ON THE DESIGN AND IMPLEMENTATION OF PRACTICAL MEASURES TO SUPPORT INSTRUCTIONAL IMPROVEMENT AT SCALE

Jessica Thompson[1] & Kara Jackson[2]
University of Washington

[1]Building Capacity for the Next Generation Science Standards through Networked Improvement Communities

[2]Investigating and Supporting the Development of Ambitious and Equitable Mathematics Instruction at Scale

Getting to know you and your interest

- What is your level of familiarity with practical measures?
- What do you hope to get out of this session?

Plan for the session

1. Brief overview of practical measures

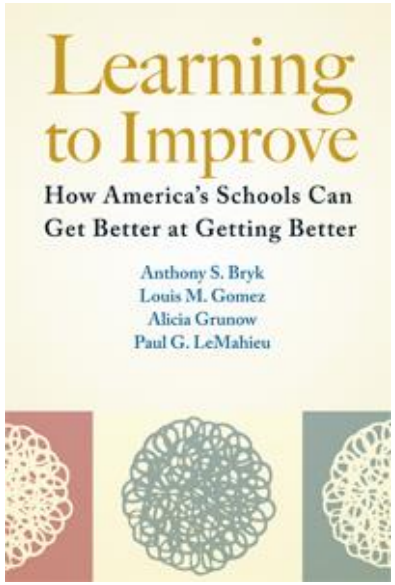
1. Kara: the process researchers and practitioners developed to design a set of practical measures focused on improving the quality of discussion (math)

1. Jessica: the implementation of practical measures within a Networked Improvement Community (science)

1. Discussion of challenges, trade-offs, and other pressing issues

BRIEF OVERVIEW OF PRACTICAL MEASURES

What are practical measures? Why might they be useful tools in instructional improvement?



Yeager, D., Bryk, A. S., Muhich, J., Hausman, H., & Morales, L. (2013). *Practical measurement*. Carnegie Foundation for the Advancement of Teaching. Stanford, CA.

What are practical measures? Why might they be useful tools in instructional improvement?

- Designed to provide practitioners with frequent, rapid feedback that enables them to assess and adjust their practices during the process of implementation

- Designed to inform *improvement*

- In contrast to:
  - Research measures
  - Accountability measures

Key features of practical measures

- Specific to improvement goals
- Focus/language is relevant and meaningful to practitioners
- Collection of data must be relatively undemanding
- Resulting data must be able to be analyzed quickly
- Sensitive to change
- Actionable
- Embedded in routines (e.g., administering the measures, making sense of the resulting data)

MIDDLE SCHOOL MATHEMATICS AND THE INSTITUTIONAL SETTING OF TEACHING

Paul Cobb, Erin Henrick, & Nicholas Kochmanksi
Vanderbilt University

Hannah Nieman
University of Washington

MIST
MIDDLE SCHOOL MATHEMATICS AND THE INSTITUTIONAL SETTING OF TEACHING
DESIGNING LEARNING ORGANIZATIONS FOR INSTRUCTIONAL IMPROVEMENT IN MATHEMATICS

Why we saw value in practical measures

- Worked with large, urban districts for 8 years to generate, refine, and elaborate a *theory of action* for instructional improvement at scale

- Useful for *design* of instructional improvement strategies

- However, a number of challenges arose for districts as they attempted to *implement* the instructional improvement strategies
  - Urgency to roll out strategies across the district
  - Lack of routines and tools for providing ongoing, rapid feedback to inform improvement of strategies

MIST
DESIGNING LEARNING ORGANIZATIONS FOR INSTRUCTIONAL IMPROVEMENT IN MATHEMATICS
MIDDLE SCHOOL MATHEMATICS AND THE INSTITUTIONAL SETTING OF TEACHING

Context of practical measurement work

- Multiple research-practice partnerships
  - Vanderbilt/UW/JCPS Partnership: Math Design Collaborative / Formative Assessment Lessons
  - SERP/SFUSD Partnership: De-tracking reform

- Focus: Initially improve the quality of discourse in math classrooms (small group, whole class)
  - Student surveys

VANDERBILT UNIVERSITY

Jefferson County Public Schools
Shaping the Future

SERP Strategic Education Research Partnership

CSET center to support excellence in teaching
STANFORD UNIVERSITY

UNIVERSITY of WASHINGTON

UC RIVERSIDE UNIVERSITY OF CALIFORNIA

MIST MIDDLE SCHOOL MATHEMATICS AND THE INSTITUTIONAL SETTING OF TEACHING
DESIGNING LEARNING ORGANIZATIONS FOR INSTRUCTIONAL IMPROVEMENT IN MATHEMATICS

UNIVERSITY OF MARYLAND

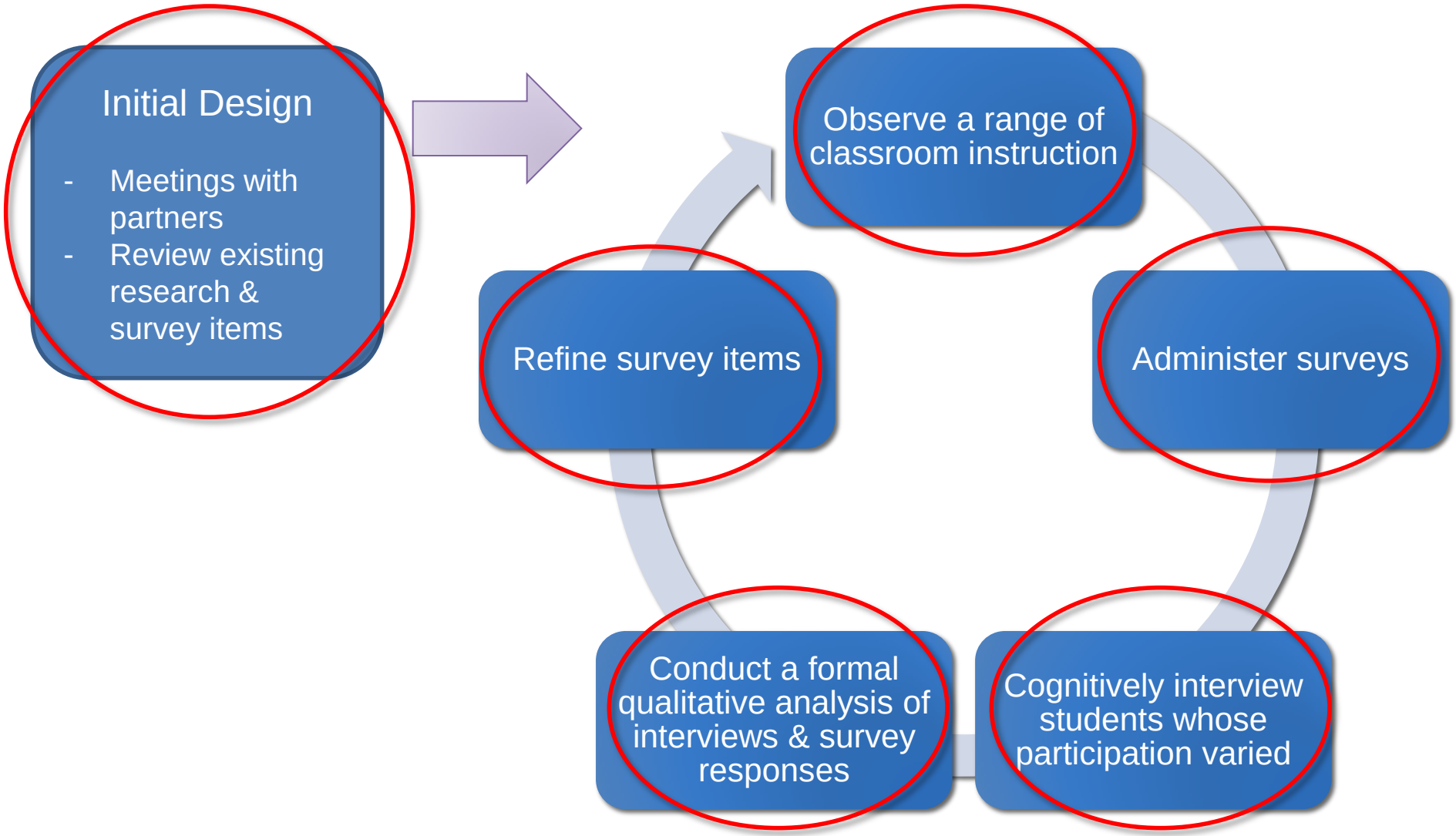
SFUSD SAN FRANCISCO PUBLIC SCHOOLS

R + P

Intended users

- District leaders (e.g., mathematics leaders)
  - Inform professional development plans and curricular revisions
  - Inform allocation / focus of coaches
- Coaches
  - Inform coaching cycles and PD designs
- Teachers
  - Inform daily practice

Process to design surveys



Sample items: Small Group Discussion

1. What did you need to do in order to be successful in your math class today? (Choose **one** item that best describes your experience.)

- ☐ Solve problems using the steps the teacher showed me
- ☐ Listen to and make sense of other students' reasoning
- ☐ Finish all of my work
- ☐ Other

2. Was there one right way to solve the problem(s) today?

☐Yes ☐No

Assess the nature of mathematical activity

3. What was the purpose of discussion in your math class today? (Choose one.)

- ☐ Make sure I did the problem the way the teacher taught me
- ☐ Check to see if our answers are correct
- ☐ Learn different ways that work to solve a problem
- ☐ Other

Sample items: Small Group Discussion

4. How comfortable were you sharing your thinking in your small group today? (Choose one.)

- ☐ Not comfortable
- ☐ Somewhat comfortable
- ☐ Very comfortable

6. In your small group, did listening to other students help you make your thinking better?

☐Yes ☐No

7. In your small group, did you have trouble understanding your group members' explanations?

☐Yes ☐No

Is the talk supporting students' learning?

