Uncovering the Black Box: Impacts on Mediators of a Science Teacher Professional Development Model

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Agenda

❑ Setting the stage

❑ Overview of Making Sense of SCIENCE (MSS)

❑ Overview of the study and this exploratory analysis

❑ Description of the analysis specific to unpacking the logic model

❑ Findings: Unpacking the logic model

❑ Making sense of the findings

Fundamental Shifts in Science Education

- Release of Next Generation Science Standards (NGSS) in 2013

- Focus on three-dimensional learning

- Guidance calls for systematic changes

  - Curriculum and curriculum resources

  - Teacher professional development

 - Instructional practices

 - Assessment

Overview of the Intervention

Making Sense of
SCIENCE

- Science teacher professional learning model
- Developed by WestEd
- Focuses on the critical connections between **science understanding**, **literacy support, and classroom practices**, in ways that support the implementation of NGSS and the CCSS
- Capacity building for school administrators and a Leadership Cadre
- Professional learning activities for teachers each year for 2 years
    - 30 hours of professional learning in the summer
    - 12 hours of Professional Learning Communities (PLCs)
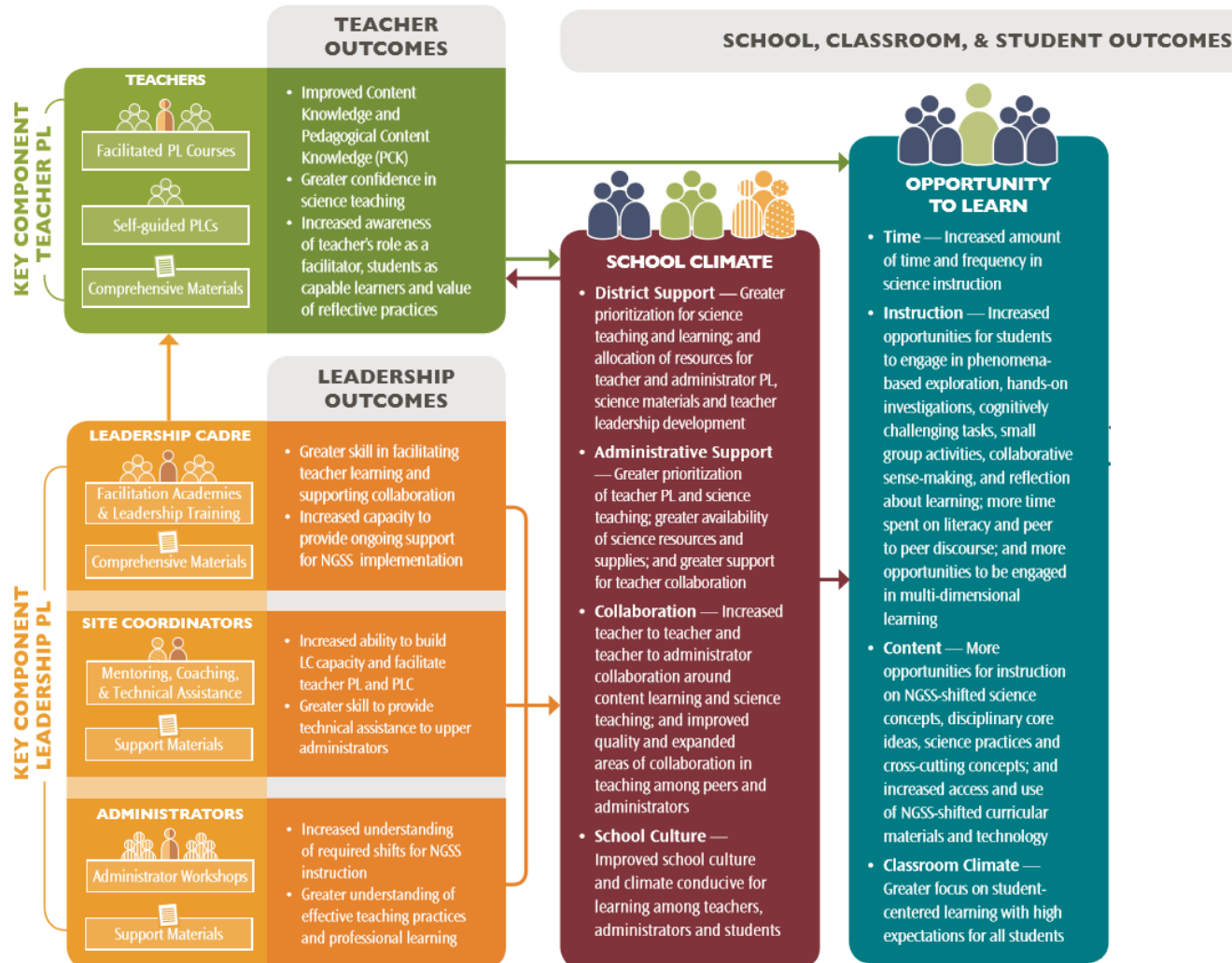
Making Sense of SCIENCE: Logic Model
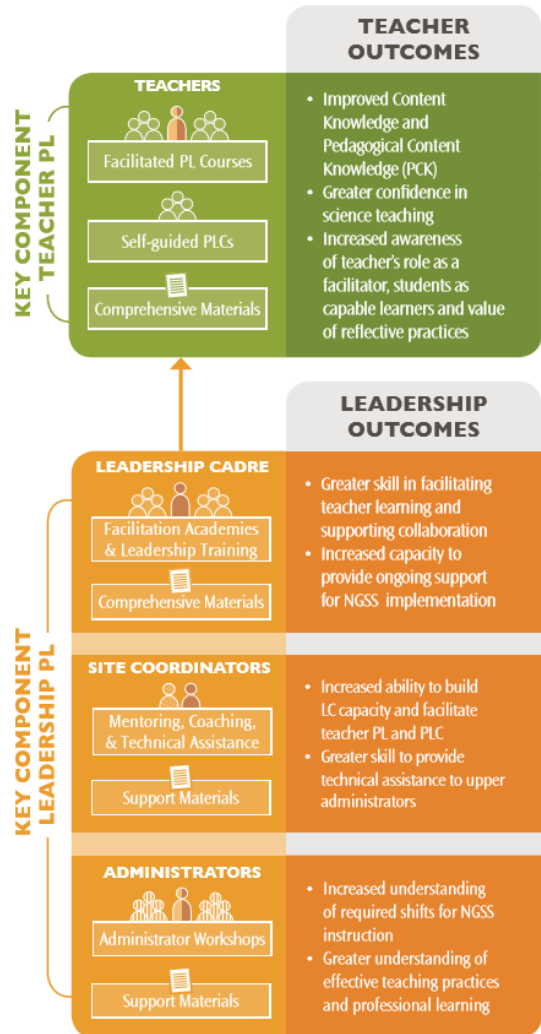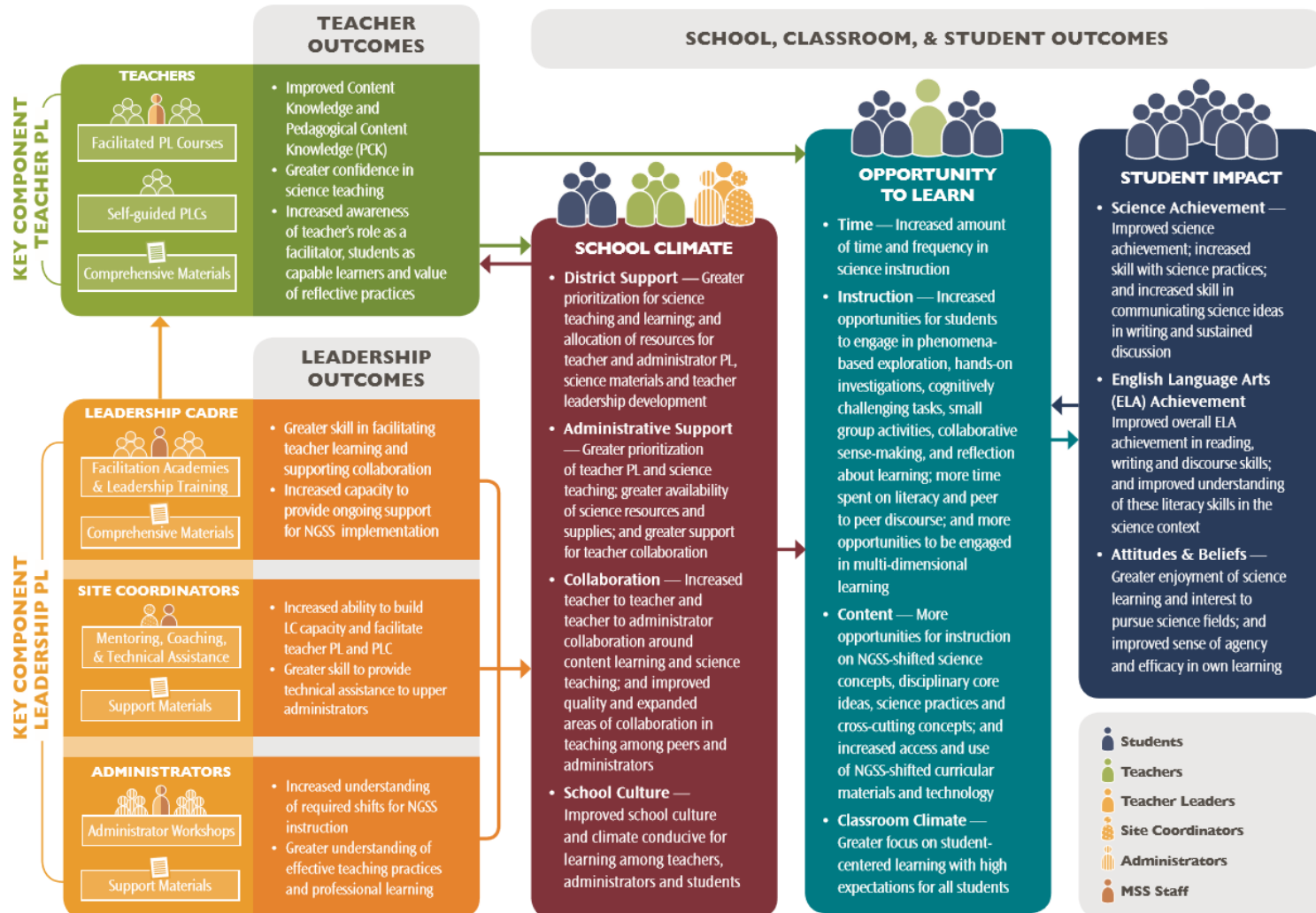
Making Sense of SCIENCE: Logic Model
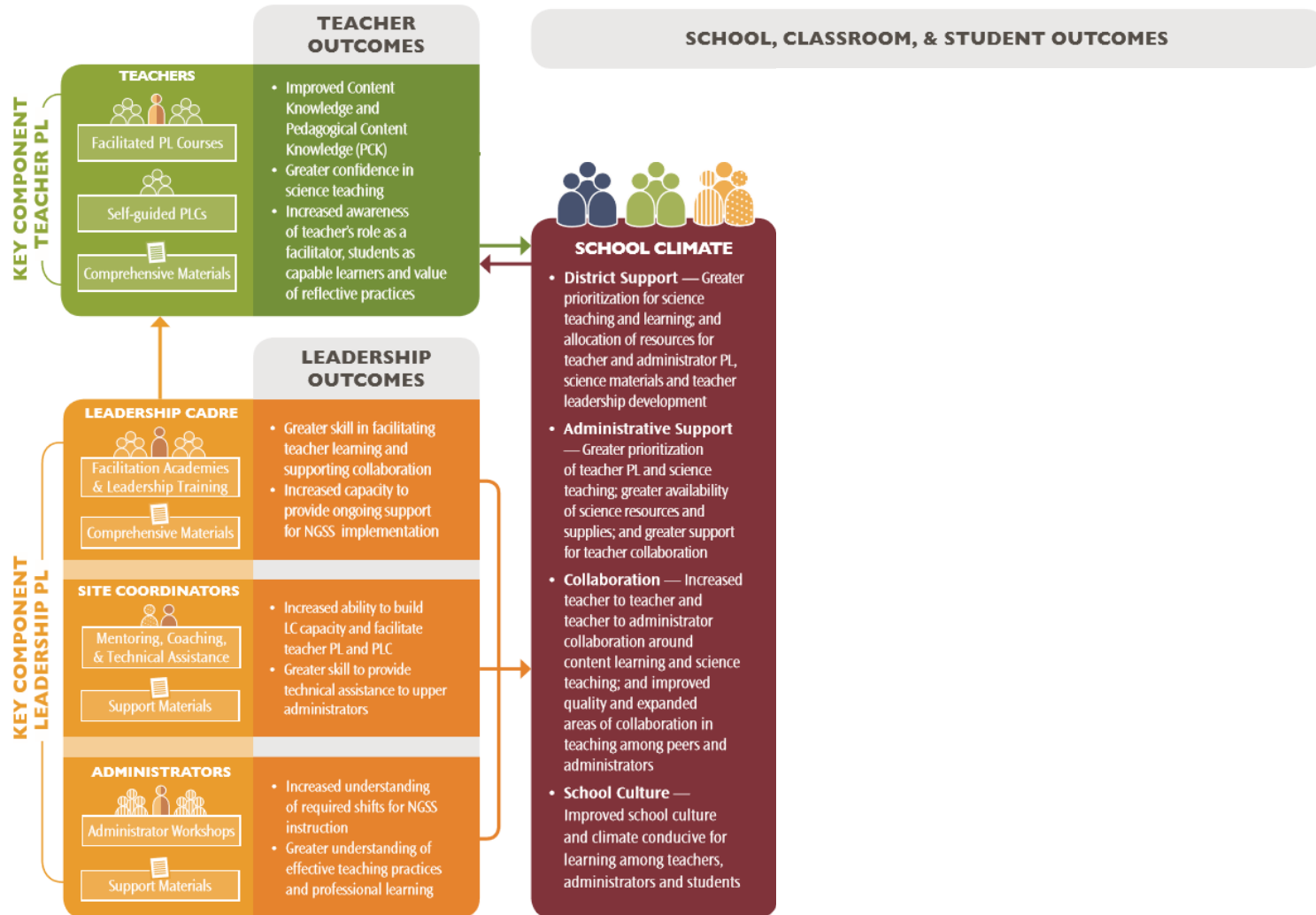
Making Sense of SCIENCE: Logic Model

