Students' Responses to Curricular Activities as Indicator of Coherence in Project-Based Science

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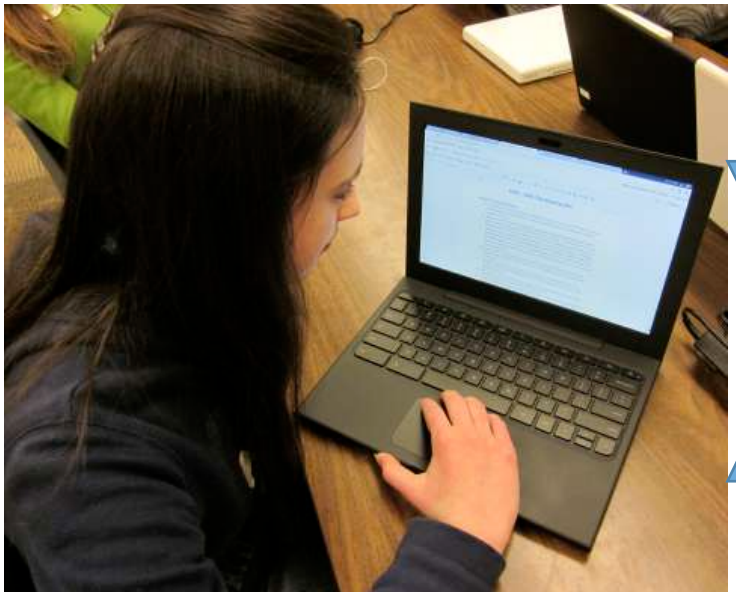
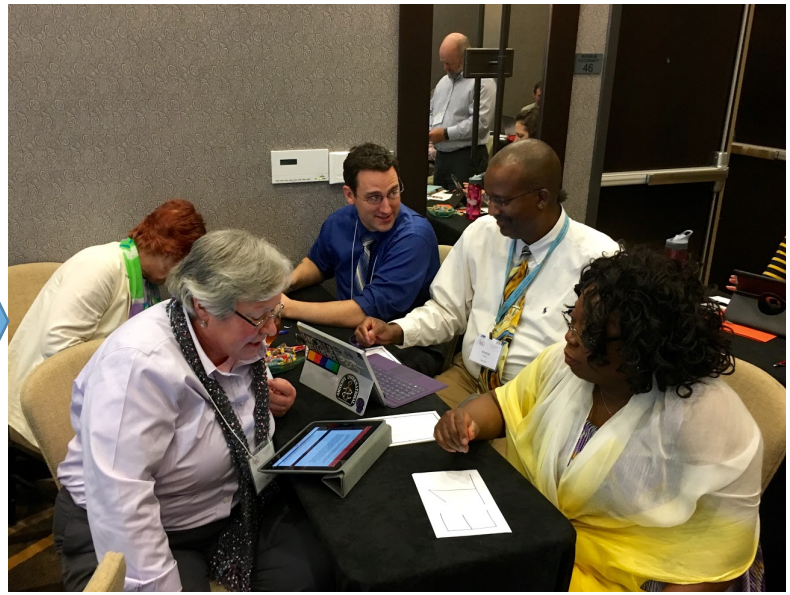
Project-based Learning:
The Promise

Project-Based Learning:
The Reality

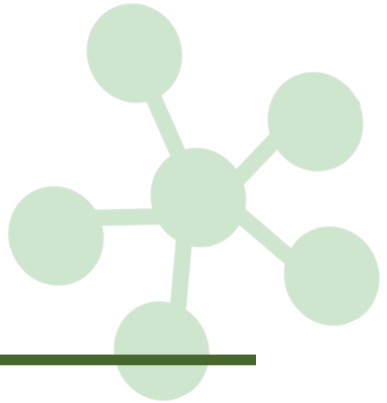
A Measurement and Design Challenge

- How can we study students' day-by-day experiences of units?
- How can we use data from students' varied experiences of unit coherence to inform design?





Coherence: A Definition



- Lessons organized so that:
  - Each builds a piece of knowledge that is needed to explain a science phenomenon or solve an engineering design challenge.
  - Each generates new student questions that are addressed in subsequent lessons through student engagement in science and engineering practices.