Sample items: Small Group Discussion

8. What was the purpose of working in a small group today? (Choose one.)
   - ☐ Work together to solve a problem using the steps our teacher taught us
   - ☐ Check with my group members to see if my answers were correct
   - ☐ Investigate a mathematical idea
   - ☐ Share the different ways students in my group were solving a problem
   - ☐ Other

9. What was the purpose of your teacher asking questions during small group time? (Choose one.)
   - ☐ Tell us we had a problem wrong
   - ☐ Help us work together as a group
   - ☐ Help us figure out how to solve a problem
   - ☐ Find out how we were thinking about a problem
   - ☐ Remind us of the right steps for solving a problem
   - ☐ My teacher did not talk to my group today

Role of the teacher

Examining classroom data

- Look at the classroom data.
  - Teacher 1, 7th grade (n = 17)
  - Teacher 2, 8th grade (n = 31)

- What do you notice?
  - For a given class?
  - Across classrooms?

- What questions do these data raise for you? (as a coach? teacher?)

Small Group Discussion Survey: Sample Data

Item	Teacher 1 N = 17	Teacher 2 N = 31
1. What did you need to do in order to be successful in your math class today? (Choose one item that best describes your experience.)		
☐ Solve problems using the steps the teacher showed me	14*	3*
☐ Listen to and make sense of other students' reasoning	2*	28*
☐ Finish all of my work	2*	4*
☐ Other	1	1*
2. Was there one right way to solve the problem(s) today?		
☐Yes	8	6
☐No	9	25
3. What was the purpose of discussion in your math class today? (Choose one.)		
☐ Make sure I did the problem the way the teacher taught me	8*	0
☐ Check to see if our answers are correct	3*	3*
☐ Learn different ways that work to solve a problem	6*	21*
☐ Other for Teacher 1 / Learn something new from another student in my class for Teacher 2	0	10*

Small Group Discussion Survey: Sample Data

Item	Teacher 1 N = 17	Teacher 2 N = 31
8. What was the purpose of working in a small group today? (Choose one.)		
☐ Work together to solve a problem using the steps our teacher taught us	9	1
☐ Check with my group members to see if my answers were correct	2	2*
☐ Investigate a mathematical idea	1	19*
☐ Share the different ways students in my group were solving a problem	3	12*
☐ Other	0	1
Did not respond	2	
9. What was the purpose of your teacher asking questions during small group time? (Choose all that apply for T1 / choose one for T2.)		
☐ Tell us we had a problem wrong	4	0
☐ Help us work together as a group	8	1
☐ Help us figure out how to solve a problem	11	12
☐ Find out how we were thinking about a problem	5	15
☐ Remind us of the right steps for solving a problem	5	1
☐ My teacher did not talk to my group today	0	1
Did not respond	1	

Small Group Discussion Survey: Sample Data

Item	Teacher 1 N = 17	Teacher 2 N = 31
4. How comfortable were you sharing your thinking in your small group today? (Choose one.)		
☐ Not comfortable	0	3
☐ Somewhat comfortable	8	17
☐ Very comfortable	8	10
Other	1	
Did not respond		1
5. In your small group, did students work together to solve a problem?		
☐Yes	16	29
☐No	0	2
Did not respond	1	
6. In your small group, did listening to other students help you revise your thinking?		
☐Yes	14	30
☐No	2	1
Did not respond	1	
7. In your small group, did you have trouble understanding your group members' explanations?		
☐Yes	8	28
☐No	7	3
Did not respond	2	

Where we are & moving forward

- Designed initial surveys (5 pilots)
- SFUSD/SERP coaches have been using the measures with teachers; JCPS will start this coming year
- Over the next year …
  - Investigate routines for supporting users to make sense of the data / act on it
  - Investigate technology for data collection, data representations, and analyses
  - Investigate how data can interface with existing data platforms

Moving forward: Research questions

- How can practical measures of the **quality of classroom instruction** be used so that they serve as *levers for* as well as *assessments of* instructional improvement?

- How can practical measures of the **quality of supports for teacher learning** be used to inform the improvement of supports for mathematics coaches' and/or teacher leaders' learning?

- How can **data visualizations** of the practical measures support teachers, professional development facilitators, and district leaders to make instructional improvement decisions?

BUILDING CAPACITY FOR THE NEXT GENERATION SCIENCE STANDARDS THROUGH NETWORKED IMPROVEMENT COMMUNITIES

Jessica Thompson, Jen Richards, Karin Lohwasser, Christine Chew, Soo-Yean Shim

University of Washington

Ambitious Science Teaching

HIGHLINE PUBLIC SCHOOLS
A path to success for every student

NSF

Improvement of practice in an RPP

Year 1

Supporting shifts in discourse & scientific modeling Windschitl, Thompson, Braaten, & Stroupe, 2012; Thompson, Windschitl & Braaten, 2013

Year 5- 2 schools

Job-embedded PD & supporting teams of teachers in working on practice Horn & Little, 2010; Lave & Wenger; Kazemi & Hubbard, 2008; Kazemi, Franke, & Lampert 2009

Year 7- 5 schools

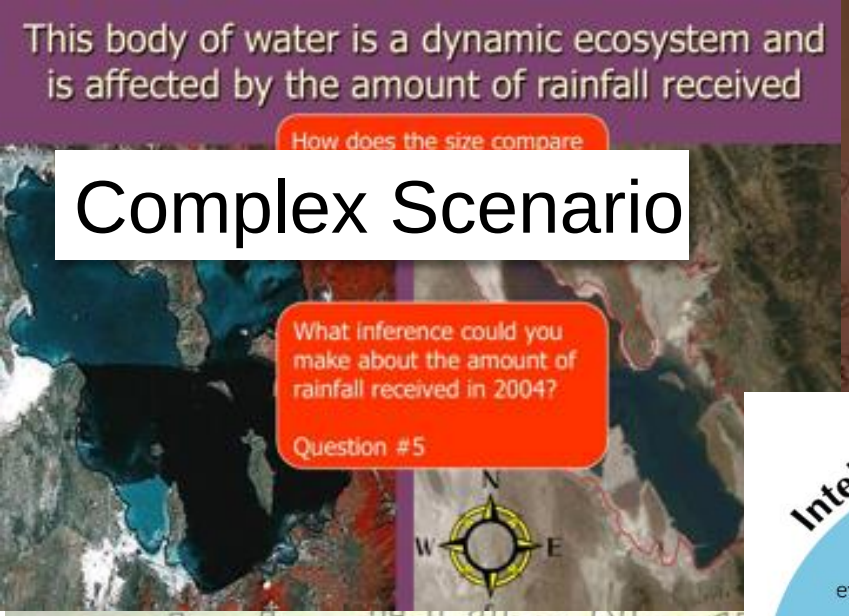
Developing coaches, naming and testing "bite size" teaching practices within and across schools Bryk, Gomez, & Grunow, 2011; Hiebert & Morris, 2012; Lampert, 2010

Year 8- 8 schools

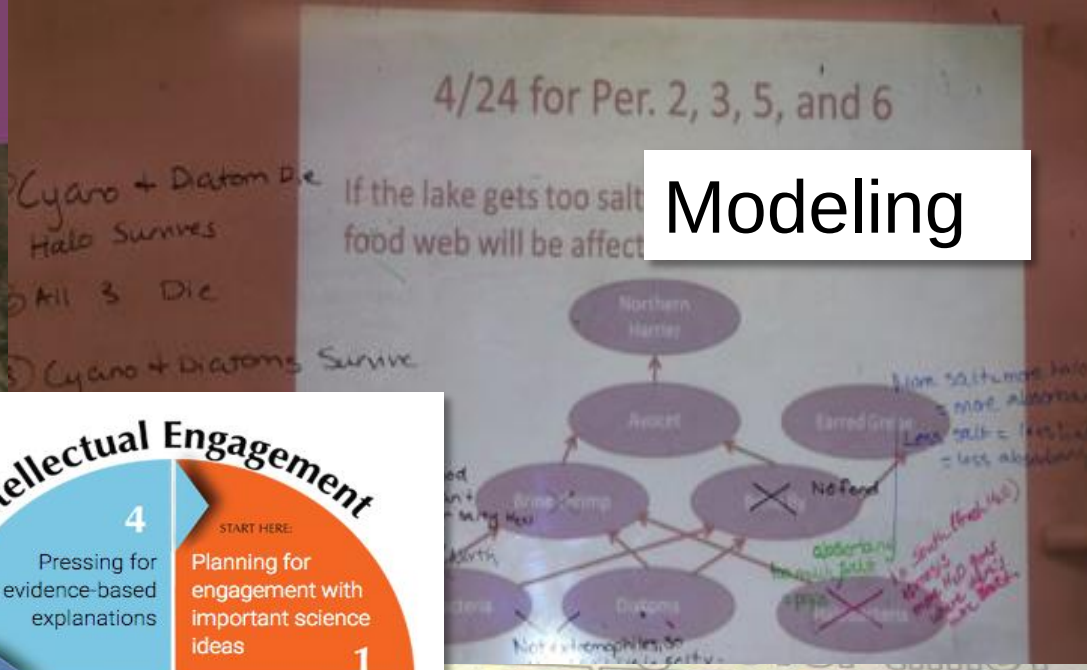
Involving students & ELL coaches, developing hybrid Science-ELL practices Bunch, 2014; Gibbons, 2007 & 2015