Making Sense of SCIENCE: Logic Model

The Impact Study

i3 Validation grant (2015-2019) to WestEd

Cluster (school-level) randomized control trial

Elementary schools (4th and 5th grades)

2 Year study   **2** States   **7** Districts   **66** Schools   **329** Teachers   **~8000** Students

Research Questions

Confirmatory research questions:

What is the impact of MSS after two years of implementation on:

1. **Teacher content knowledge** when compared to study participants in control schools receiving the business-as-usual science PD?

2. **4th and 5th grade students** science achievement in Earth and space science and physical science domains

3. **4th and 5th grade students with low incoming achievement** on science achievement in Earth and space science and physical science domains

Exploratory research question discussed today

- What is the impact of MSS on teacher attitudes and beliefs, on opportunity to learn, and on school climate?

- To what extent was MSS implemented with fidelity?

Data Collection

	Instrument	Time
Teachers	Pretest for Teacher Content Knowledge (TCK)	As teachers joined the study and prior to participation in any MSS PD
	Baseline survey	As teachers joined the study and prior to participation in any MSS PD
	Surveys (Beliefs about students, Teaching philosophies, Confidence and self-efficacy, OTLs science topics, School climate, Professional learning, Collaboration, Classroom discourse)	3 times a year in 2016-17 and 2017-18
	Posttest for TCK and Pedagogical Content Knowledge (PCK)	Spring 2016-17 and spring 2017-18
Students	Science achievement assessment that included selected response and constructed response components	Spring 2016-17 and spring 2017-18
	Survey Attitudes toward science (e.g., aspirations for careers in science, enjoyment of science, self-efficacy around science, and quality of science instruction)	Spring 2016-17 and spring 2017-18
Administrators	Baseline survey	As administrators joined the study and prior to the school's participation in any MSS PD
	Surveys	Spring 2016-17 and spring 2017-18

From school districts:
- Class rosters, student demographic data, and state assessment data from 2014-15 to 2017-18 for 3rd, 4th, and 5th graders
- Third grade Math and ELA assessment data ("pretest scores") for all students with a posttest in spring 2017-18
- Science state assessment administered only to 4th graders in WI and 5th graders in CA. No science test scores available for CA for 2016–17 and 2017–18

Analysis on Impact of Intermediate Outcomes: Methods

- Based on sample of 147 teachers

- Employs a three-level hierarchical linear model (teacher, schools and matched pairs) that regresses each of the 30 intermediate outcomes on an indicator of assignment status and a series of teacher- and school-level covariates.

Teacher covariates for precision

Ethnicity
Gender
Certification
Highest level of education
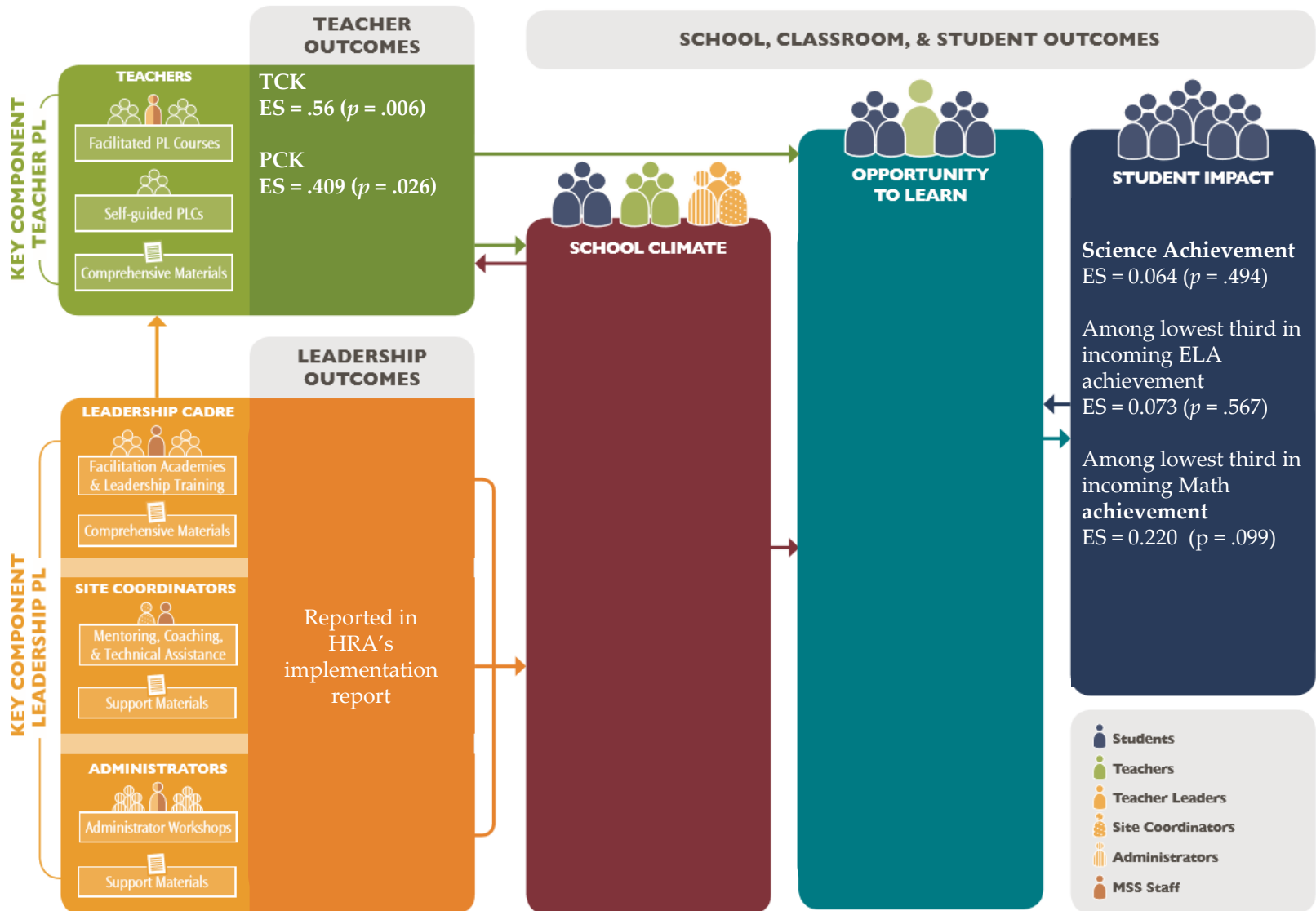Confidence in teaching science
Teaching philosophies

