- Urban school district
- BSCS Biology curriculum
- Study participant for 3 years
Professional Development: Accountable Talk

Paradigm: Content-focused-coaching (Staub & West, 2003)

(Scientific) Knowledge

Community

Standards of Reasoning

(Resnick, Michaels & O’Connors, 2010; Michaels & O’Connor, 2015)
Data Sources

<table>
<thead>
<tr>
<th>YEAR</th>
<th>PD</th>
<th># Classes</th>
<th>Track</th>
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<tr>
<td>1</td>
<td>5 workshops</td>
<td>3</td>
<td>Lower</td>
</tr>
<tr>
<td>2</td>
<td>7 coaching cycles</td>
<td>4</td>
<td>Lower</td>
</tr>
<tr>
<td>3</td>
<td>None</td>
<td>2</td>
<td>Intermediate</td>
</tr>
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</table>

Data

70 (5 baseline recordings, 65 recordings of target lessons on energy and matter, and inheritance)

Pre- and Post- interviews (Yr 1 + Yr 3 respectively)
Discussions recorded, transcribed and verified
Studying pedagogical metamorphoses
Accountable Talk

Positioning (Greeno, 2015)

(Scientific) Knowledge

Community

Standards of Reasoning

(Resnick, Michaels & O’Connors, 2010; Michaels & O’Connor, 2015)
Change in knowledge/beliefs → Professional experimentation → Salient outcomes

D. Clarke & Hollingsworth (2002)
DISCOURSE ANALYSIS

EXCHANGE Initiation Reply

SPEAKER Teacher Student

REFERENCE Addressee Addresseeee

POSITIONING Knowledge Reasoning
**Analysis**

**Sampling**
Random sample of 2 lessons at beginning, middle and end of each year/observation period (n=18 lessons)

**Coding**
Initiation – Replies 2 Raters – kappa=.72 *very good agreement* (Goffman, 1976; Mehan, 1979)

Positioning 2 Raters – kappa=.70 * (e.g., Martin & Rose, 2002; Veel 1999; Greeno, 2015)

**Social Network Analysis in Stata**

**Narrative Analysis** (Labov & Waletsky, 1967; Riessman, 1993)
Niall: It was a trait.

NELSON: Think about that.

Chloe: It was in the DNA.

NELSON: What did she just say? It’s in the DNA. That’s great. So, in general when we study diseases there are infectious diseases. And then there’s these other diseases that are in your DNA. What would we call those?

Chloe: AIDS.

NELSON: AIDS? No, AIDS is an infectious disease; you catch that. You don’t catch these kind of diseases that you get from your parents.
NELSON: So you think the white one's homozygous recessive.

Alex: No, [what I said] the first time.

Chris: I think it's homozygous recessive.

NELSON Well this is what we're struggling with we're how, how do we get to the answer, that's what we want to do. Ok? What'd you do? You want to come up and or just explain what you were thinkin'.

Wesley: Well at first the thing I did was I did it in my head to see how, what the possibilities are.

NELSON He did it in his head to see what the possibilities were. That's a good way to start.

Wesley: And then since we were on a team [--] told that everybody else that orange was dominant. And orange was probably the capital A since it was dominant and then since they're all orange so it would be a bigger possibility [--] if that orange cat was double A and that white cat was [--] small.
NELSON: Jaliah’s proposing that, that is a possibility. Go ahead, Derek.

Derek: Um, I disagree because if it would be heterozygous, then it would make the dark cats and not both white cats.

Silas: No, I agree with Isabel. It could also be--no, no, no, no.

NELSON: Address what Derek just said.

Aamir: I disagree.

NELSON: Go ahead.

Aamir: I disagree with Derek because if you do the Punnett square, all of the combinations would have an uppercase D, which is expressed in all of them, so that’s [--] the lowercase ds do not have anything to do with the possibilities.

Silas: I disagree with um Isabel. I was gonna say, um, if a white cat has to be, um, little d little d because it’s recessive.
Changes in positioning of knowledge and reasoning in science discussions

2 raters, kappa = .70
Qualitative changes in opportunity structures

Year 1, obs 5

Year 3, obs 69
Beliefs and Salient Outcomes

Shifting perspective: Goals and role of the teacher

Uh, a good discussion is when students talk to each other and they take the reins of the discussion rather than me having to prompt them. And we’re nowhere near that yet.

Because they hear a little bit here and there and they come in with all of these misconceptions. And that’s what I wanted to touch upon. Accountable Talk helps me identify misconceptions. Because they’re brought out... And if they’re brought out, you can address them. Where as if I’m here talking, giving lectures and they’re taking notes, the misconceptions don’t come out. So that’s where I find it pretty valuable.
**Beliefs and Salient Outcomes**

**Perspective Maintained**
Deficit view of students

“It works better with the ah the medium and the advanced classes. The lower level classes you know, I’m no expert on analyzing these kids but I seems to me with the **lower level kids** a couple things. One thing is self-discipline. They **don’t have self-discipline** and they **go off-task really quickly**. Number two, attention spans. **Attention spans are very short.** And so to keep them on a topic and to try to get them to go deeper into a topic is much more of a challenge. Third, to have a discussion you have to know a few things. You have to have some background knowledge, you have to maybe have read something. And a lot of the **lower kids have difficulty reading, so** they **don’t read a whole lot.** They don’t read independently at all. And so that, those are obstacles.”