Year 10- 17 schools

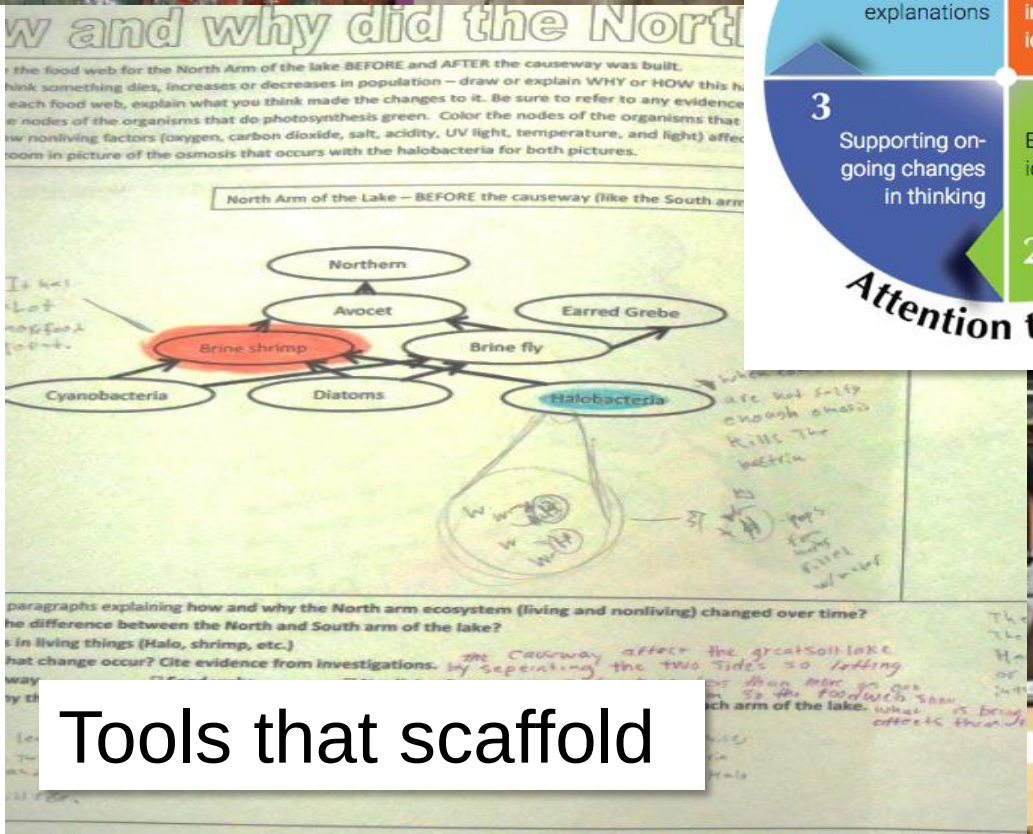
Data days & supporting principals Bryk et al. 2015; Stein & Coburn, 2008; Spillane & Thompson, 1997



Complex Scenario



Modeling



Tools that scaffold

Purposeful talk

GOAL:

Improve all students' written and spoken science explanations, arguments & models for all students and for EL students in particular

PRIMARY DRIVERS:

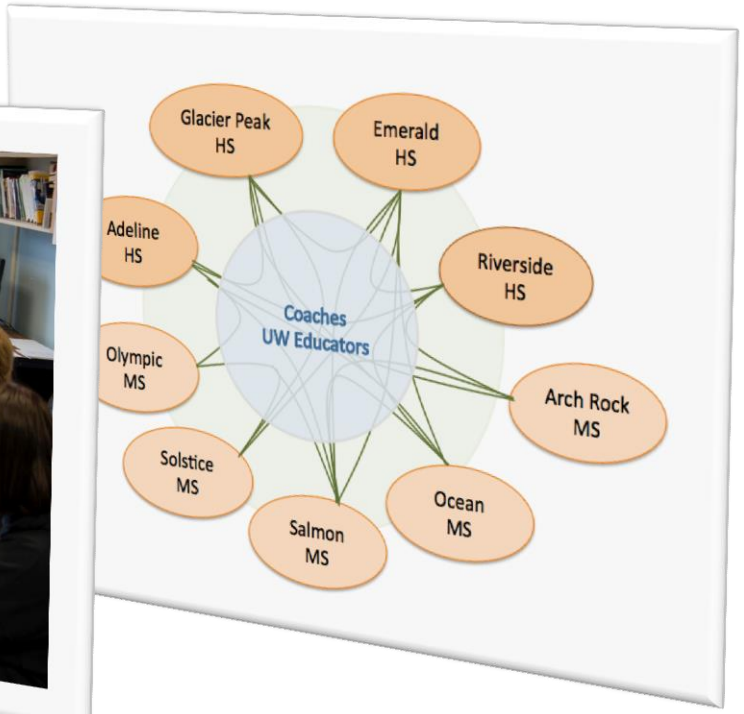
- Making the language of science explicit
- Equitable talk for how/why explanations
- Using evidence to construct and revise explanations
- Revising models with evidence

SECONDARY (ACTIONABLE) DRIVERS:

- Using language functions as lens for reading, writing, and modeling
  - Yr2: 1 school
- Structured talk for how/why reasoning
  - Yr 1: 1 school
  - Yr 2: 4 schools
  - Yr 3: 3 schools
- Peer feedback to deepen written explanations
  - Yr 3: 3 schools
- Revising lists of student generated hypotheses with evidence
  - Yr 2: 1 school
- Sequenced share-out of models
  - Yr 2: 2 schools
  - Yr 3: 2 schools

Ambitious Science Teaching

Our Aim: generate practice-based evidence by investigating how the science teaching practices work, under which conditions and for whom

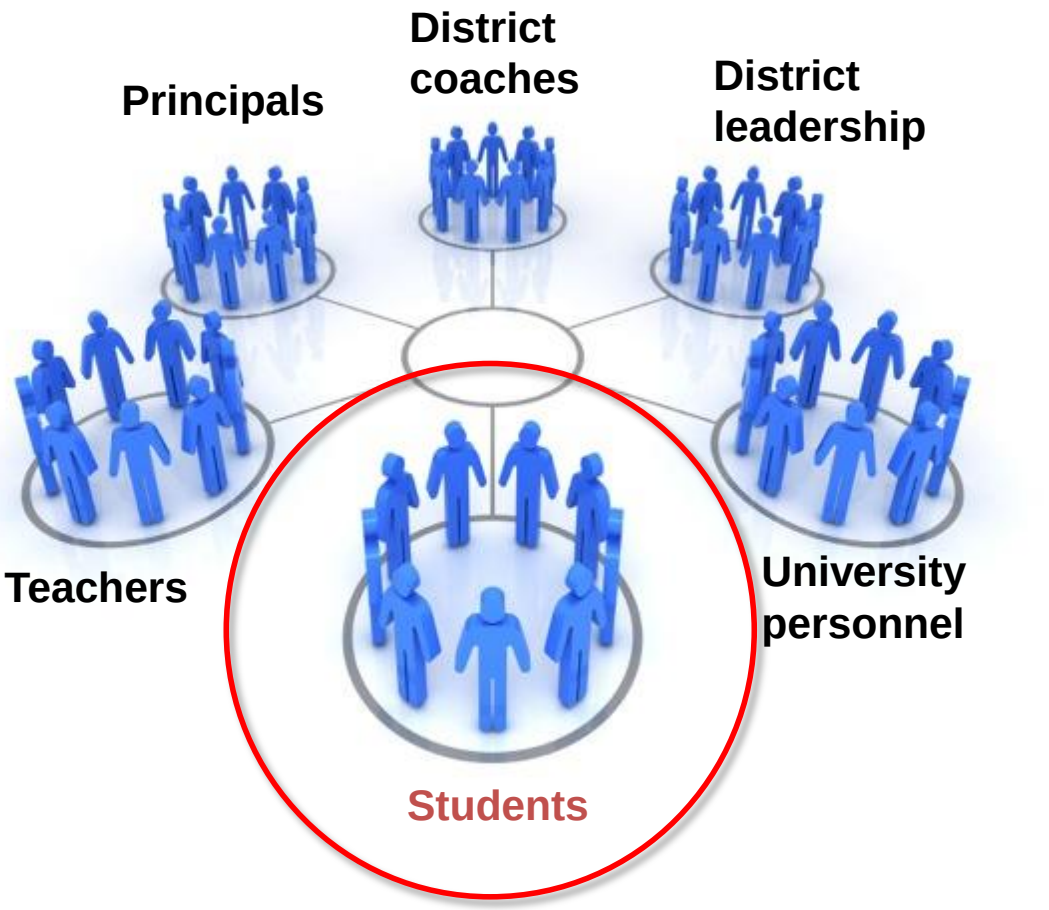


Ambitious Science Teaching

NICs & Practical Measurements

Networked Improvement Communities:

Across institutions, a commonly shared set of core **practices**, along with its **tools**, could evolve over time to improve and innovate within the work of teaching



Bryk, Gomez, & Grunow, 2011; Hiebert & Morris, 2012

Ambitious Science Teaching

Structured talk for how/why reasoning

When you engaged in structured talk with a partner, which of the following did you try? (check **ALL** that apply

- [x] I shared my idea
- [x] I listened to my partner's idea
- [x] I agreed with my partner's idea
- [x] I added on to my partner's idea
- [ ] I disagreed with my partner's idea
- [x] I used scientific evidence to support my idea
- [ ] I asked a clarifying question
- [ ] I could revoice my partner's idea
- [x] My partner and I looked for similarities and differences in our ideas
- [x] I used a sentence stem to explain my idea
- [ ] Other _____

What did you and your partner talk about? Be specific.

~~about~~ My partner and I talked about our own thinking abo
r hypothesis on our lab and what are the optimal ranges of an enzy

What went well in your discussion? What could have gone better?

rything went well in my discussion because we both listened
h other and was able to build off our ideas.

xplain one thing in this unit that you understand better or differently after talking with your partner today.

Now understanding ~~better~~ about how enzymes catalases works and h
have a better
they are effected by different variables.

Ambitious Science Teaching

The Concord Consortium

Welcome Soo-Yean Shim
Help | My Preferences | Logout

MY CLASSES | SEARCH | NEW EXIT TICKET | COLLECTIONS ▶ | ABOUT | HELP

- Recent Activity
- Soo-Yean test class
- 4th period biology class (2016)
- Integrated Science
- 1st Per Integrated Science 2015-2016
- 3rd Per Integrated Science 2015-2016
- 4th Per Integrated Science 2015-2016
- 5th Per Integrated Science 2015-2016
- ELL 6th Per Integrated Science 2015-2016

Ambitious Science Teaching

As a network of elementary, middle and high school science teams, we are aiming to improve students' written and spoken scientific explanations, models and arguments.

