



National Center for **Research** on
Rural Education (R²Ed)

CSI: Coaching Science Inquiry in Rural Schools
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CSI: Coaching Science Inquiry in Rural Schools

- CSI is a **research** study conducted by the National Center for Research on Rural Education (R²Ed) at the University of Nebraska-Lincoln
 - Funded by the U.S. Department of Education
 - Randomized controlled trial
 - Involves 119 middle/high school rural teachers over two years

CSI: Coaching Science Inquiry in Rural Schools

- **CSI Professional Development targets**
 - Nebraska State Standards for science inquiry
 - Science inquiry instructional strategies
 - Supports for classroom implementation
 - Student engagement in science inquiry

CSI Inquiry Approach

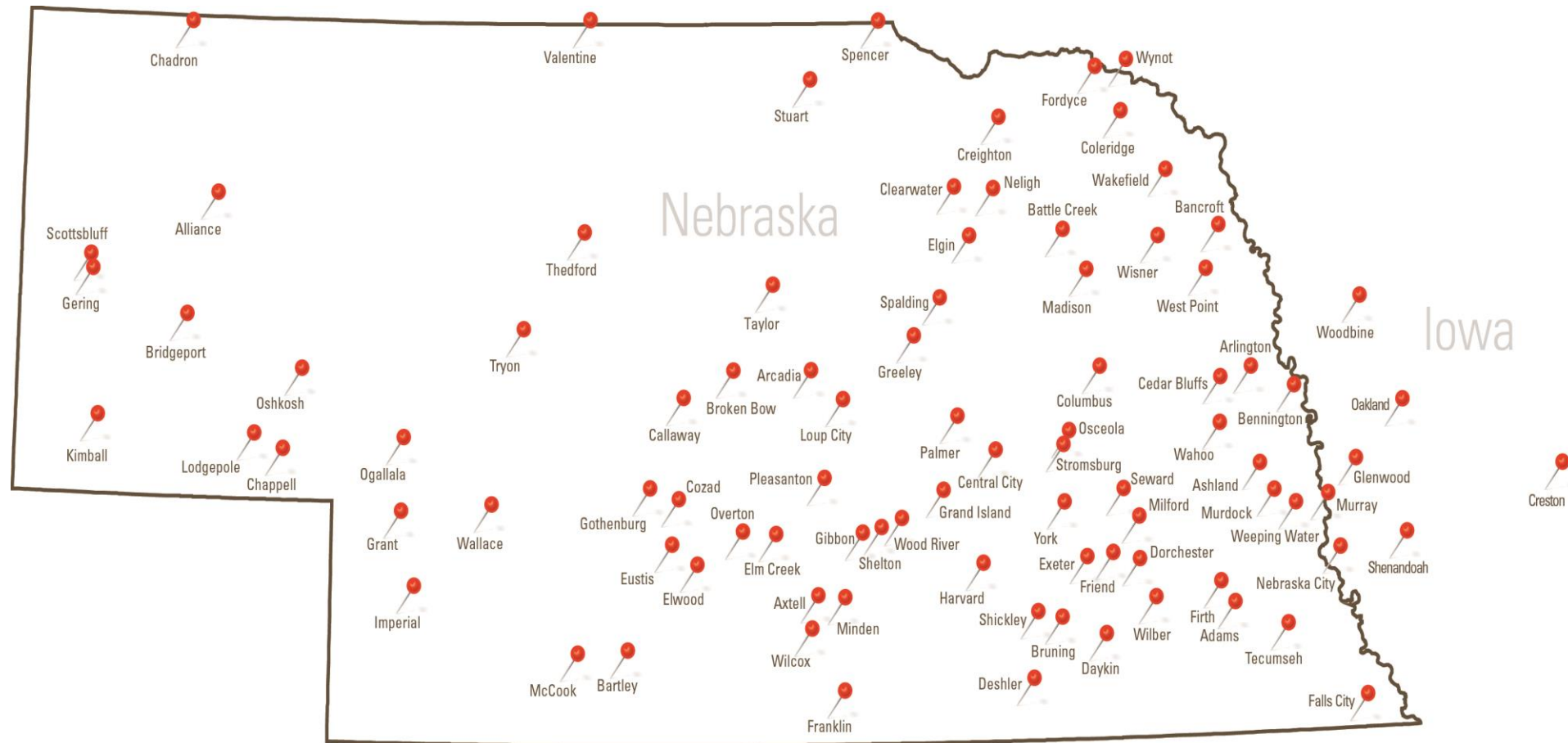
- Discovery approaches with minimal guidance are not effective (Kirschner, Sweller, & Clark, 2006; Klahr & Li, 2005; Vanosdall, et al., 2007)
- Guided inquiry instruction with scaffolding