Assumptions

- Coherence is only partly a function of the design of the unit; it is also a function of:
  - Teacher implementation
  - Student sensemaking
- Sustained engagement is supported by strong perceptions of relevance (Polman, 2012).

Initial Conjectures (1 of 2)

Student experience will differ, depending on less on type

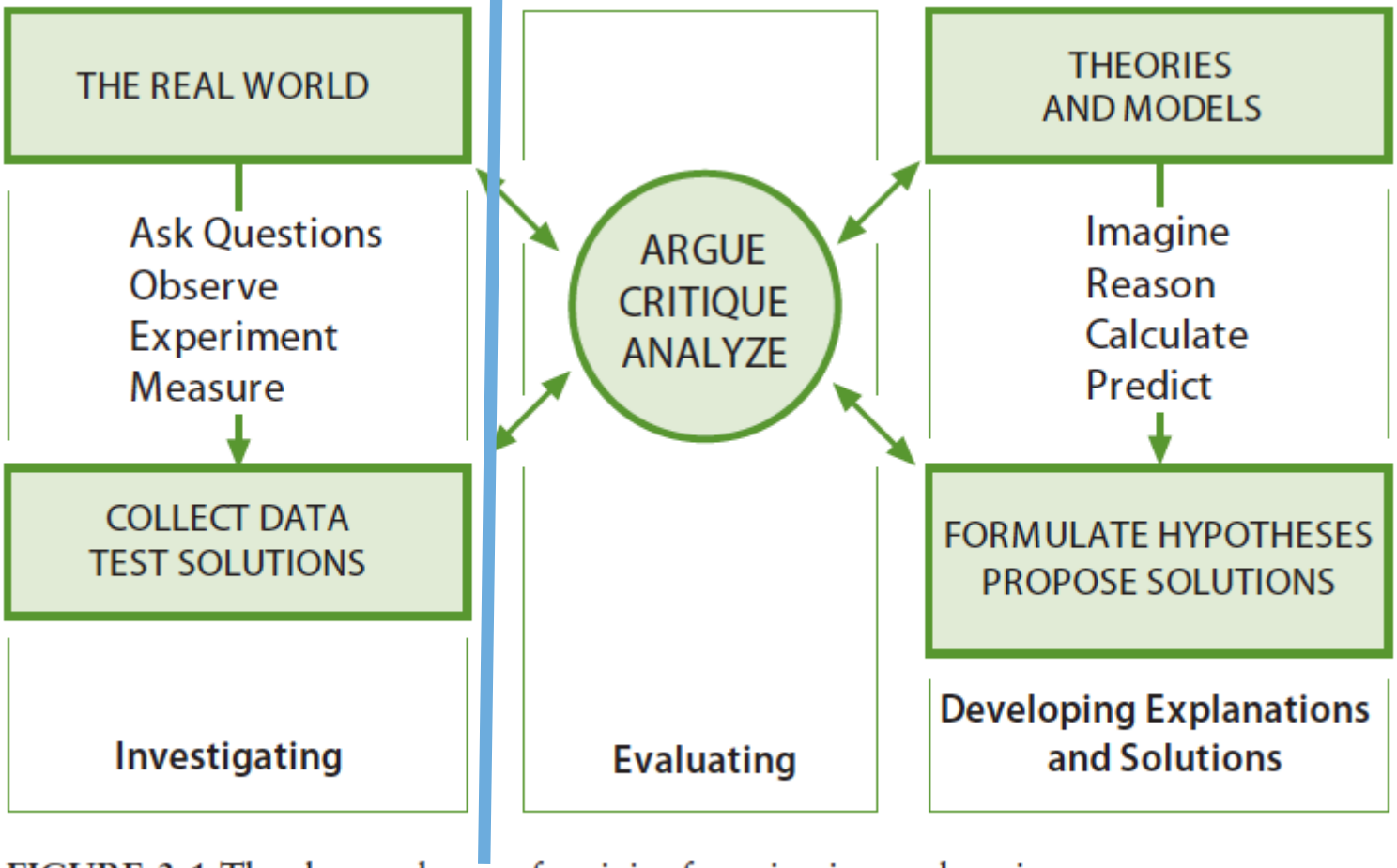
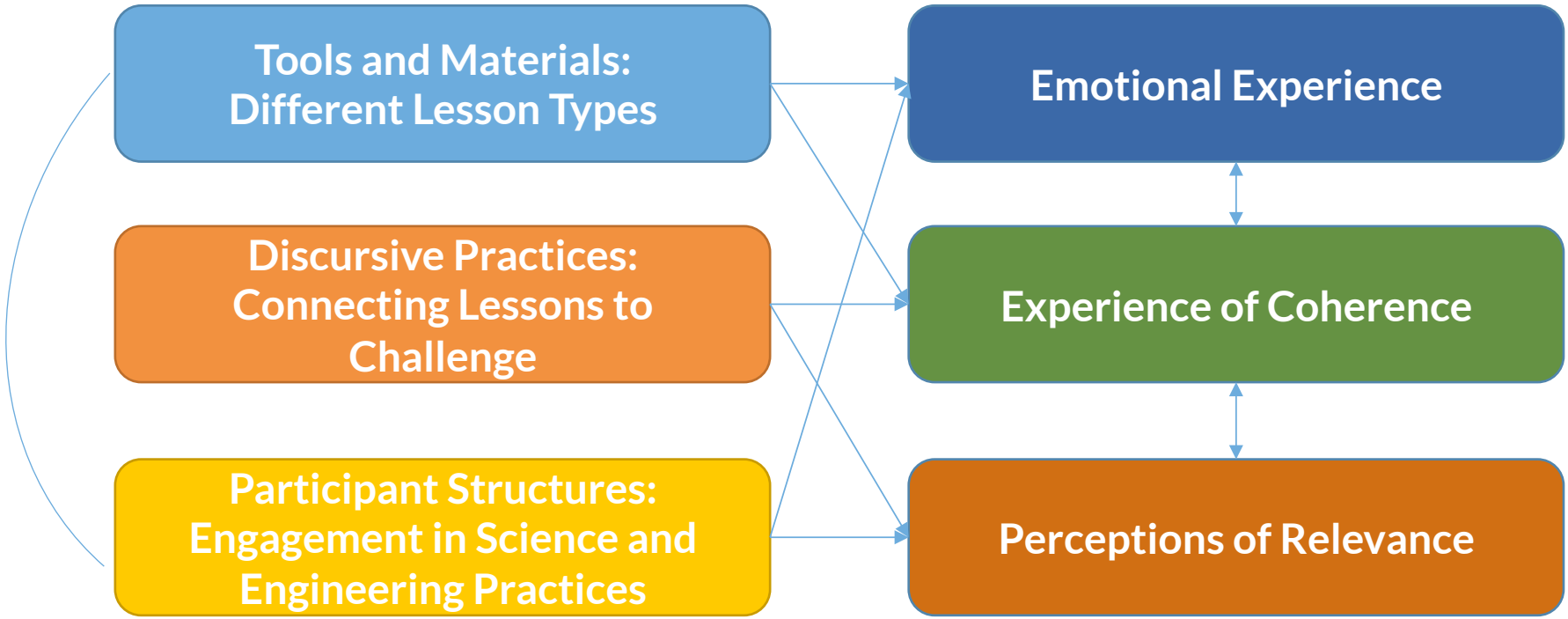