School covariates for precision

School size
Locale
Title 1 eligibility
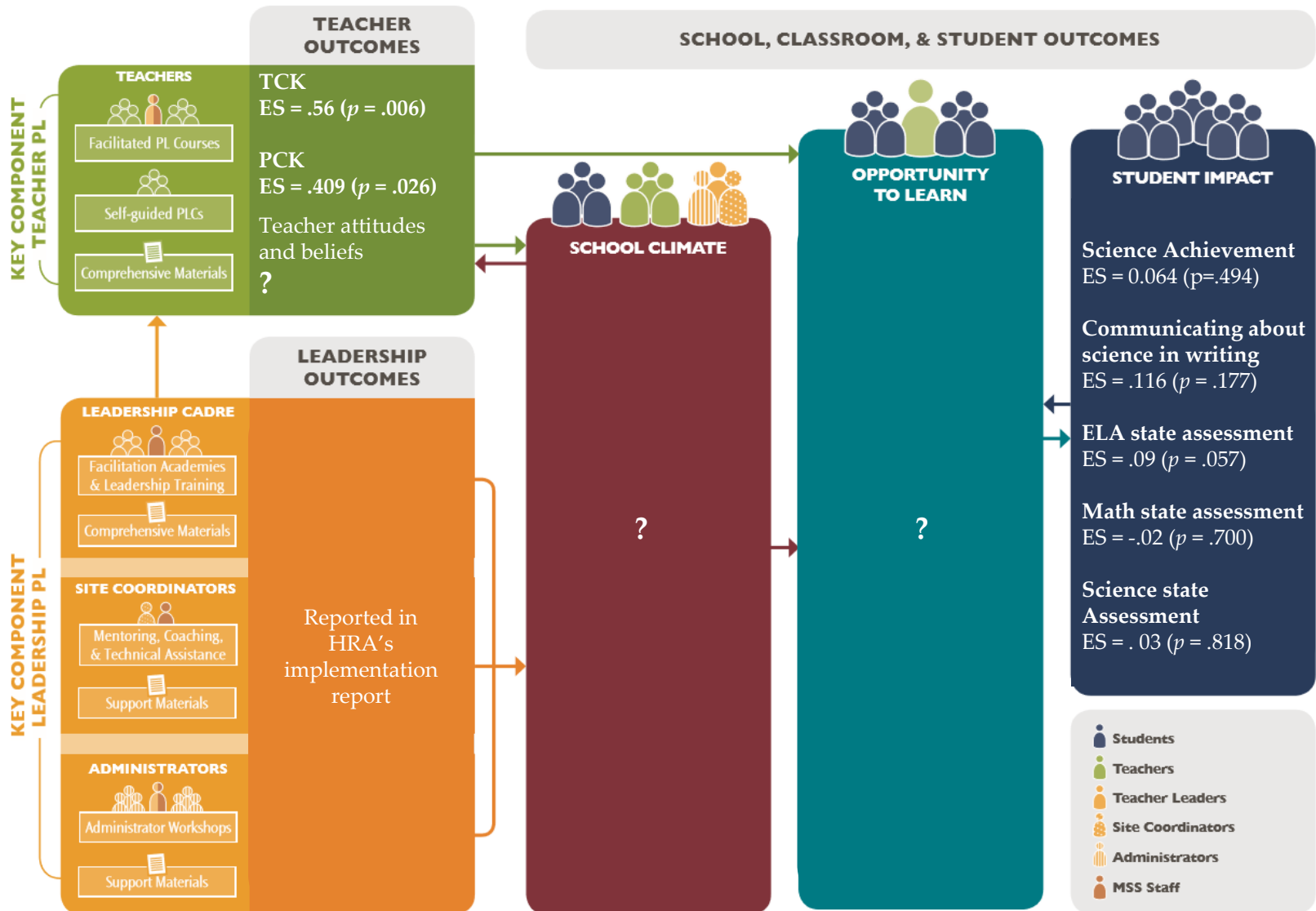
Unpacking the Logic Model