NOT

Verification of teacher-presented content through demonstration

CSI: COACHING SCIENCE INQUIRY IN RURAL SCHOOLS

PARTICIPATING TEACHER SITES



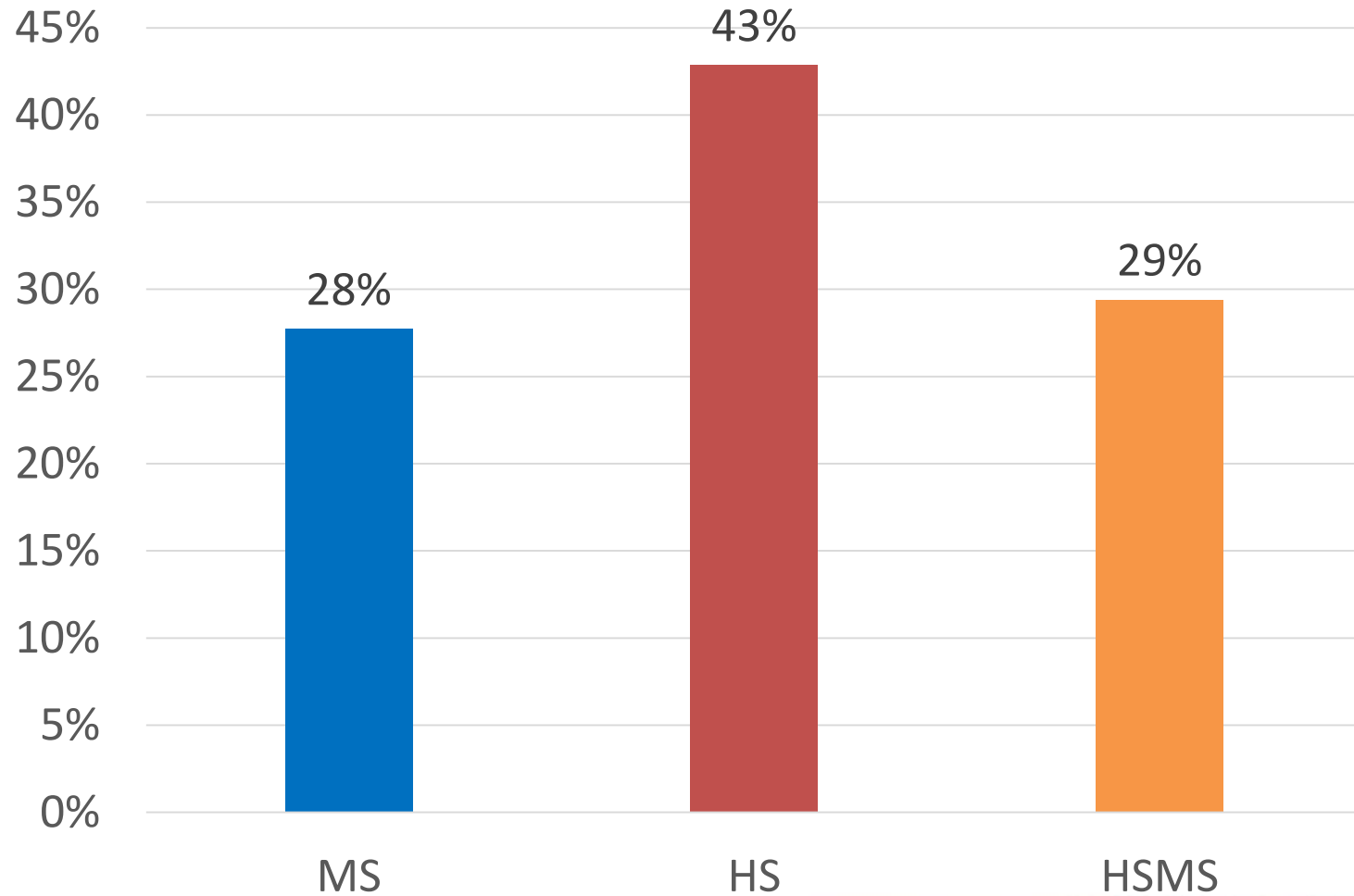
Teacher Demographics

- 119 Teachers from 109 schools
 - 70% Female / 30% Male
- Average of 14 years of teaching experience
- 50% have master's degree

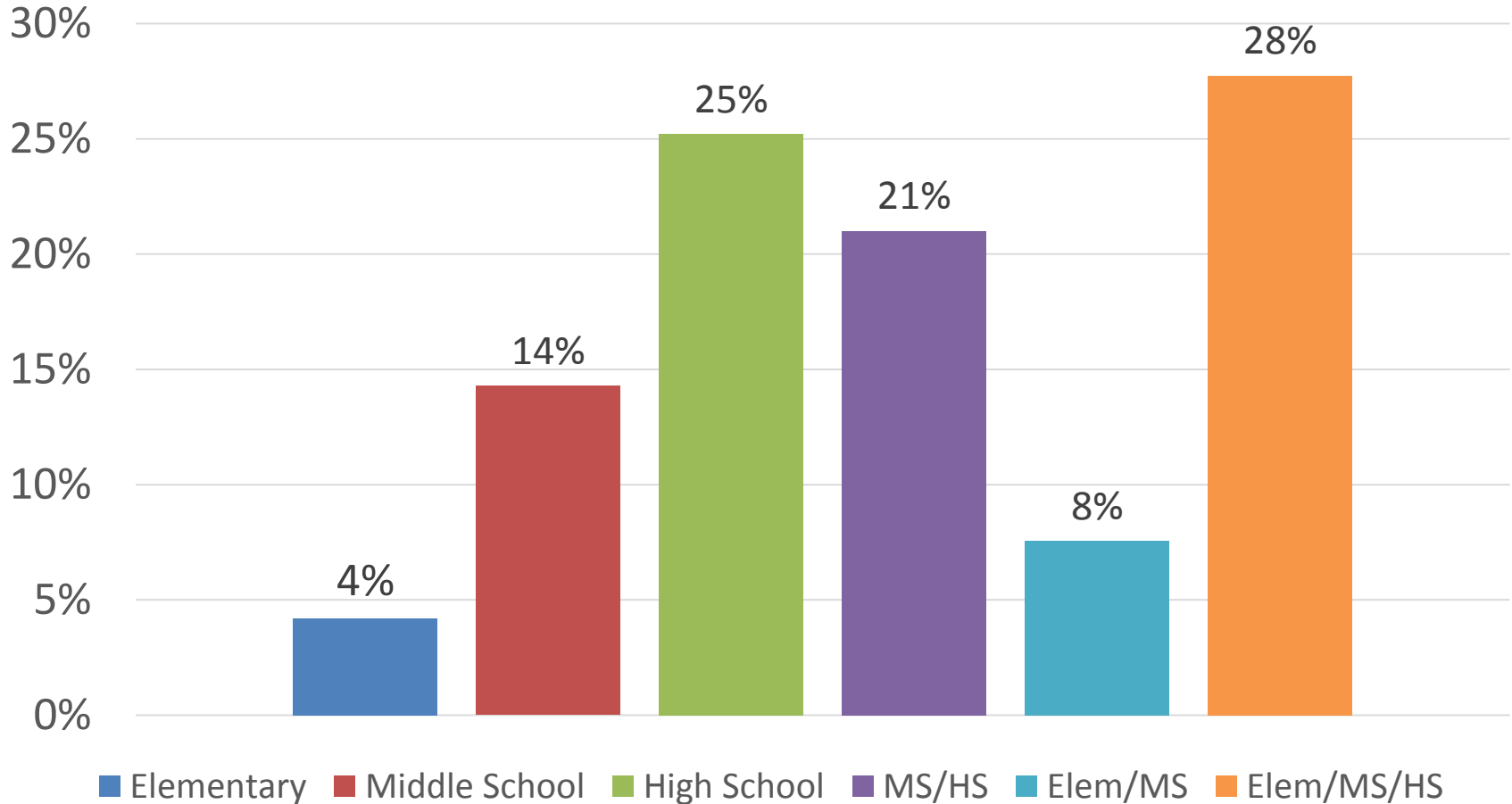
Teacher Demographics

- Courses taught
 - Biology 75%
 - Physical Science 71%
 - Earth Science 56%
 - Chemistry 48%
 - Physics 47%
 - Natural Science 32%

Grades Taught



Grades Served in Teachers' Schools



CSI Students

- Approximately **3,900** Students from Nebraska and Iowa schools
- ~1,950 High School Students (9-12)
- ~1,950 Middle School Students (6-8)

CSI Research Study Research Question

*What is the impact of professional development on guided scientific inquiry with follow-up coaching (treatment) versus no professional development (control) on (a) **teacher** inquiry knowledge, skills, self-efficacy, and beliefs and (b) **student** inquiry knowledge, skills, engagement and science attitudes?*