Year 1

…so there’s been a little bit of umm, push back. A little bit of a problem for me managing them. / Umm, the other classes are, umm, **typical mainstream kids**. Umm, **a lot of them have low reading abilities** by tests and so, um, so we have to work with them, you know. Trying to help them read. And the book is very- has a lot of hard readings, so it’s, um, that’s a challenge. / Umm, ninth graders like to talk a lot and so that’s a challenge because **when they’re talking, they’re not listening.**

Year 3

so there’s been a little bit of umm, push back. A little bit of a problem for me managing them. / Umm, the other classes are, umm, **typical mainstream kids**. Umm, **a lot of them have low reading abilities** by tests and so, um, so we have to work with them, you know. Trying to help them read. And the book is very- has a lot of hard readings, so it’s, um, that’s a challenge. / Umm, ninth graders like to talk a lot and so that’s a challenge because **when they’re talking, they’re not listening.**
Growth tensions

Relinquishing authority over scientific knowledge and how it can be constructed

Inquiry stance: Teaching science as inquiry

Attributions of students’ capabilities, and opportunities provided to students to think together

Opportunities

What you ask for in dialogic class discussions... you get.

Seeing is believing
Overview of talk

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Critical case study of teacher growth

Designing for teacher growth
Engineering growth

PD

Change in knowledge/beliefs

Professional experimentation

Salient outcomes

D. Clarke & Hollingsworth (2002)
Talkways
Situating Cognition about Dialogic Science Discussions

- Pedagogical Content Knowledge
- Beliefs
- Pedagogical Reasoning

= Pedagogical Actions
i.e., Professional Experimentation
Talkways
Situating Cognition in Dialogic Science Discussions

Pedagogical Content Knowledge + Beliefs + Pedagogical Reasoning = Pedagogical Actions

i.e., Professional Experimentation
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Talkways
Situating Cognition in Dialogic Science Discussions

Adapted from Shulman (1987)
Study Introduction

Thank you for participating in this survey. You will be listening to a 9th-grade biology class as they talk about inheritance and Punnett squares.

If you need a refresher on Punnett squares, we recommend watching the following short (and cute) video.

Instrument: Introduction to science topic + instructional context
**Instrument Design**

<table>
<thead>
<tr>
<th>Design phases</th>
<th>Audio Sampling</th>
<th>Science</th>
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<tbody>
<tr>
<td>Survey design</td>
<td>Samples of previously collected biology discussions</td>
<td>Genetic inheritance</td>
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<tr>
<td>Pilot 1 n=6</td>
<td>Theoretical sampling</td>
<td>Discussions where teacher leads students in</td>
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<td>Analysis/ refinement</td>
<td>Segments where Pedagogical Action may be needed</td>
<td>reasoning with</td>
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<tr>
<td>Pilot 2 Administration n=26</td>
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<td><strong>Punnett Squares</strong></td>
</tr>
<tr>
<td>Analysis</td>
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</table>
Mr. Nelson has projected the following picture on the smart board for the students to see:

He asks the students to discuss what the genotypes of the parent cats could be in order to produce this litter of kittens that all express the dark orange colored fur.
Simulation scenario probes

Reasoning about student thinking

Reasoning about pedagogical tools

Reasoning with content goals
Science PCK

“Phil was probably at a slightly lower level of understanding because he believed that the color of the litter was by chance or luck which is a possibility but when there is only heterozygous allele there is no way for there to be any other color other than dark orange.” T6: Novice

“Phil probably has an advanced level of understanding since he was able to see that there was more than one answer and [the] probabilities.” T2: Experienced

Clarke, Gerritsen, Grainger & Ogan, 2016
Pilot Findings

Logic of Pedagogical Reasoning and Action

“I feel like the students are missing the recessive phenotype and I would want to pull the class back to examining the phenotypes of the adults again.”  

T2: Experienced

Novices generally indicated they would either continue current trajectory:

“I would continue the activity by have the students draw out the Punnett square and discuss what they found.”  

T6: Novice

Or suggest something unconnected:

“I would just make sure that the problems are on the board to give them a visual reason to believe it as well.”  

T5: Novice

Clarke, Gerritsen, Grainger & Ogan, 2016
Qualitative differences in explications

“Students are presenting their thinking about the genotypes of the cats and attempting to support their thinking with explanation of how their genotypes fit the parent cats...Phil was able to see past Aamir's solution to how it could be possible for the orange parent cat could be heterozygous. At no time however did any of the students express their thinking in probabilities or by referencing evidence beyond the explanation of what they could see.”

*T1: Experienced*
Qualitative differences in explications

“The teacher gives a prompt. Then one student responds with his answer and explanation. The next student gives his answer and explanation. The teacher then cues the other group members to speak. They agree.”  **T4: Mid-level**

“In this segment there is a small group discussion on inheritance.”  **T5: Novice**
Qualitative differences in the way novice and more experienced teachers see dialogic and conceptual processes in science discussions which may be amenable to professional development
Implications and Conclusions

Qualitative differences in the way novice and more experienced teachers see dialogic and conceptual processes in science discussions which may be amenable to professional development

Implications for design

- first address misconceptions in domain
- provide scaffolds to support teachers pedagogical reasoning
  - elicit more detail about dialogic processes in discussion
  - connecting detail to students’ representations of the science
    - scaffold very explicitly the connection between what teachers notice about student thinking and their pedagogical actions
    - Broaden repertoire of pedagogical actions
Next Steps

Examining connections between pedagogical reasoning about science discussions in and out of the classroom.

Examine how knowledge, beliefs and reasoning mediate teachers’ decisions across contexts (in and out of the classroom).

Leverage these insights to design adaptive technology supported professional development for teachers learning how to orchestrate dialogic science discussions.
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