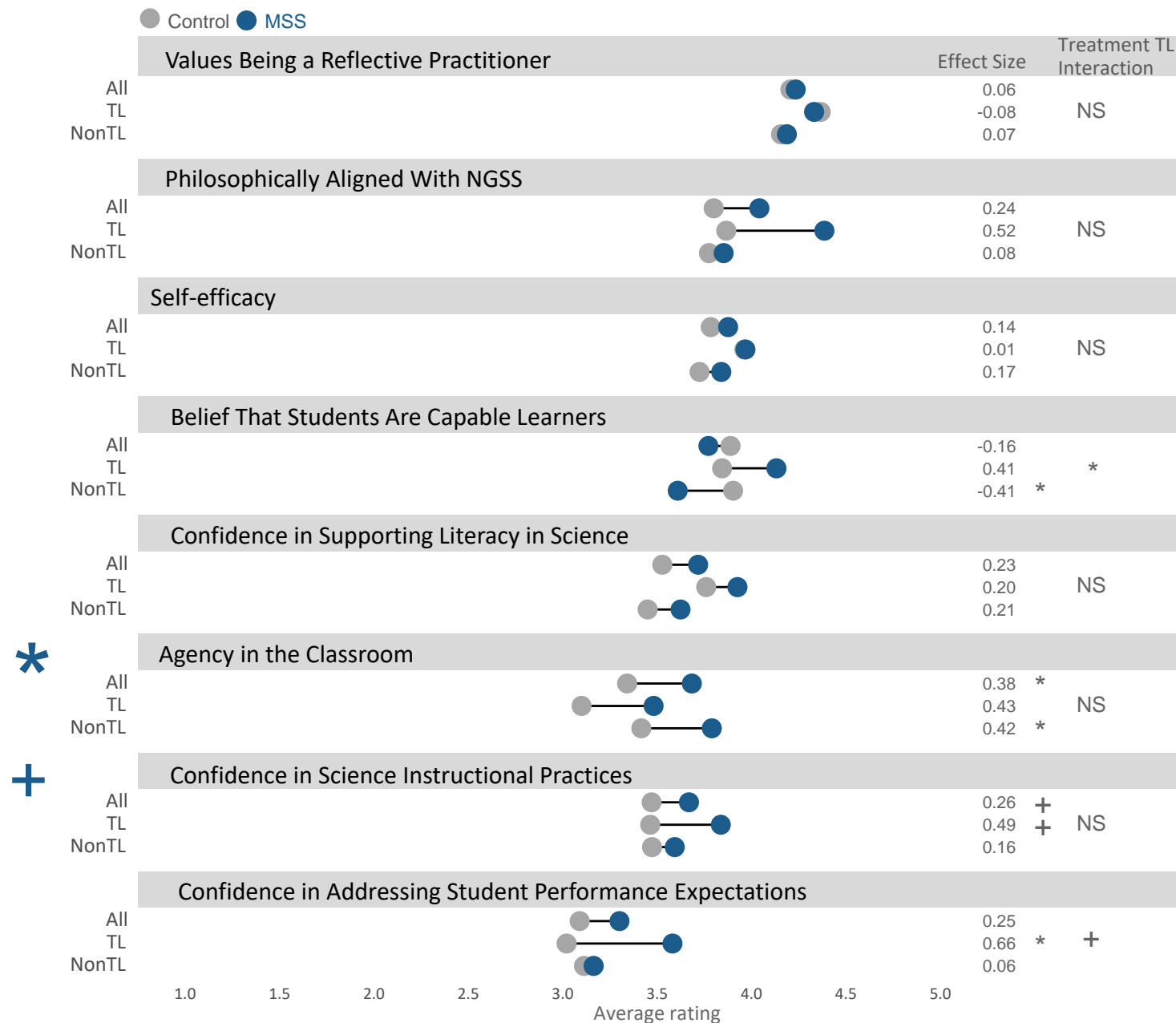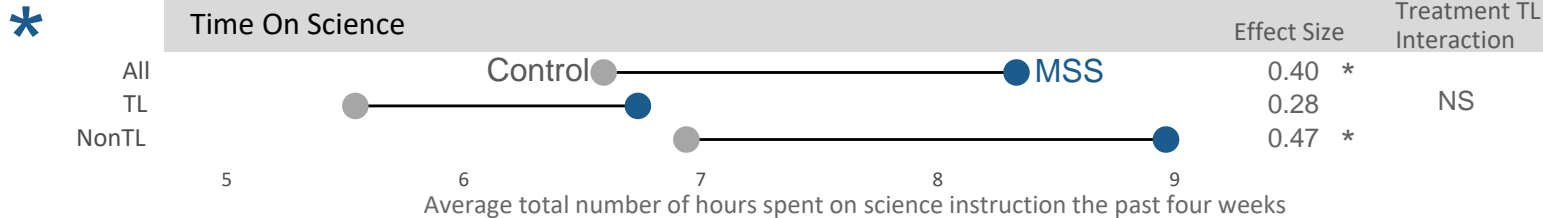# Unpacking the Logic Model

Unpacking the Logic Model

Impact on Teacher Attitudes and Beliefs

Impact on Opportunity to Learn – Time & Instruction

Time on science instruction

Time On Science			Effect Size		Treatment TL Interaction
All	Control ● ——————— ● MSS		0.40	*	
TL	●————●		0.28		NS
NonTL	●——————●		0.47	*	

5   6   7   8   9

Average total number of hours spent on science instruction the past four weeks

Instruction

Explaining Ideas and Phenomena			Effect Size		Treatment TL Interaction
All	Control ● —— ● MSS		0.32	+	
TL	●—●		-0.06		NS
NonTL	●———●		0.44	*	

Sensemaking of Hands-on Investigations					
All	●———●		0.40	*	
TL	●—●		0.13		NS
NonTL	●———●		0.48	*	

Participating in Collaborative Discourse					
All	●———●		0.46	**	
TL	●——●		0.29		NS
NonTL	●————●		0.51	**	

Integration of Science Literacy					
All	●————●		0.49	**	
TL	●——●		0.23		NS
NonTL	●—————●		0.57	**	