Summer Institute

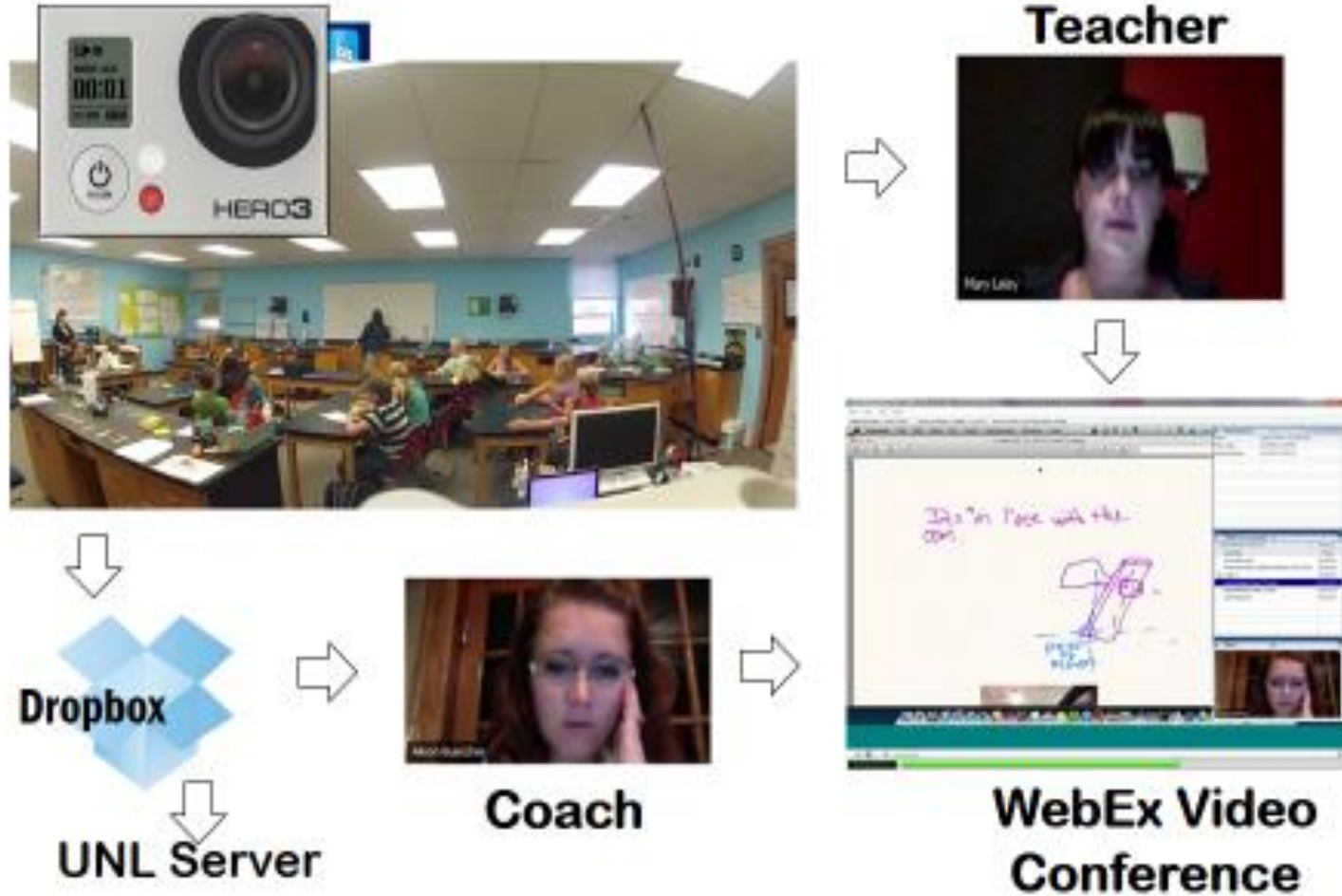
- 8-day workshop in Lincoln using evidence-based strategies
 - Modeling by faculty, expert teachers, and coaches with commentary
 - Teacher practice of new skills
 - Feedback from coaches, peers, and faculty
- Use of video examples of pedagogical strategies (concept identification, questioning, scaffolding)
- Teachers provided with 6 – 8 week inquiry units
- Provided a foundation for a common language and shared understanding of what inquiry is and how to implement it

Over 60,000 miles traveled by teachers for
Summer Institute

Technology-delivered Coaching

- Coaches are experienced science teachers
 - Nearly 100 years of classroom experience at both middle and high school level
- Coach training was one week with video examples and modeling
 - Establishing effective teacher-coach relationships
 - Co-creating behavioral targets for teacher instruction
 - Skills for teacher observation
 - Providing feedback
 - Technology training

Coaching Process



Study Outcomes

- Based on student scientific inquiry abilities/practices specified in standards
 - Questioning
 - Designing and conducting a scientific investigation
 - Data collection, analysis and interpretation
 - Developing explanations
 - Communicating results
- Focus on teacher behaviors needed to elicit student skills