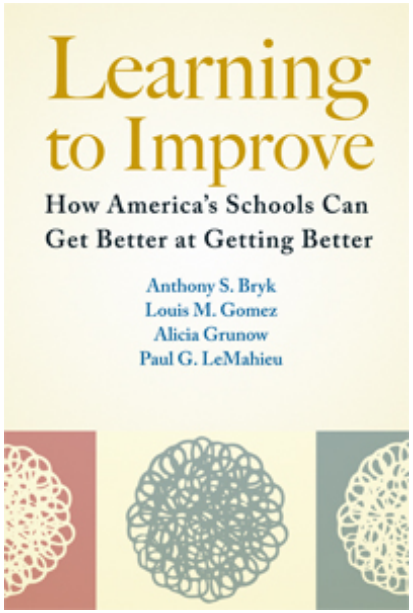
FIGURE 3-1 The three spheres of activity for scientists and engineers.

Initial Conjectures (2 of 2)



"Practical" Measurement Approach

- Relies on a handful of items
- Collected weekly from all students
- Aggregated and analyzed quickly for patterns to inform iterative design and implementation guidance to teachers



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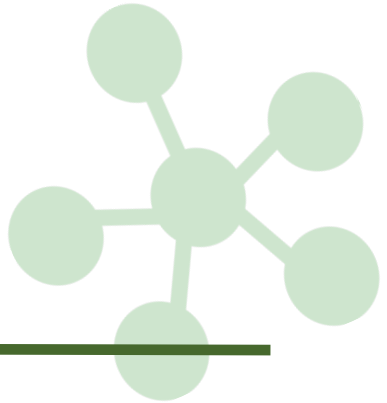
Project-Based Unit: Ecosystems

What species of tree should we plant and where, in order to benefit human beings and other organisms in the city?

Participants

- **592** students of **11** teachers from **8** schools in a large urban school district
- The majority of students in the district are Hispanic and **69%** participate in the free/ reduced lunch program.
- Our data sample consists of **1,223** surveys submitted by participating students from August 25 through October 28, 2015.

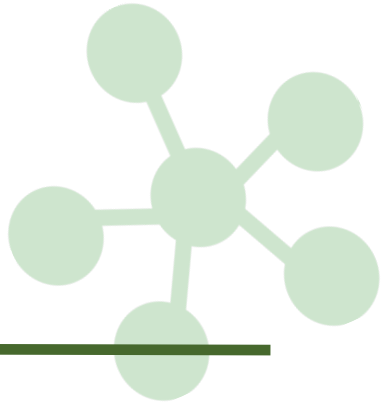
Data Sources



- Emotional experience in class (Morozov et al., 2014)
  - "Today in class, I felt…."
- Perceived coherence of lesson
  - "We learned about something today that connects to the challenge."
- Relevance to self, class, and community

Measure is available online: http://tinyurl.com/ihubpm

Approach to Analysis



- Hierarchical linear models fit to the data
  - Unconditional models to analyze teacher and student variance first
- Outcomes
  - Emotional experience in class
  - Coherence
- Predictor
  - Lesson type: Investigative or discursive

Findings: Excitement and Boredom

Table 2: Model of *excited* emotion with lesson connected to the challenge.

Outcome - Model	Predictor	Coefficient in log odds (se)	Coefficient in probability	% of Variance at the Teacher Level
Excited				13.7%
Excited *Connected to challenge*	Connected to challenge	0.84* (0.37)	0.70	40.1%

Table 3: Model of *bored* emotion with lesson connected to the challenge.

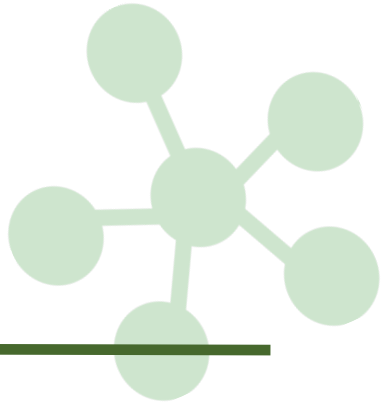
Outcome - Model	Predictor	Coefficient in log odds (se)	Coefficient in probability	% of Variance at the Teacher Level
Bored				29.9%
Bored *Connected to challenge*	Connected to challenge	-0.79 (0.48)	0.31	40.6%

Findings: Coherence

Table 1: Model of lesson connected to the challenge with type of challenge as predictors.