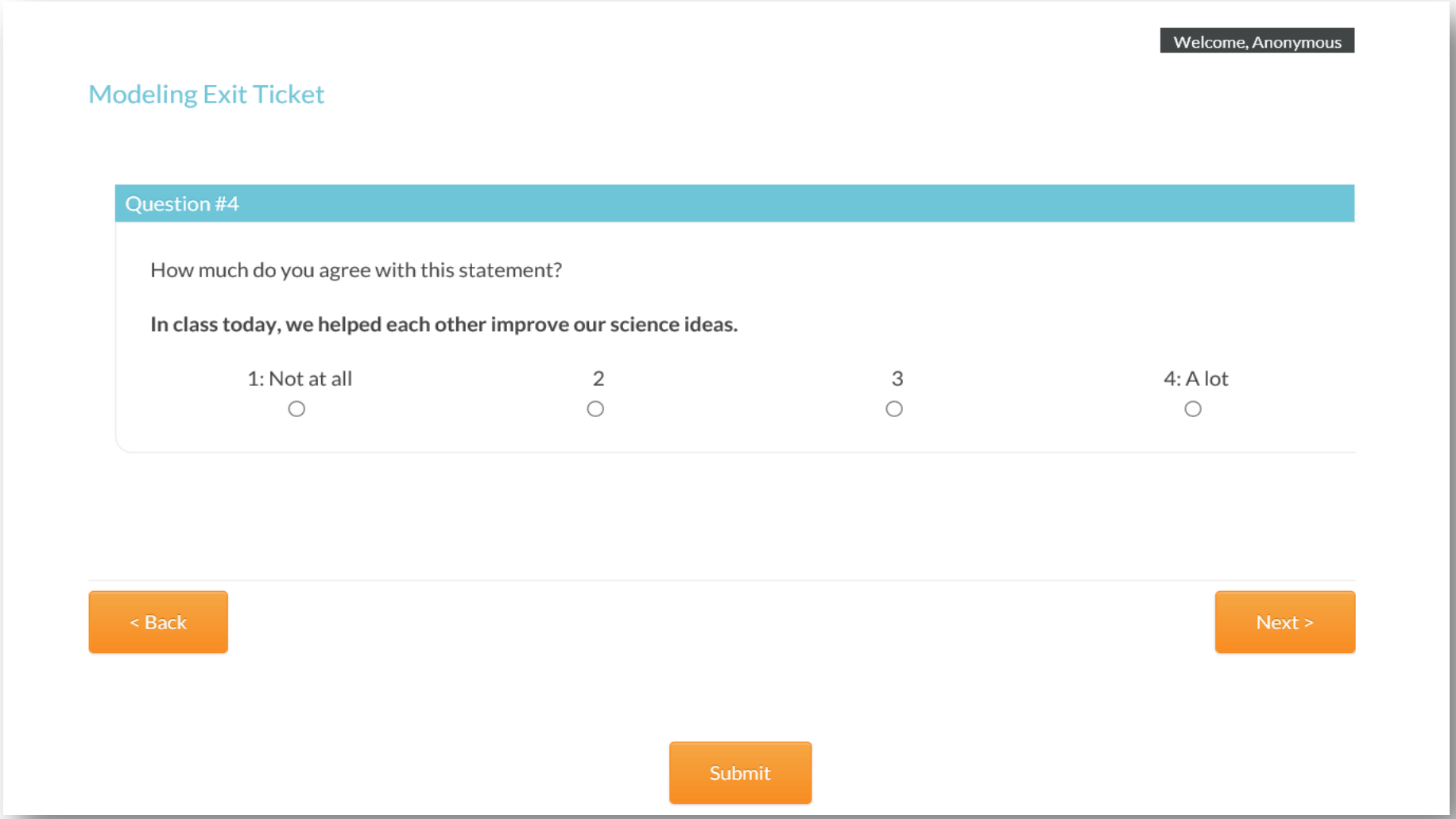
Exit Tickets

Basic AST Exit Ticket	Preview	Create
Modeling Exit Ticket	Preview	Create

Ambitious Science Teaching

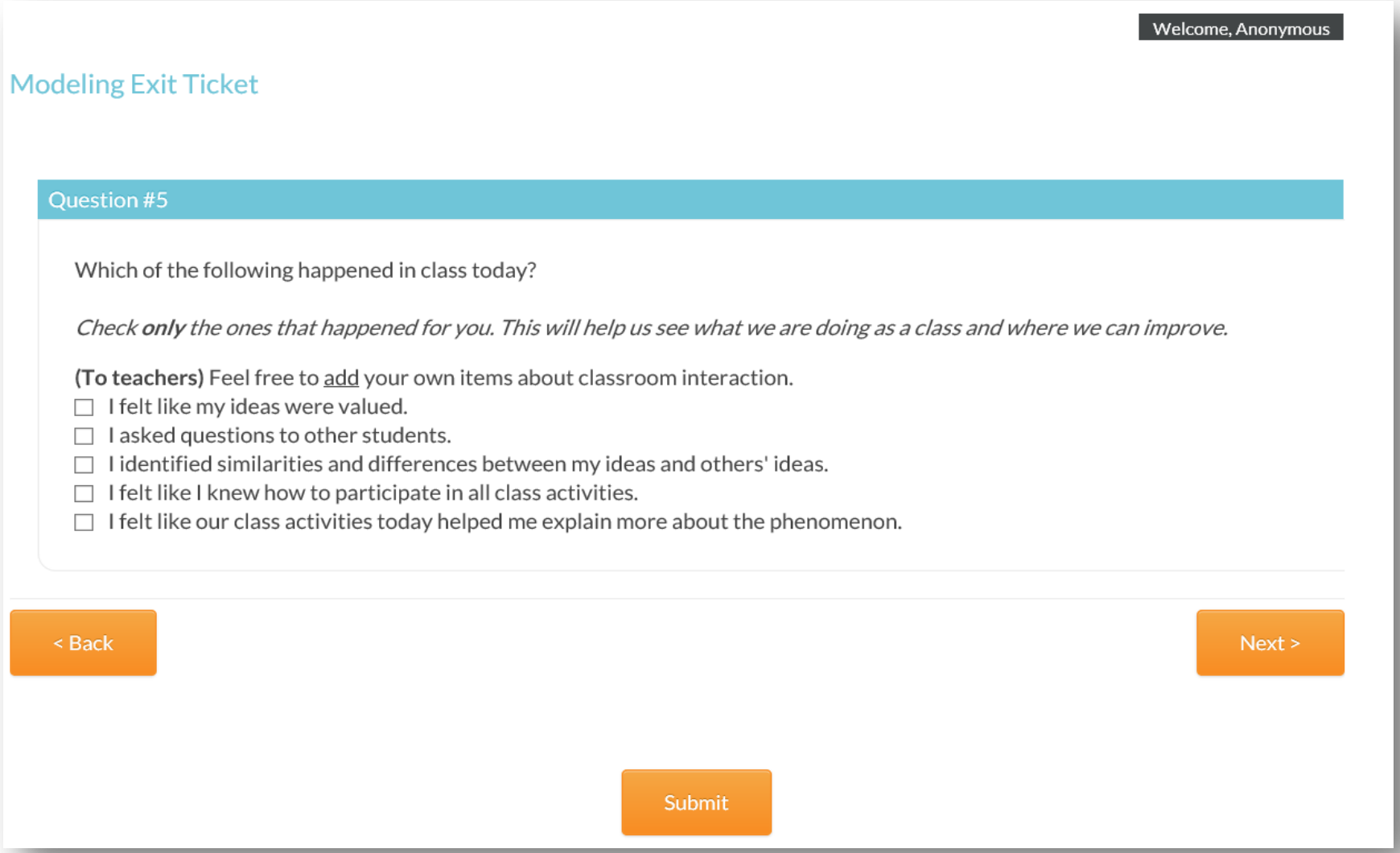
Student-facing

Sequenced share-out of models



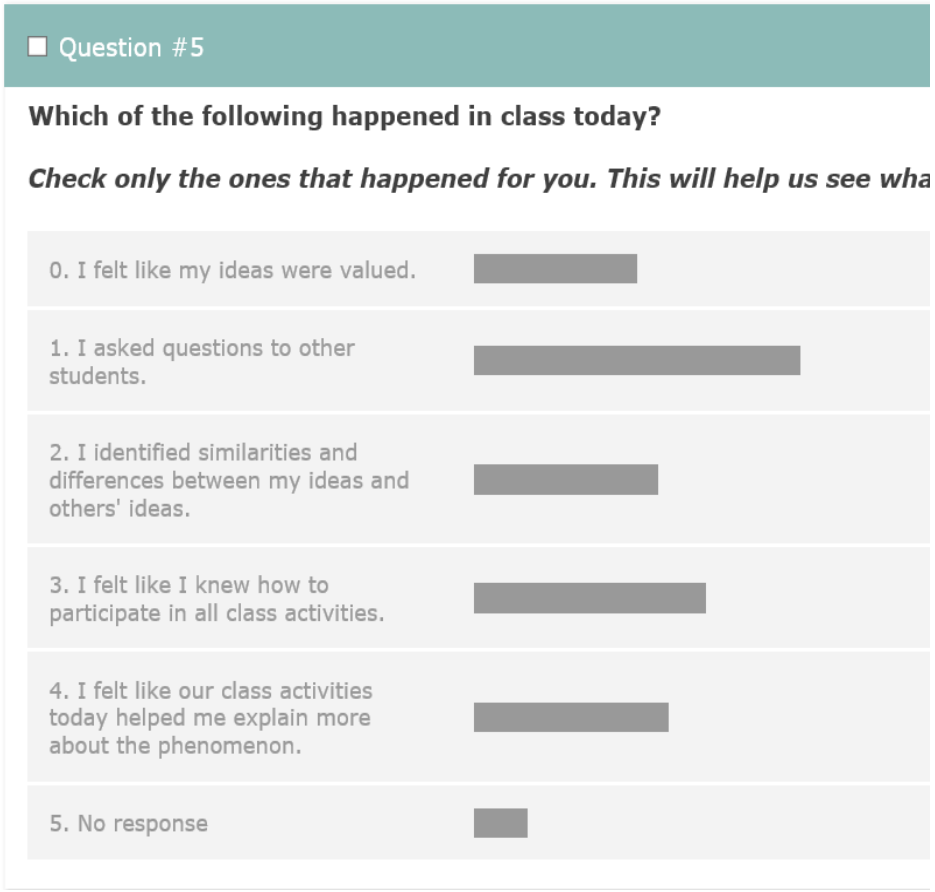
Student-facing

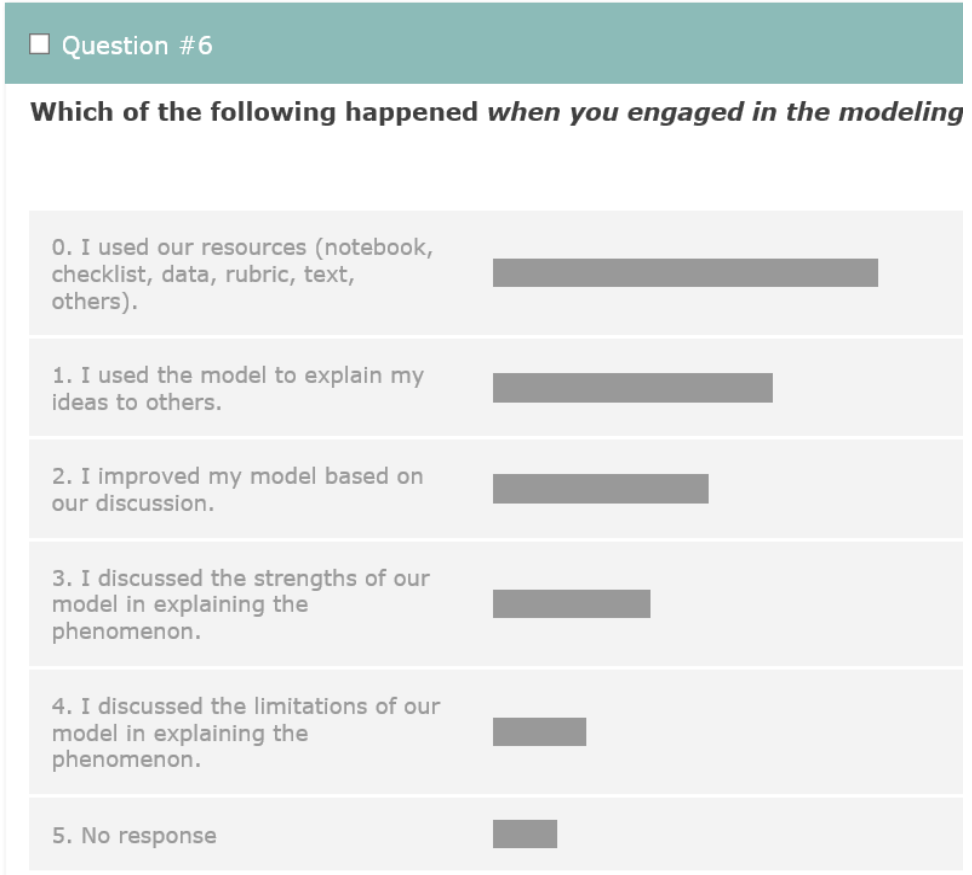
Sequenced share-out of models



Teacher-facing

Sequenced share-out of models



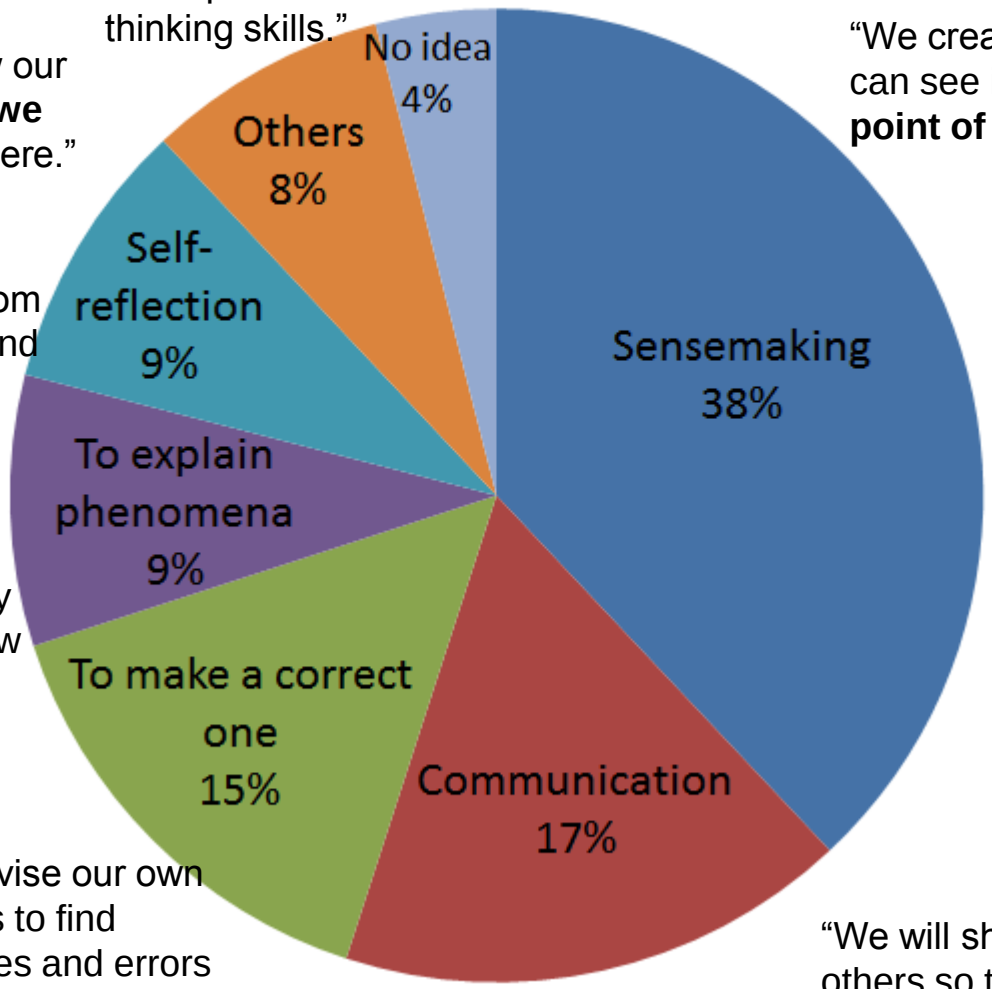


Ambitious Science Teaching

Sequenced share-out of models

Why do you think we create and revise our own models?

(Total N=100)



"We create them so we can see it from **our point of view**."

"So we **understand** and know how to explain how an object works in a larger or smaller scale."

"To have a **strong understanding** of what we are trying to explain., so we can produce informative and reliable facts and answers."

"We will show it to others so that means **it has to be clear** for them"