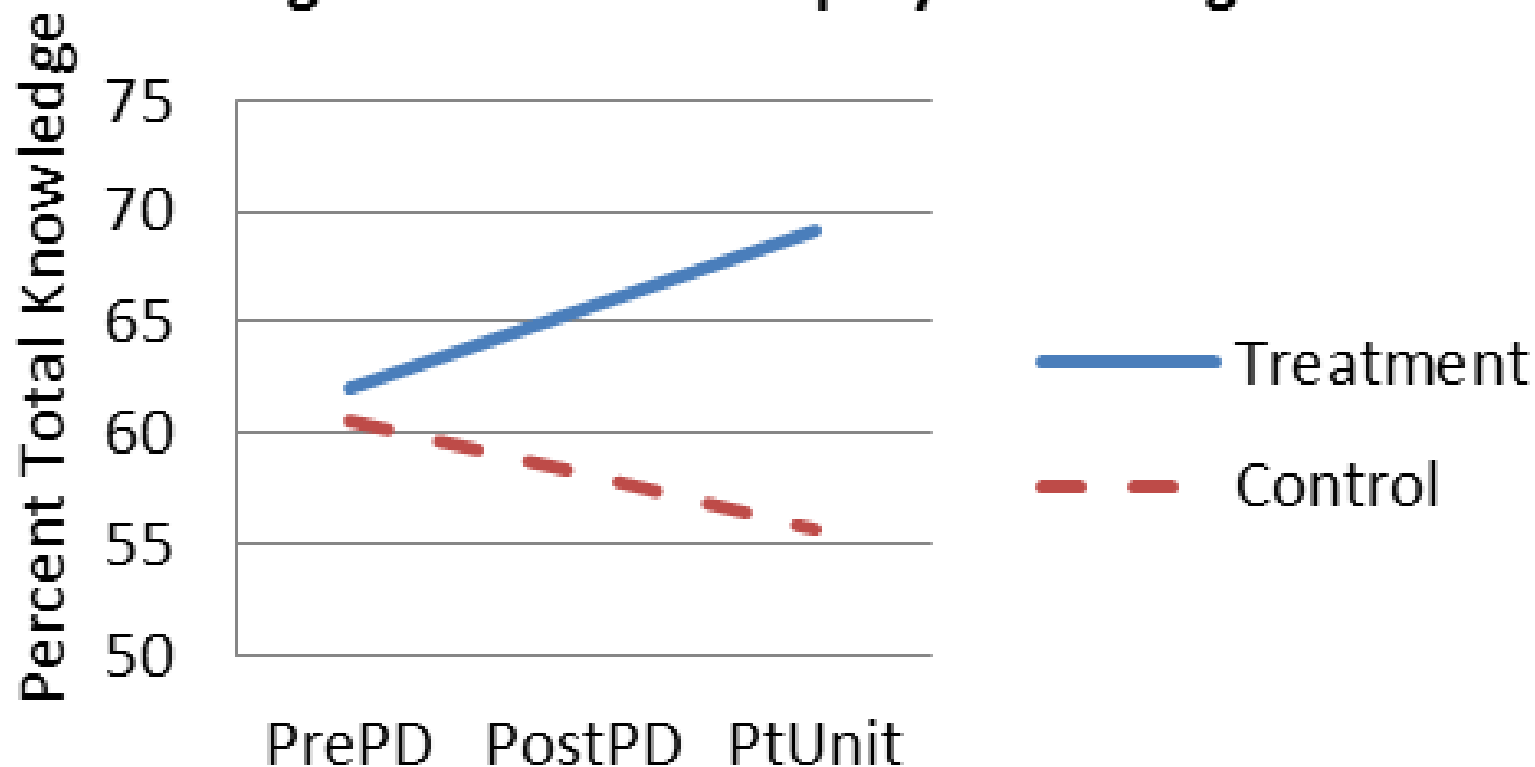
Preliminary Teacher Results Year 1

47 treatment teachers

43 control teachers

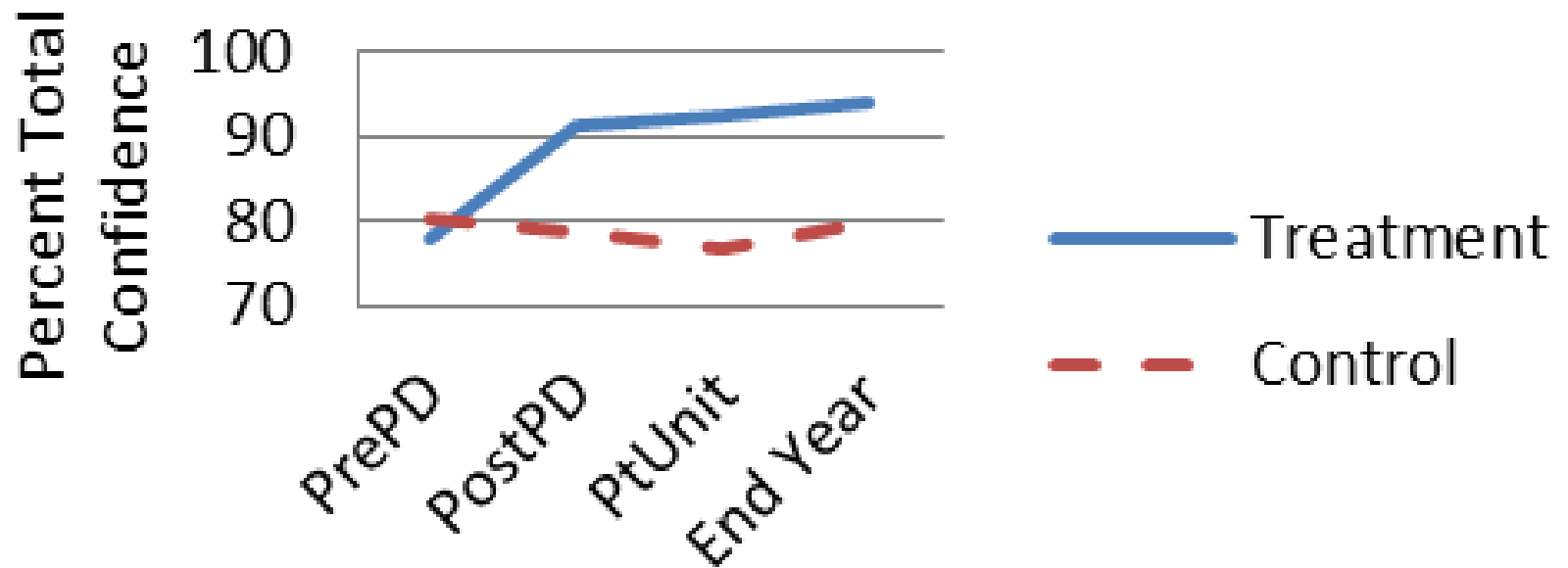
Teacher Inquiry Knowledge

Figure 1. Teacher Inquiry Knowledge



Teacher Self-Efficacy

Figure 4. Teacher Self-Efficacy in Teaching Scientific Inquiry



Teacher Instructional Practice

- Three observational instruments
 - Teacher Inquiry Rubric (project-developed)
 - EQUIP (Electronic Quality of Inquiry Protocol, Marshall, 2009)
 - Partial Interval Classroom Inquiry Observation System (PICI; project-developed)