1.0   1.5   2.0   2.5   3.0   3.5   4.0   4.5   5.0

Average rating

*

+

*

**

**

Impact on Opportunity to Learn – Content (ESS and PS)
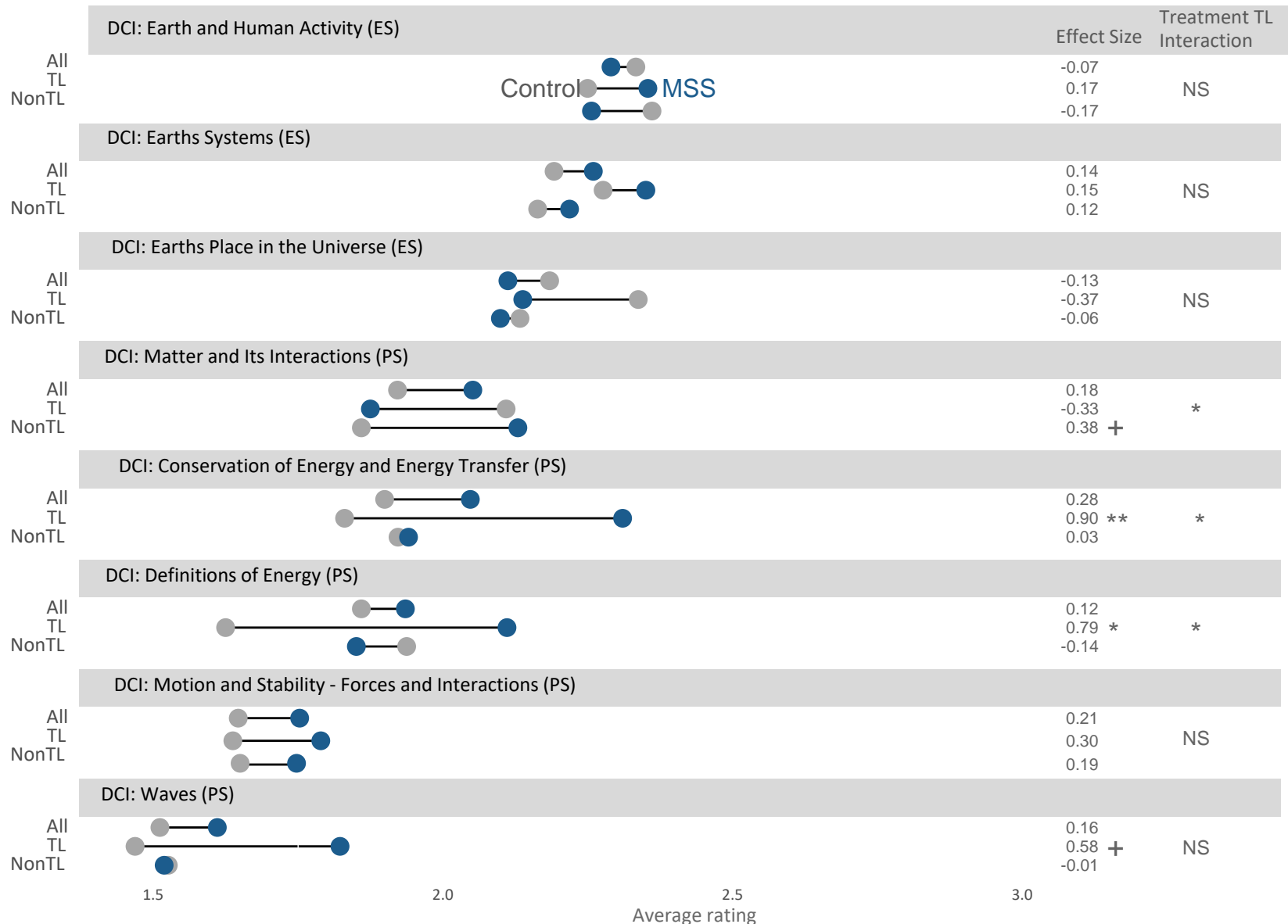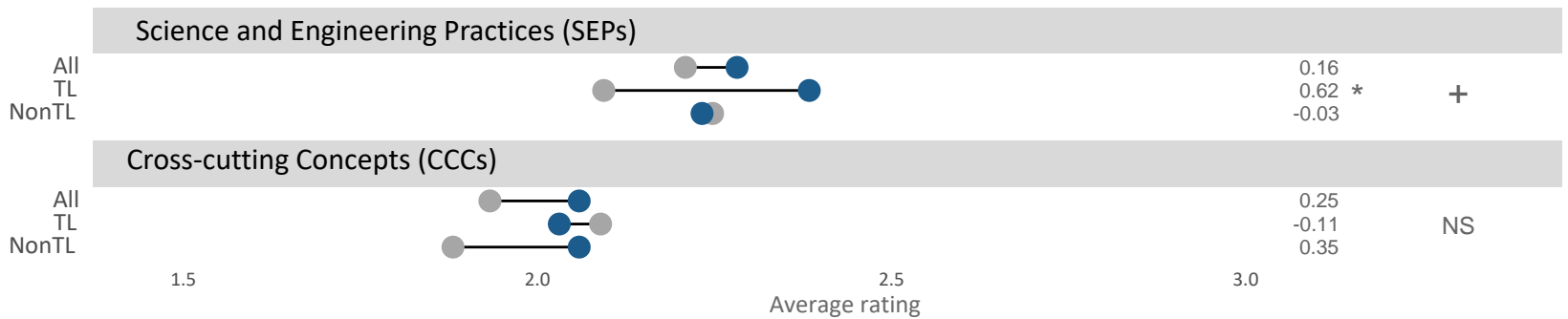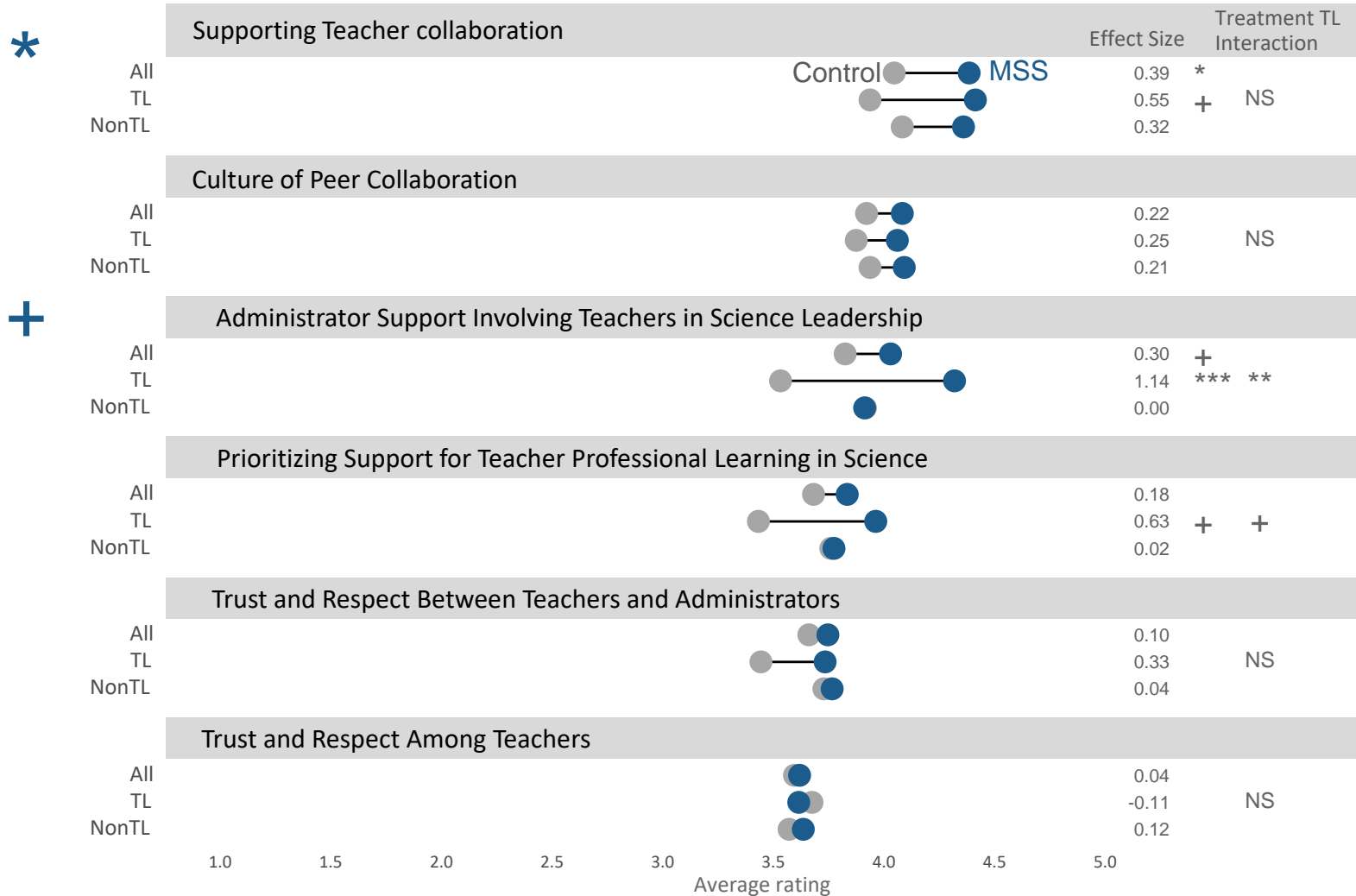
Impact on Opportunity to Learn – Content: SEPs and CCCs