"So we can explain that **information for people** who need it, help people learn."

"We revise our own models to find mistakes and errors so we can **correct them**."

"So we can **explain more** about electricity and explain how electricity is made."

"So that we can learn from our previous mistakes and **improve**."

"So we can know our limits and **see if we are stuck** anywhere."

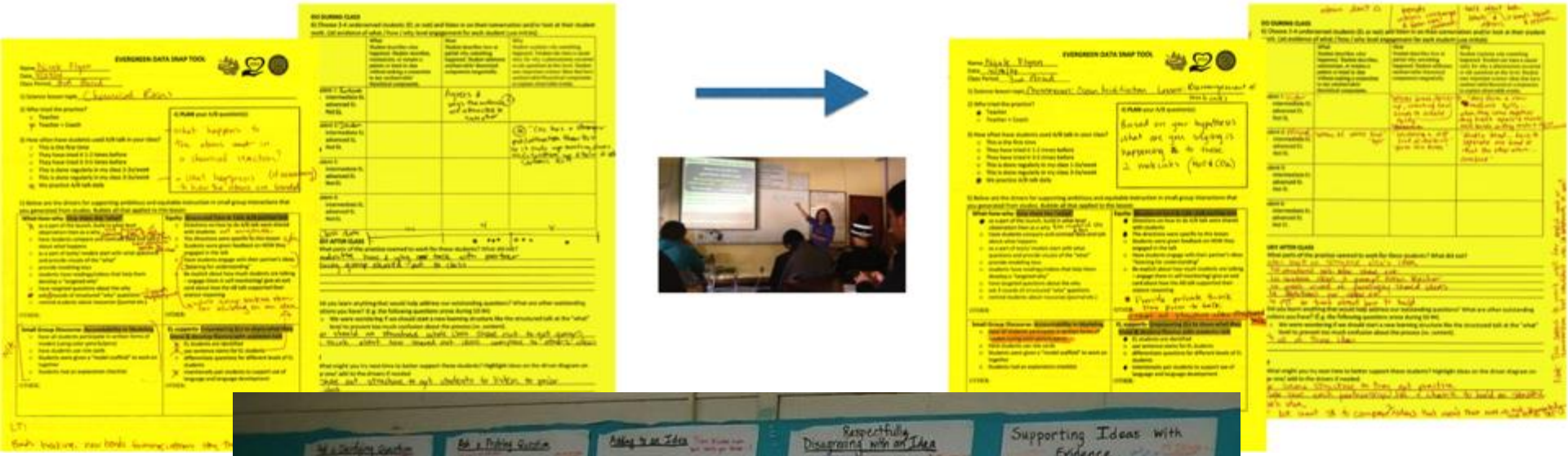
"To get a better grade."
"To improve science thinking skills."

Temporal dimensions

- Which practical measures do teachers track over time? Should they be tracked over time?
- How do practical measures co-evolve with teaching practice?
- Which data matter most to teachers, coaches and to school teams, and how does this change over time?
- Which data representations are most useful in the short-term? In the long term?
- How do teachers couple practical measures with assessments?