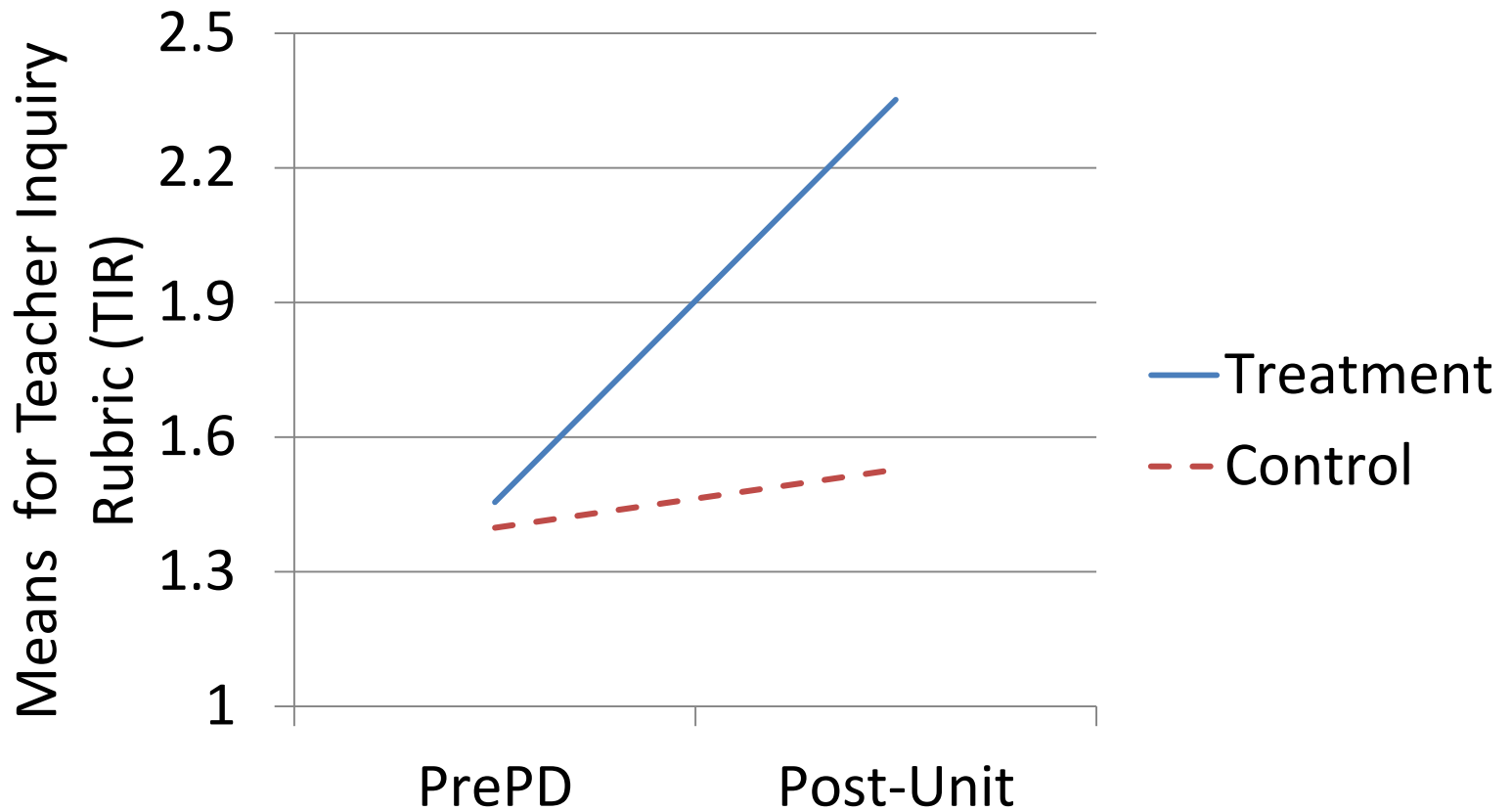
Teacher Inquiry Rubric

- Six constructs based on student scientific inquiry abilities specified in standards (questioning, investigation, collect data, explanation, communication & application)
- Focuses on teacher behaviors needed to elicit student skills
- 31 individual indicators across constructs

TIR Proficiency Levels

1. Beginning – No evidence of instruction for particular skill
2. Progressing – Direct presentation by teacher using lecture or demonstration
3. Proficient – Teacher use of guiding questions, experiences, scaffolding and/or feedback
This is guided inquiry!
4. Exemplary - Use of guiding questions, scaffolds, and/or feedback to guide students to *perform* the skill

Teacher Inquiry Rubric Results



EQUIP

Electronic Quality of Inquiry Protocol

- 19 indicators with overall construct scores targeting areas of reform or inquiry-based instruction that are linked to student achievement.

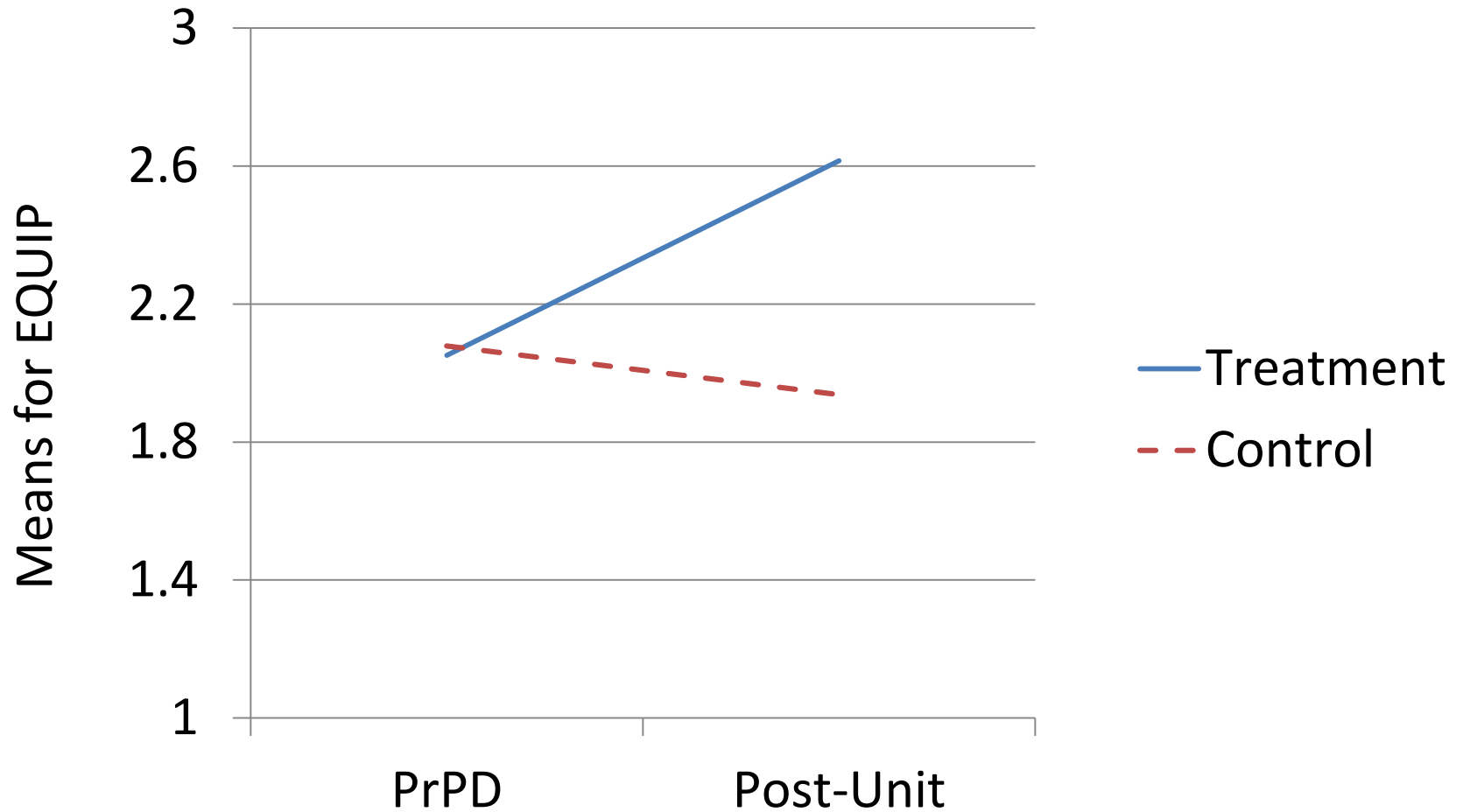
Instruction (How do I lead?)