Science and Engineering Practices (SEPs)

All	0.16	
TL	0.62	*
NonTL	-0.03	+

Cross-cutting Concepts (CCCs)

All	0.25	
TL	-0.11	NS
NonTL	0.35	

Average rating

Impact on intermediate outcomes: Findings for School Climate

	Effect Size	Treatment TL Interaction	
Supporting Teacher collaboration			
All	0.39	*	
TL	0.55	+	NS
NonTL	0.32		
Culture of Peer Collaboration			
All	0.22		
TL	0.25		NS
NonTL	0.21		
Administrator Support Involving Teachers in Science Leadership			
All	0.30	+	
TL	1.14	***	**
NonTL	0.00		
Prioritizing Support for Teacher Professional Learning in Science			
All	0.18		
TL	0.63	+	+
NonTL	0.02		
Trust and Respect Between Teachers and Administrators			
All	0.10		
TL	0.33		NS
NonTL	0.04		
Trust and Respect Among Teachers			
All	0.04		
TL	-0.11		NS
NonTL	0.12		

Control   MSS

Average rating

1.0   1.5   2.0   2.5   3.0   3.5   4.0   4.5   5.0

*

+

Impact on Intermediate Outcomes: Findings on Amount of Teacher Collaboration

Positive Results

Proximal outcomes

Direct effects of summer PD and PLCs

Teacher outcomes

- Teacher content knowledge
- Pedagogical content knowledge based on holistic ratings
- Greater sense of *Agency In the Classroom*
- Greater *Confidence In Science Instructional Practices* (marginally significant)

Opportunity to learn

- More time on science instruction
- Greater emphasis on NGSS-aligned instructional practices

School climate

- More collaboration beyond MSS PLCs
- Greater support of administrators for teacher collaboration
- More involvement by administrators of teachers in science leadership (marginally significant)

Null Results

Distal outcomes

Teacher's attitudes and beliefs

- Self-efficacy
- Values being a reflective practitioner
- Belief that students are capable learners

School culture

- Trust and respect among teachers
- Trust and respect between teachers and administrators
- Prioritizing support for teacher PL in science

Student science achievement and communicating about science in writing

So what happened? Hypothesis # 1

The assessment was difficult, and there was low test information (low score reliability) for students with low incoming achievement.

Decile	N	Mean	Std Dev	Minimum	Maximum
1	214	0.30	0.12	0.00	0.80
2	214	0.32	0.11	0.04	0.64
3	214	0.32	0.12	0.04	0.72
4	214	0.35	0.12	0.04	0.76
5	214	0.40	0.13	0.08	0.80
6	214	0.41	0.13	0.16	0.84
7	214	0.44	0.14	0.13	0.84
8	214	0.46	0.13	0.16	0.84
9	214	0.51	0.15	0.17	0.88
10	214	0.57	0.14	0.24	0.88


Total information curve
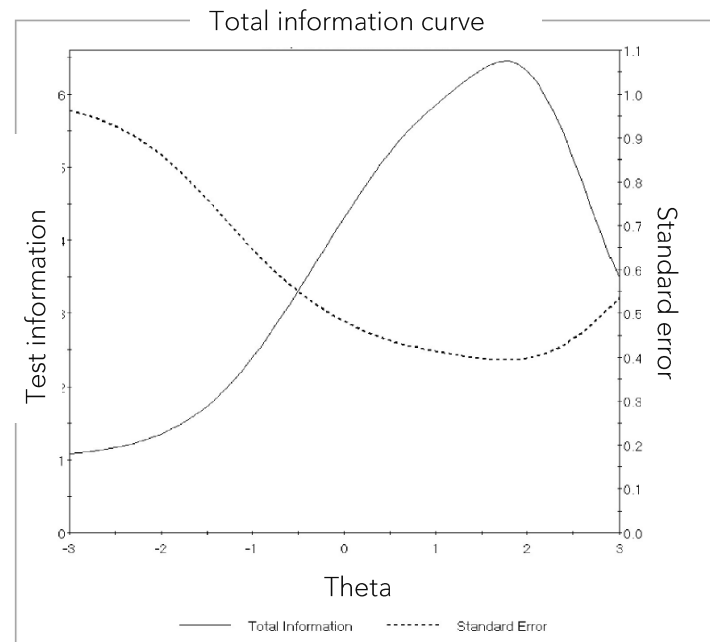
So what happened? Hypothesis # 2