Outcome - Model	Predictor	Coefficient in Log Odds (se)	Coefficient in Probability	% Variance at Teacher Level
Connected to Challenge *Unconditional Model*				30.5%
Connected to Challenge *Type of Lesson*	Investigation-focused	-0.28 (0.33)	0.43	34.7%
	Discursive-focused	-0.37 (0.20)	0.32	

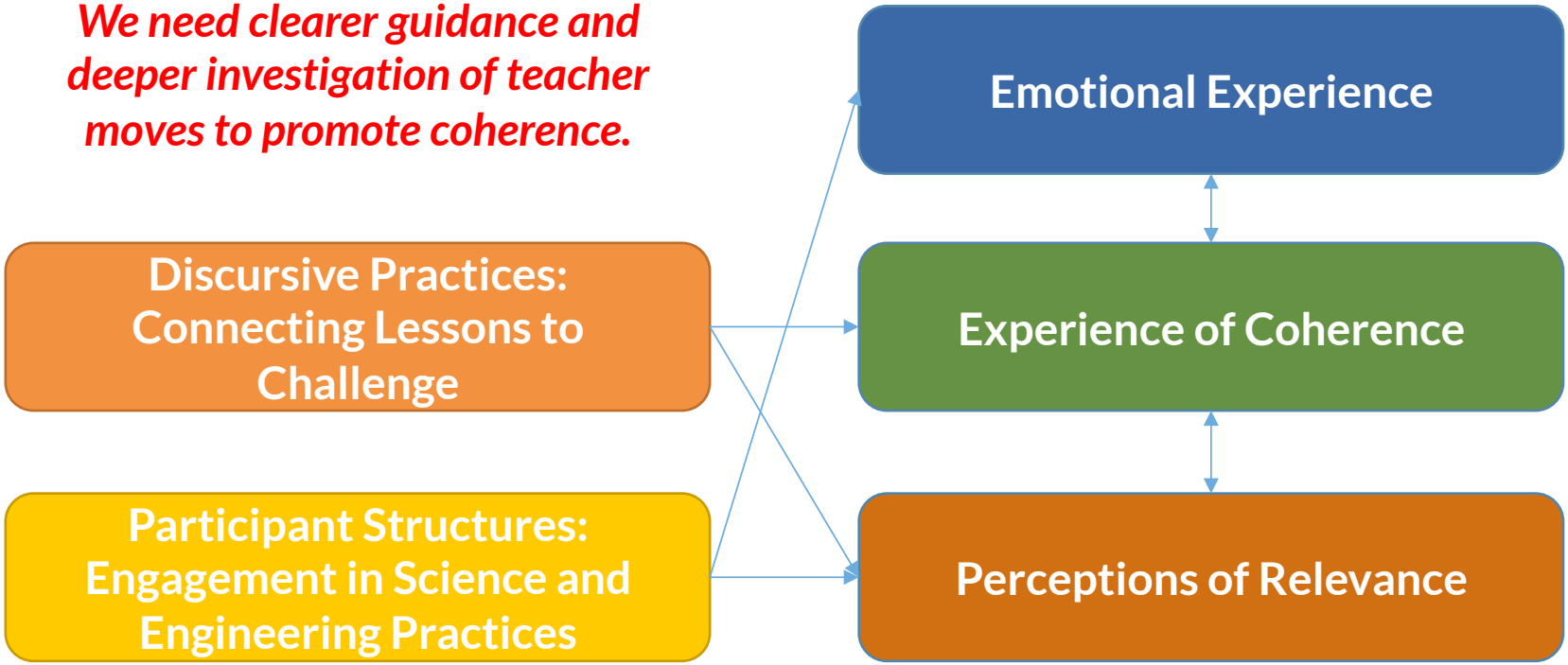
Additional Findings



- We found a significant correlation between perceptions of relevance and perceptions of coherence
- Perceived relevance, like coherence, has a high percent of teacher variance (37%)
  - Lesson type was not associated with perceived relevance.

Revised Conjectures

We need clearer guidance and deeper investigation of teacher moves to promote coherence.



Informing Iterative Design

- Evidence presented to teachers for why challenge is important for student engagement.
- Developing additional guidance in the form of:
  - Lesson plan templates that engage students in reflection on coherence.
  - Heuristics for teachers to use when making adjustments to planned sequence of lessons.

Conclusions

- Curriculum design is important, but not enough to ensure coherence.
- With moderately coherent curriculum, student experience can still vary widely.
- There is value in using small surveys that elicit student experience in coherence for informing design.

Thank you.

Presentation is available at:
http://learndbir.org/talks-and-papers

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