Practical measures are part of specified improvement cycles that have suites of tools and routines for collaborative professional learning and classroom learning

PDSA/Practice



EVERGREEN DATA SNAP TOOL

Name
Date 4/24/14
Class Period 3rd Period

1) Science lesson topic Chemical Rxns

2) Who tried the practice?
- ○ Teacher
- ☒ Teacher + Coach

3) How often have students used A/B talk in your class?
- ○ This is the first time
- ○ They have tried it 1-2 times before
- ○ They have tried it 3-5 times before
- ○ This is done regularly in my class 1-2x/week
- ○ This is done regularly in my class 3-5x/week
- ☒ We practice A/B talk daily

4) **PLAN** your A/B question(s):

- What happens to the atoms ~~and~~ in a chemical reaction?
- What happens (if necessary) to how the atoms are bonded

5) Below are the drivers for supporting ambitious and equitable instruction in small group interactions that you generated from studios. Bubble all that applied to this lesson:

What-how-why: Give them the "what"
- ☒ as a part of the launch, build in what level observation then as a why (gave example of chemical rxn to just question to context)
- ○ hav...
- ○ as a... and provide visuals of the "what"
- ○ provide modeling keys
- ○ students have readings/videos that help them develop a "targeted why"
- ○ have targeted questions about the why
- ● ask (3) rounds of structured "why" questions — 2 rounds targeted pts
- ○ remind students about resources (journal etc.)

OTHER:

Equity: Structured Turn & Talk- A/B partner talk
- ○ Directions on how to do A/B talk were shared with students — not anymore
- ○ The directions were specific to this lesson — n/a
- ... on HOW they
- ... their partner's ideas "listening for understanding"
- ○ Be explicit about how much students are talking – engage them in self-monitoring/ give an exit card about how the AB talk supported their science reasoning
- → whole group sentence stem for building on an idea

OTHER:

Under which conditions?

Small Group Discourse: Accountability in Modeling (N/A)
- ○ have all students participate in written forms of models (using color pencils/pens)
- ○ have students use role cards
- ○ Students were given a "model scaffold" to work on together
- ○ Students had an explanation checklist

OTHER:

EL supports- Empowering ELs to share what they know & develop fluency with academic talk
- ☒ EL students are identified
- ☒ use sentence stems for EL students
- ○ differentiate questions for different levels of EL students
- ☒ intentionally pair students to support use of language and language development

OTHER:

LT:
Bonds breaking, new bonds forming, atoms stay the same but form different "molecules" "particles"

---

atoms don't Δ | bonds: atoms rearrange & form new molecules | talk about both bonds & atoms → bonds break & reform

DO DURING CLASS

6) Choose 2-4 underserved students (EL or not) and listen in on their conversation and/or look at their student work. List evidence of what / how / why level engagement for each student (use initials):

	What Student describes *what* happened. Student describes, summarizes, or restates a pattern or trend in data without making a connection to any unobservable/ theoretical components.	How Student describes *how* or partial why something happened. Student addresses unobservable/ theoretical components tangentially.	Why Student explains *why* something happened. Student can trace a causal story for why a phenomenon occurred or ask questions at this level. Student uses important science ideas that have unobservable/theoretical components to explain observable events.
Student 1: Victor ○ intermediate EL ○ advanced EL ○ Not EL		"atoms break/split up, creating new bonds to create H_2CO_3"	→ "they form a new molecule H_2CO_3 ... when they come together they break apart & create new bonds so they make a new molecule"
Student 2: Miguel ● intermediate EL ○ advanced EL ○ Not EL	"atoms of same kind" "type"	"becoming a diff kind of molecule" "form new bonds"	"double bond... have to separate one bond so that the other atom... combine"
Student 3: ○ intermediate EL ○ advanced EL ○ Not EL			
Student 4: ○ intermediate EL ○ advanced EL ○ Not EL			

For whom? Proximal outcome measure

STUDY AFTER CLASS

7) What parts of the practice seemed to work for these students? What did not?

Victor built on someone else's idea
- ↳ structured talk before share out
- ↳ sentence stem + prompt from teacher
- ↳ public record of previously shared ideas
- ↳ directions for share out
- ↳ PTT to think about how to build

8) Did you learn anything that would help address our outstanding questions? What are other outstanding questions you have? (E.g. the following questions arose during SD #4)
- ○ We were wondering if we should start a new learning structure like the structured talk at the "what" level to prevent too much confusion about the process (vs. content).

→ all of these ideas

ACT

9) What might you try next time to better support these students? Highlight ideas on the driver diagram on page one/ add to the drivers if needed.

- Use same structure so they get practice
- Make sure each partnership has a chance to build on someone else's idea
- If we want Ss to compare 2 ideas that aren't their own → ask separately one PT or T&T

Question: "what happens..." class

Note: This seems to work well for end of unit or summarizing but wouldn't use @ beginning of unit

Let's look at some examples…

Peer feedback to deepen written explanations

Peer Feedback Final Model: Why do fireworks give off different colors? **PAGE 1- DO FIRST!!!!**

See the graphic organizer below. Provide feedback to: 1) key concepts/gotta have's and 2) level of explanation. Use sentence starters to ensure you give feedback your peer will use to improve his/her model.

Peer Reviewer:

Author of Model/Explanation:

What/How- Modeling and Describing The Parts and Processes.

Check off 2 the following you are providing feedback on.

I am providing feedback about the following:

- ❑ Shows/describes Source of the energy that is absorbed by the electrons
- ❑ Shows Electrons "excited state" and "ground state"
- ❑ Shows 3 different versions of electrons in excited state (Li)
- ❑ Shows 3 different colors given off by electrons
- ❑ Shows and describes the energy transformations including visible light leaving atom

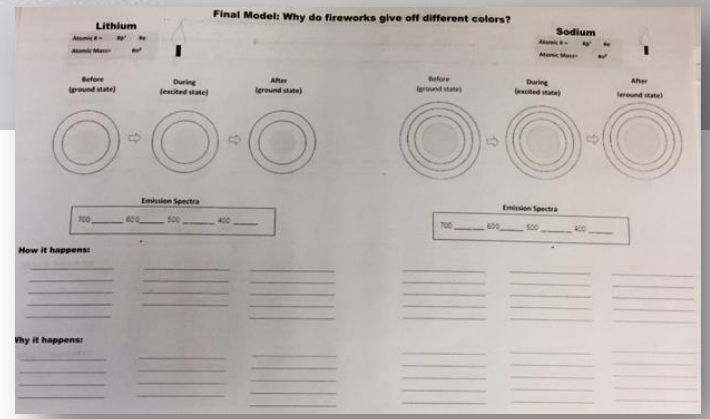
Peer Reviewer Feedback: (key concepts)

Use AT LEAST 1-2 of the sentence starters below COMPLETELY:

- *What you show/describe about ____ was clear because you [showed/explained]. I think you can even make it better by…*
- *I think the part you [showed/described] about _____ was either [confusing/not clear/incorrect/missing] because… You can fix this by…*

Instructions: Read the Feedback: Key Concepts

1. What was the most effective feedback about the key concepts?
   - The most effective feedback was when my reviewer helped me [add/explain/show]
2. **How will you revise or change your model? - Address the feedback specifically.**
   - I will address this by…



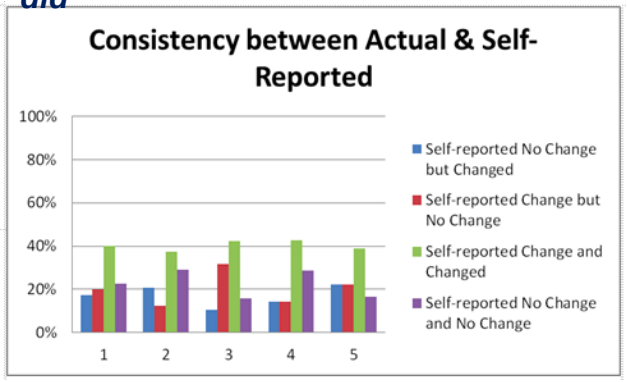
Practical measures are temporal and co-evolve with practice

Peer feedback to deepen written explanations

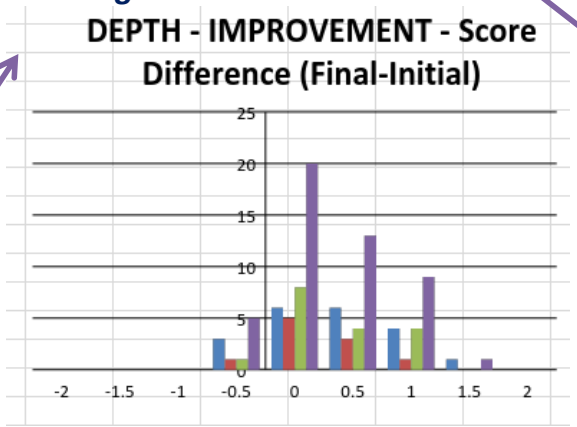
1: Seeing how talk supported students in changing to more "correct" hypotheses "correct" hypotheses

Initially "correct" hypothesis	63	37%
End-of-class "correct" hypothesis	85	49%
Change in Hypothesis	48	28%
Change FROM "correct" hypothesis	13	8%
Change TO "correct" hypothesis	35	20%

2: Considering whether students' self-reports of changes matched what they did



3: Studying the impact of talk on the depth students exhibited in their writing



4: Exploring the kinds of questions students asked each other to deepen thinking

Kinds of Questions	Question Specificity
	31%
Extension	Specific
Evidence	Specific
Press	General
Evidence	General
Press	General
Press	Specific
Press	General
Evidence	General