Coherent curriculum and corresponding curriculum resources were not yet available in participating states/districts.
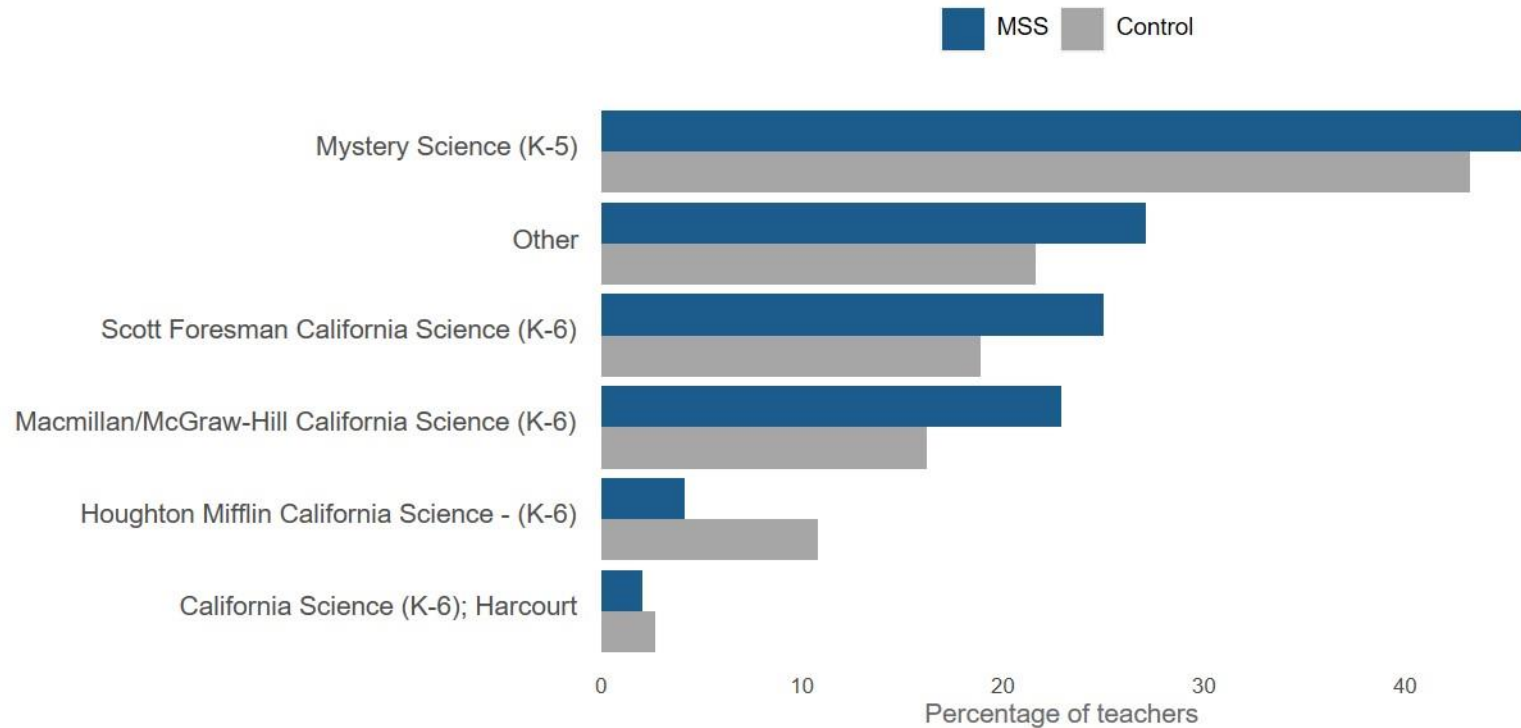
Curriculum resources used in CA (as reported by teachers)

So what happened? Hypothesis # 2

Making Sense of SCIENCE should be accompanied by a *coherent* curriculum and corresponding curricular resources
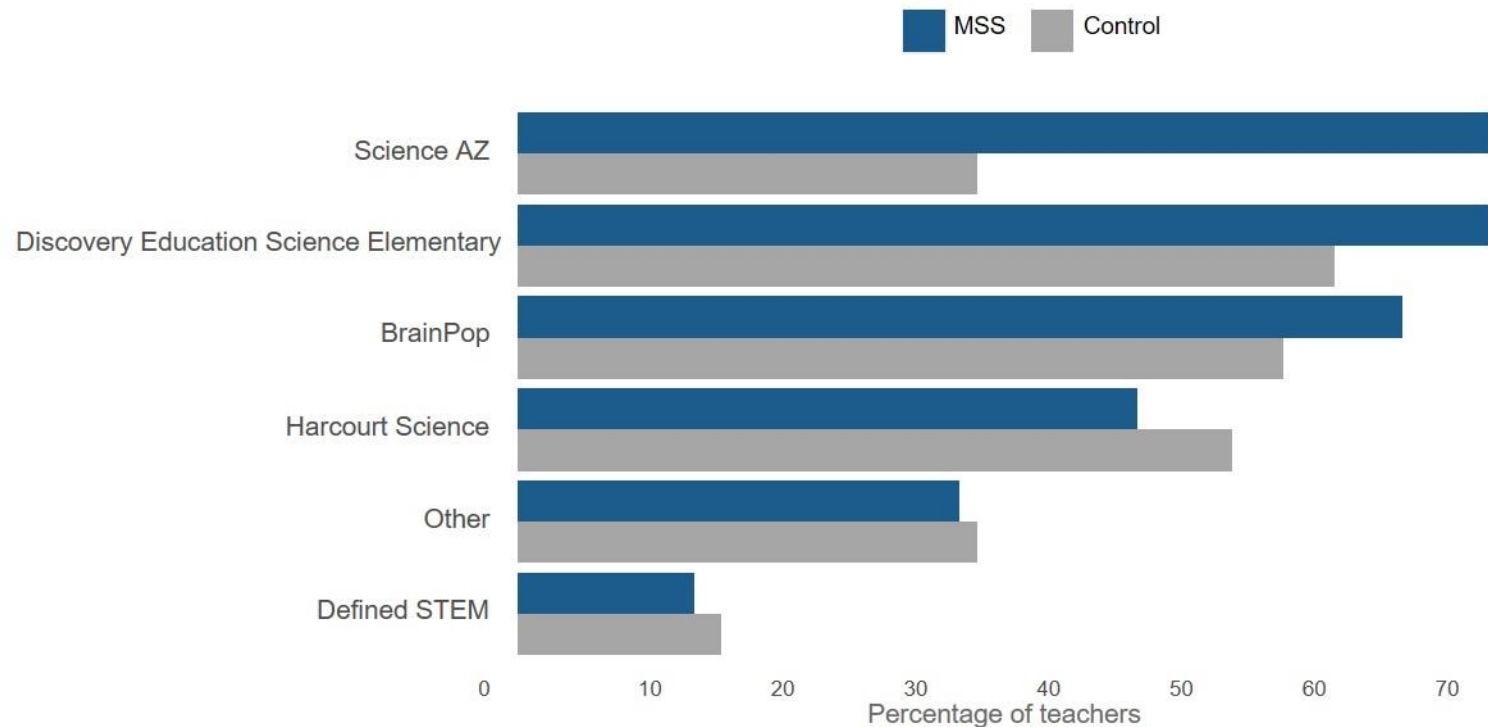
Curriculum resources used in WI (as reported by teachers)

So what happened? Hypothesis # 3

The instability of the sample over two years compromised fidelity of implementation

Percentage of teachers who met the fidelity threshold			
	2016-17	2017-18	Across the two years
Attendance at summer courses	94% (118 of 125)	88% (100 of 114)	54% (100 of 185) of all study teachers 61% (83 of 136) of baseline teachers
Attendance at PLCs	97% (121 of 125)	90% (103 of 114)	56% (103 of 185) of all study teachers 58% (79 of 136) of baseline teachers

Thank you

Reference this presentation:

Jaciw, A. P., Nguyen, T., & Zacamy, J. (2020). *Uncovering the Black Box: Exploratory Mediation Analysis for a Science Teacher Professional Development Program.* Presentation delivered in a virtual symposium on September 9, 2020 for the annual spring conference of the Society for Research on Educational Effectiveness, Washington, DC. Retrieved from https://www.empiricaleducation.com/mss/

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