Discourse (How do we interact?)

Assessment (How does instruction influence achievement?)

Curriculum (What guides teaching and learning?)

EQUIP Results



Partial Interval Classroom Inquiry (PICI) Observation System for Teachers (PICI-T) and Students (PICI-S)

- Conduct and score direct classroom observations of inquiry teaching & student inquiry engagement
- Interval recording procedure: 15 sec intervals
- Records predominant behavioral occurrence during each interval
- Estimates rate and duration of behaviors
- Behaviors of duration (e.g., on-task, off-task, instructional practice) have a specified length of continuous presence in order to determine occurrence (e.g., 10s for on-task)

PICI-Teacher

- Instruction type (Inquiry; Non-Inquiry; No Instruction)
- Five categories: organization, student activity, discussion, teacher lecture, and worksheet
- Behaviors coded by combination of *category* and *instruction type* = 15 possible teacher behaviors in each interval
- One of the 15 behaviors is coded to best represent the interval

PICI-Student

- Student Response type: On-Task, Off-Task, Inquiry Engaged
- Five categories (dependent on teacher category): organization, student activity, discussion, teacher lecture, and worksheet
- Class measure based on individual responses for each student in class.
- One student for 1 minute = 4 intervals, then switch to another student until all students included and then start over

Screen shot of PICI-T/S

Time: 0:00-0:15

Notes

	Teacher			Student			
Org:	Inq	N-Inq	N-Instr	On	Off	IE	NI
Act:	Inq	N-Inq	N-Instr	On	Off	IE	
Ds:	Inq	N-Inq	N-Instr	On	Off	IE	NI
Lc:	S	P	UN	On	Off		
Ws:	Inq	N-Inq	N-Instr	On	Off	IE	

Time: 0:15-0:30

Notes

	Teacher			Student			
Org:	Inq	N-Inq	N-Instr	On	Off	IE	NI
Act:	Inq	N-Inq	N-Instr	On	Off	IE	
Ds:	Inq	N-Inq	N-Instr	On	Off	IE	NI
Lc:	S	P	UN	On	Off		
Ws:	Inq	N-Inq	N-Instr	On	Off	IE	

Time: 1:00-1:15

Notes

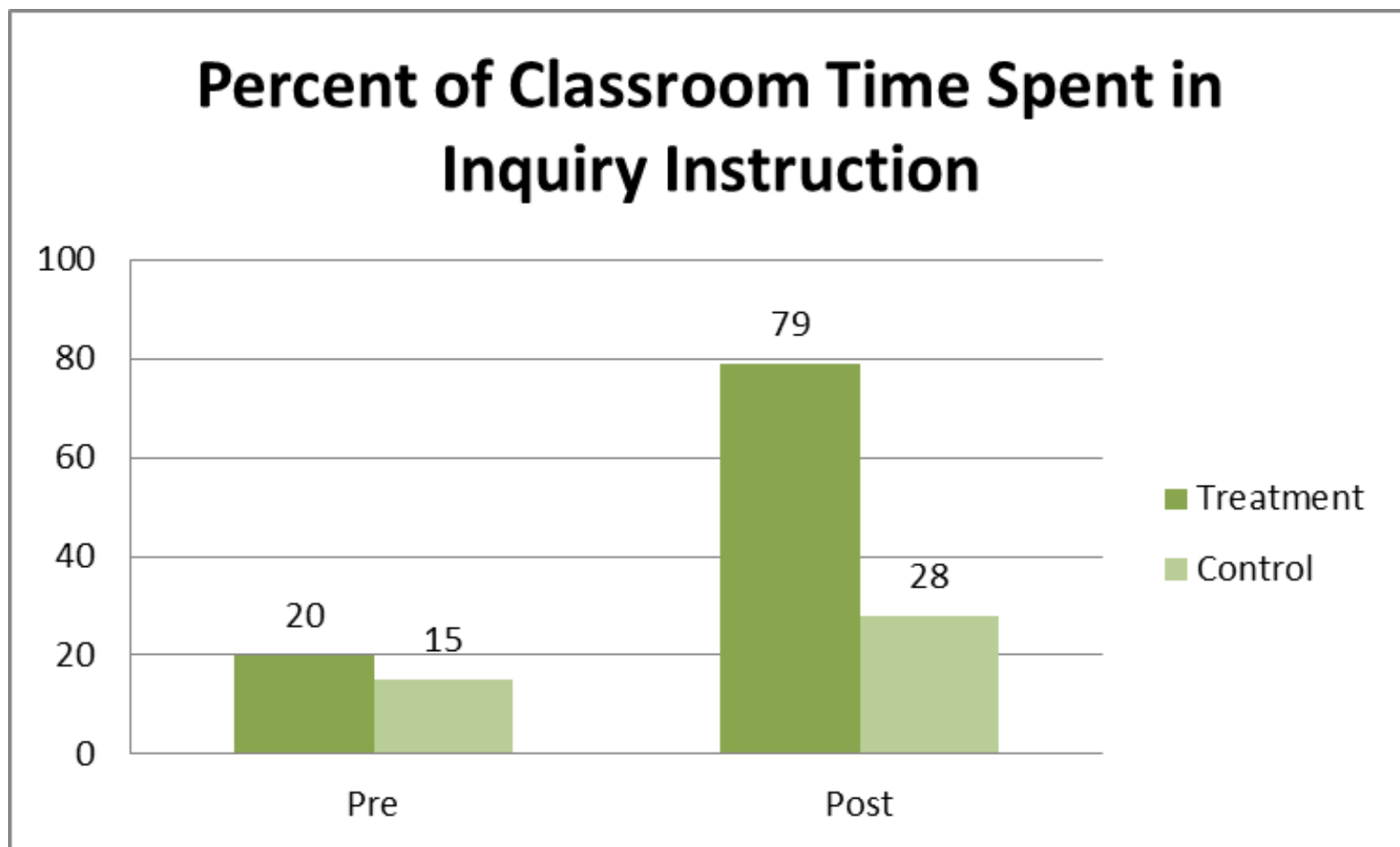
	Teacher			Student			
Org:	Inq	N-Inq	N-Instr	On	Off	IE	NI
Act:	Inq	N-Inq	N-Instr	On	Off	IE	
Ds:	Inq	N-Inq	N-Instr	On	Off	IE	NI
Lc:	S	P	UN	On	Off		
Ws:	Inq	N-Inq	N-Instr	On	Off	IE	