Questions marked as helping partners most

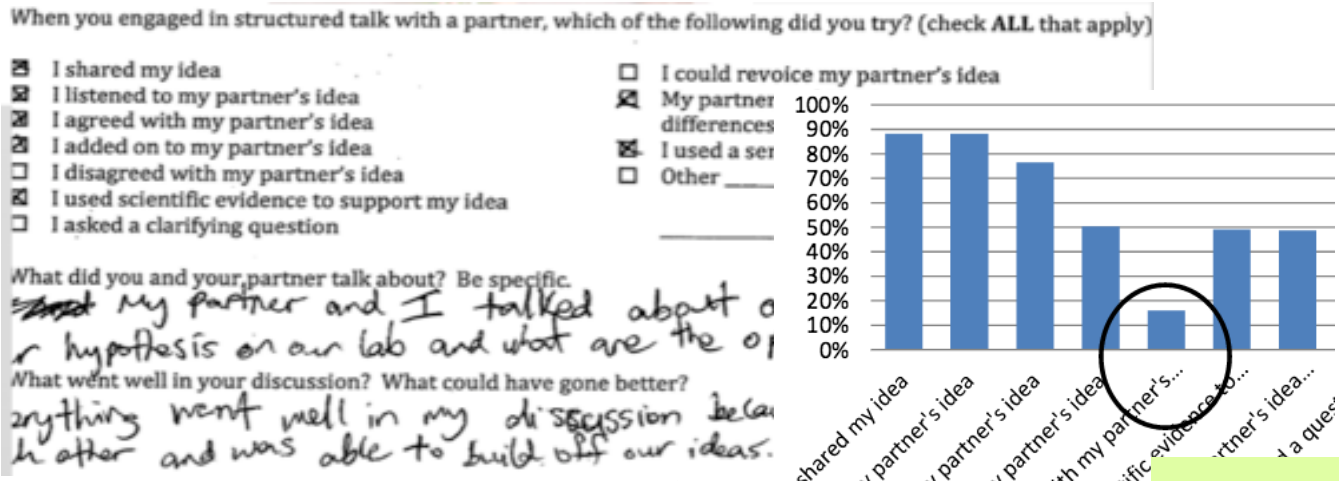
- What does the hill have to do with water?
- Do you think the fossils are inside the rocks?
- What evidence helps you prove your statement?*

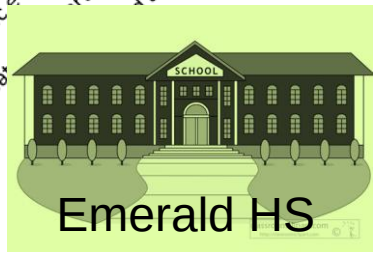
Other questions (somewhat grouped by similarity)

- More evidence. What evidence do you have?*
- What's another letter you would pick? Is there other places you could find fossils?* Does any other place have water?
- Explain your model. What is your model about?
- How is the water and rock cycle connected? What is similar from the rock/water cycle?
- Why can't rocks cycle without the water cycle?

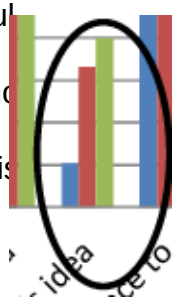
Structured talk for how/why reasoning

Practical measures & networked learning



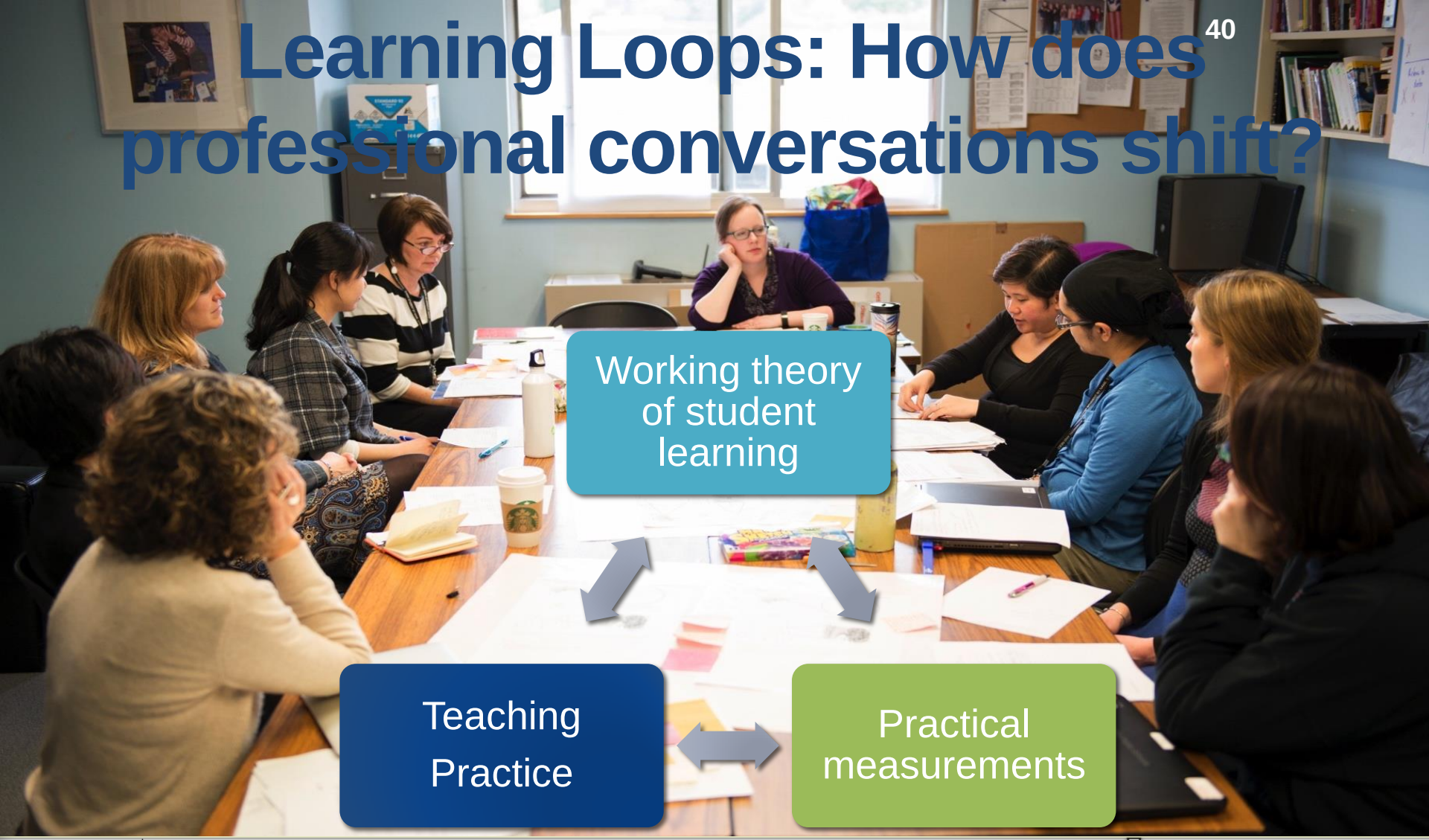


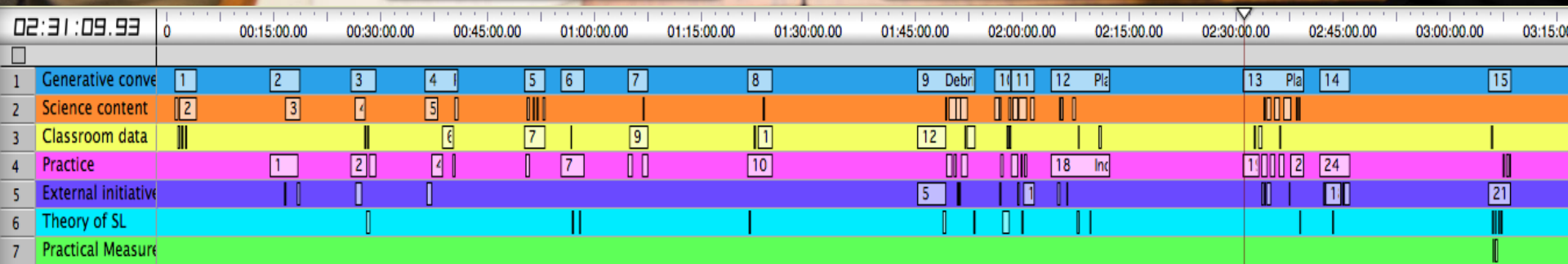
teachers decided to elevate respectful disagreement as a positive thing in science class and to ask students who did so to model their conversation for the class. They continued to track this item over time and saw growth.



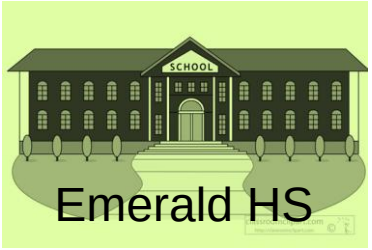
teachers dug into why students were not reporting disagreeing with each other's ideas & decided to ask students what they thought disagreeing looked like; students gave a range of responses (e.g., "cursing!"). This gave teachers an entry point for talking about disagreeing in science and in every day terms.

Learning Loops: How does professional conversations shift?





Practical measures, professional conversations & practice development



Structured talk for how/why reasoning

Classroom Data

Measurement

Practice

External Initiatives

Theory

Content

Emerald Studio Year 1, Day 2
(3 hours 8 minutes video)

Peer feedback to deepen written explanations

Content

Theory

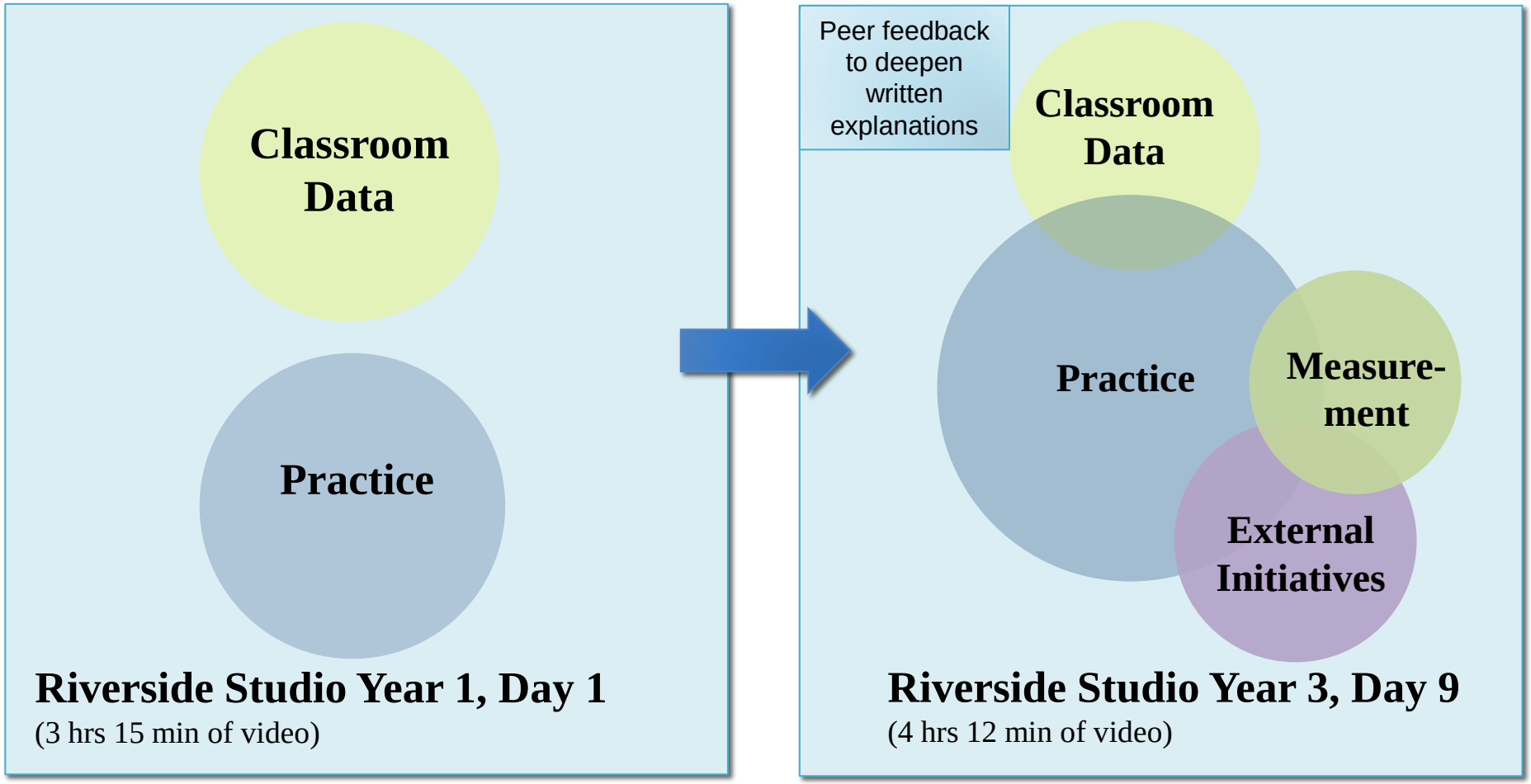
Measure-ment

Classroom Data

Practice

Emerald Studio Year 2, Day 7
(3 hours 50 minutes video)

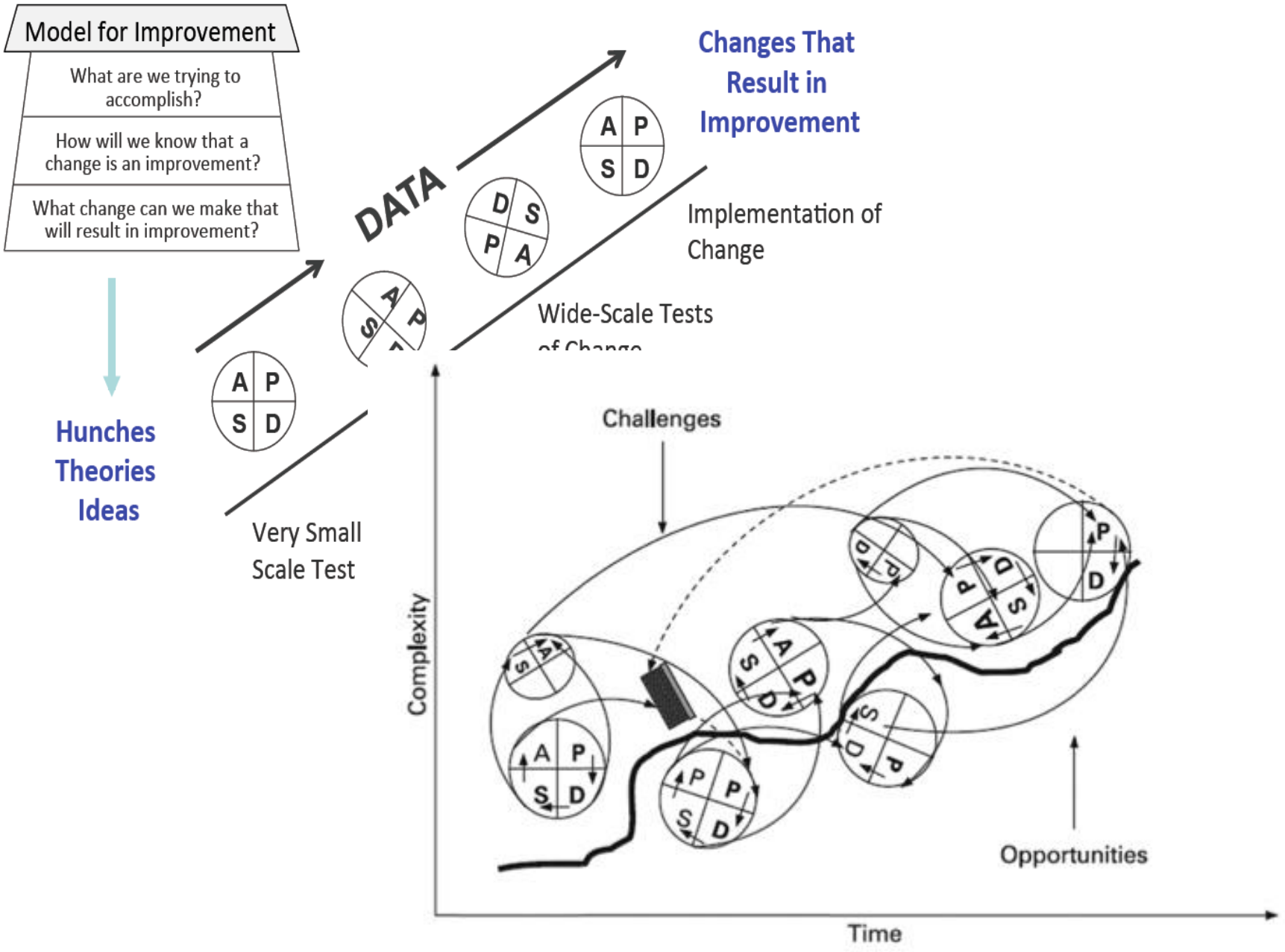
Practical measures, professional conversations & practice development



Concluding thoughts…

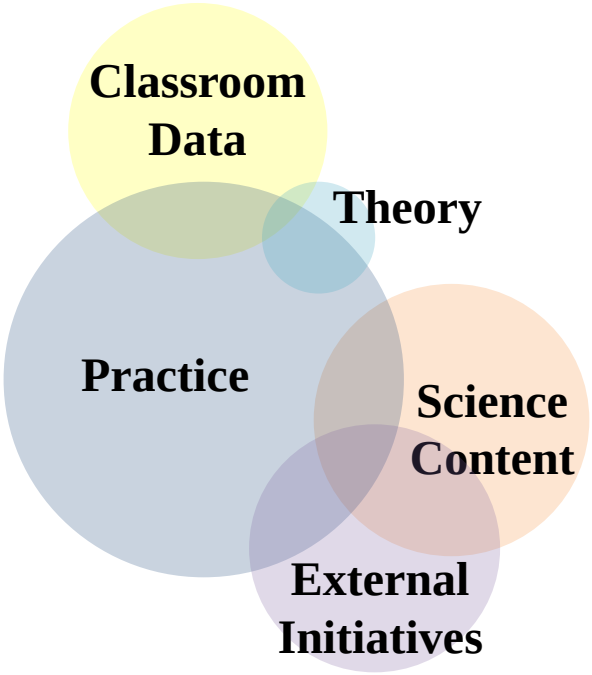
- Balance of multiple aims
  - Temporal dimensions
  - Cognitive, affective dimensions
  - Collective, individual
  - Perspective of multiple role actors

- Studying adaptation
  - Co-evolution of practical measures with practice

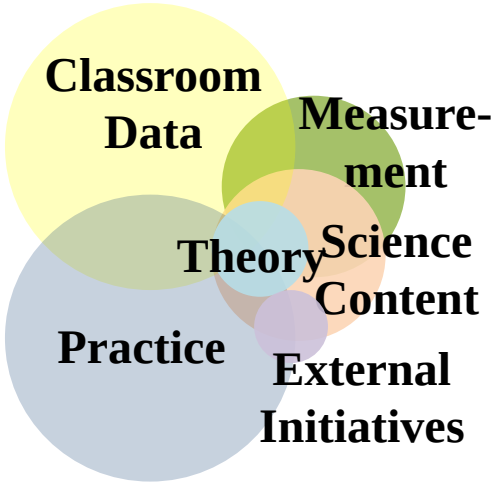

Model for Improvement
What are we trying to accomplish?
How will we know that a change is an improvement?
What change can we make that will result in improvement?
Hunches
Theories
Ideas
DATA
Changes That Result in Improvement
Implementation of Change
Wide-Scale Tests
Very Small Scale Test
Challenges
Complexity
Opportunities
Time

Your participation…

- What are some of the tensions & challenges in developing & using practical measures that you see?



Salmon Studio Year 1, Day 1
(3 hrs 15 min of video)



Salmon Studio Year 2, Day 7
(2 hrs 52 min of video)

Which Hypothesis do you agree with the most?

(You can pick more than one)

- ◯ Wolves change themselves to fit the environment.
- ◯ Wolves bred with other animals, mixing DNA to make new animals.
- ◯ Mutations occurred in the wolf's DNA, causing the differences
- ◯ Dogs have two parents so every generation just naturally gets more and more different over time.

Revise/Rewrite the hypothesis you picked based on what you learned

You can combine two or more of the hypothesis.

Pick at least two activities that support your new hypothesis

- ◯ dog breeding game
- ◯ mating game
- ◯ Punnett squares
- ◯ Interactive movie
- ◯ Other

Explain using science words how these activities supported your hypothesis