Time: 1:15-1:30

Notes

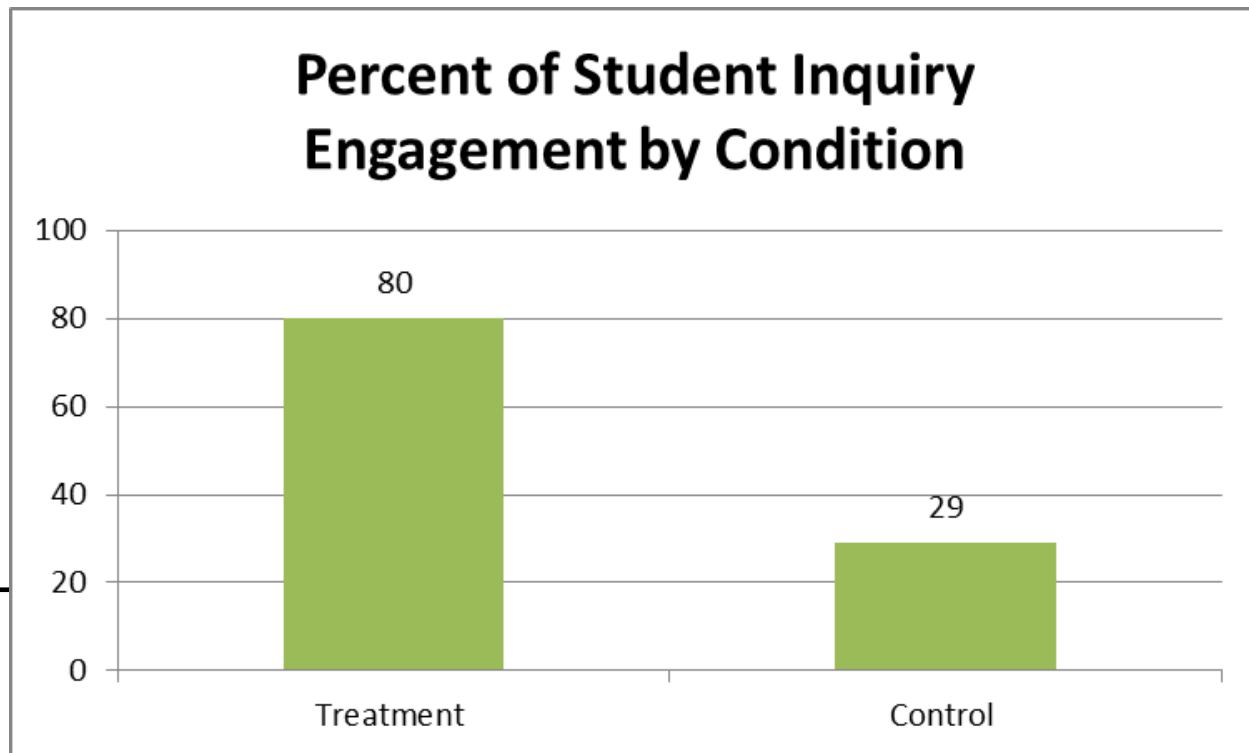
	Teacher			Student			
Org:	Inq	N-Inq	N-Instr	On	Off	IE	NI
Act:	Inq	N-Inq	N-Instr	On	Off	IE	
Ds:	Inq	N-Inq	N-Instr	On	Off	IE	NI
Lc:	S	P	UN	On	Off		
Ws:	Inq	N-Inq	N-Instr	On	Off	IE	

Preliminary PICI-T Results (30 teachers: 15 tx, 15 cnt)



Observations of Student Practice: Partial Interval Classroom Observation-Student (PICI-S)

- 15 treatment classrooms and 15 control classrooms
- Showed the percent of student inquiry engagement
- Treatment (post-only) = 80%
- Control (post-only) = 29%



Inter-rater Reliability

- 25% of videos coded for reliability
- Preliminary results:
 - EQUIP Kappa = .6
 - TIR Kappa = .95
 - PICI-T = Kappa = .91, 92% agreement
 - PICI-S = Kappa = .85, 87% agreement

Preliminary Student Results Year 1

Student Inquiry Knowledge, Self-Efficacy, and Science Attitudes

- No significant effects, although middle school results favored the treatment group.

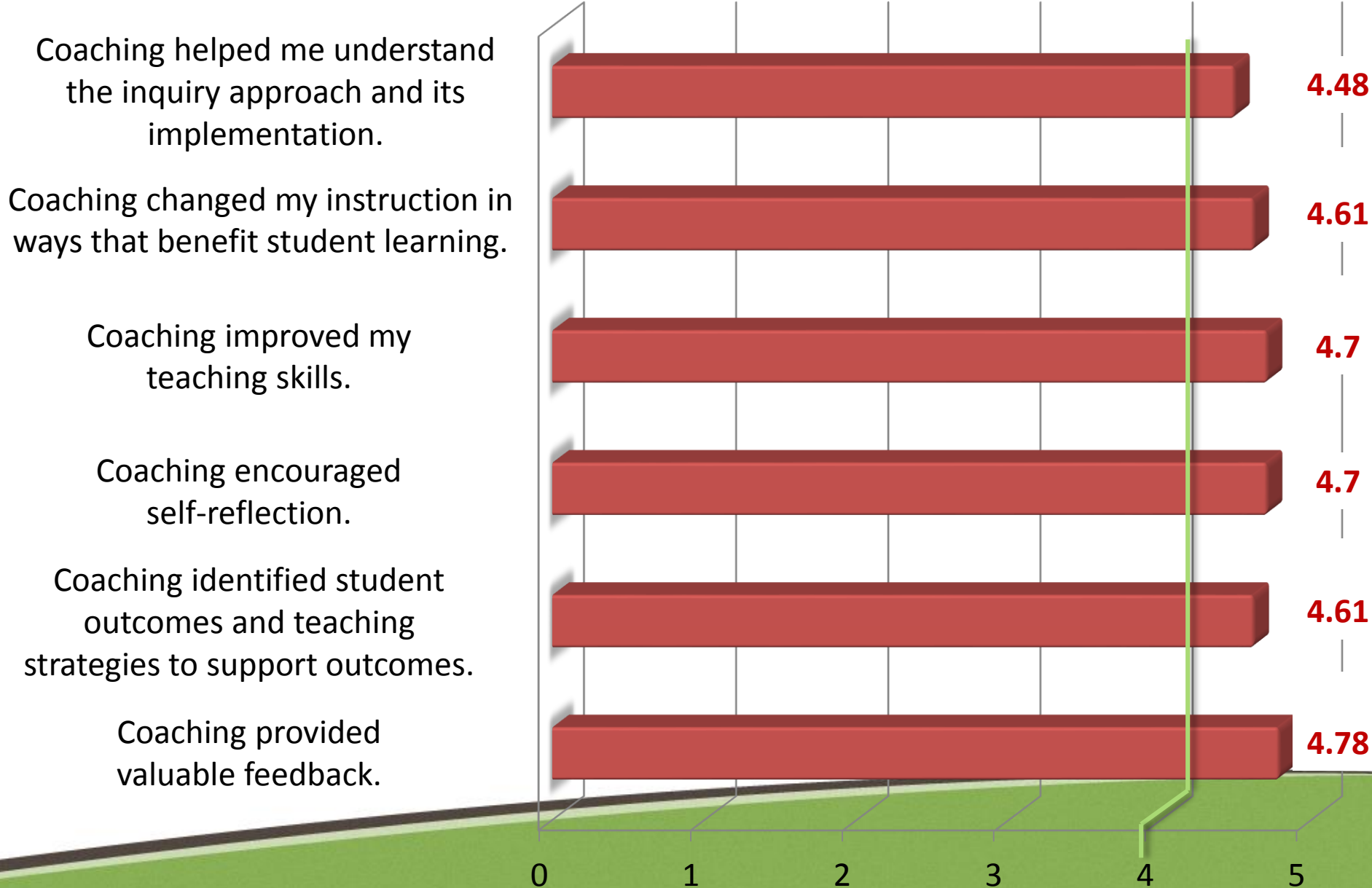
Student Inquiry Skills

- Instrument: Student Inquiry Rubric (SIR)
 - Four-level rubric investigating student's inquiry practices (questioning, collecting data, investigating, developing explanation from evidence, communicating results)
 - Adapted from instrument developed by ESU 3
 - Completed by teacher
- Results
 - Significantly higher performance for the middle school treatment group compared to control group on **all** inquiry skills
 - No significant difference for high school



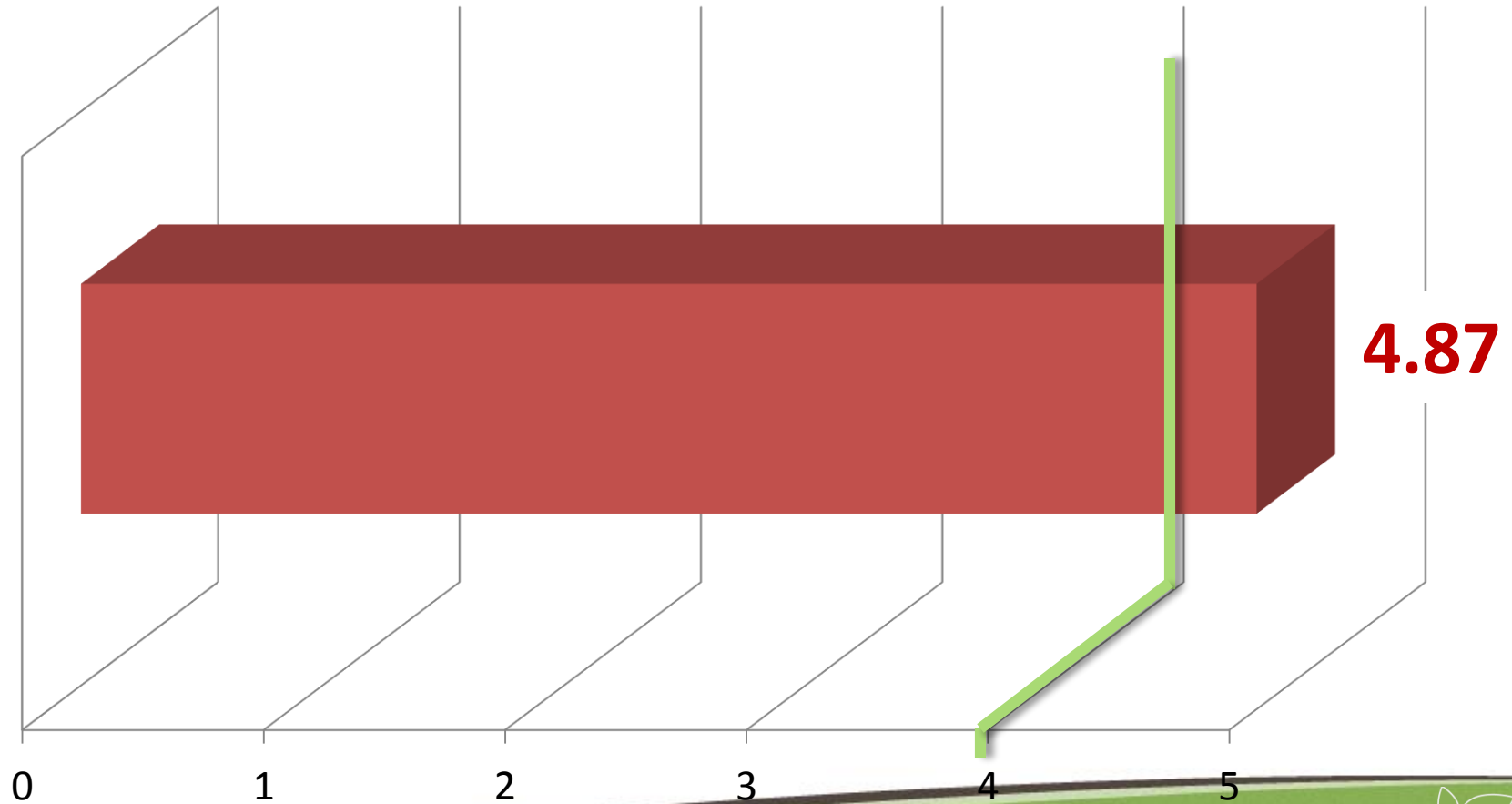
- Significantly higher scores for middle school students in treatment group (n= 288)
- No significant difference for high school (n= 49)

CSI: Rural Schools: Initial Coaching Results



CSI: Rural Schools: Initial Coaching Results

Overall, how would you rate the coaching you received as part of the CSI project?



Lessons Learned

- Value of technology and video-based data collection
- Coding videos of classroom instruction and student behaviors is challenging and time consuming
- Power of watching videos for teacher self-reflection and to lead to change in instructional practice
- Power of the repeated practice for teachers to effect change
- Quality of science teachers in rural context – high performing teachers in low resource areas
- Coaching relationship established and maintained across distance and with a non-evaluative role
- Coaching has a powerful impact on teacher classroom instruction

View from the CSI Teachers

CSI Website

<http://r2ed.unl.edu/CSI/>

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