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
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 Served in Teachers’ Schools

<table>
<thead>
<tr>
<th>Grade</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Elementary</td>
<td>4%</td>
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<tr>
<td>Middle School</td>
<td>14%</td>
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<tr>
<td>High School</td>
<td>25%</td>
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<tr>
<td>MS/HS</td>
<td>21%</td>
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<tr>
<td>Elem/MS</td>
<td>8%</td>
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<tr>
<td>Elem/MS/HS</td>
<td>28%</td>
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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

- Percent Total Knowledge
- PrePD, PostPD, PtUnit
- Treatment
- Control
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

Means for Teacher Inquiry Rubric (TIR)

PrePD | Post-Unit
--- | ---
1.3 | 2.2
1.6 | 2.5
1.9 |
2.2 |
2.5 |

Treatment
Control
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

PrPD
Post-Unit

Means for EQUIP

- Treatment
- Control
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

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<th>Notes</th>
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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%

![Percent of Student Inquiry Engagement by Condition](chart.png)
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)
Coaching helped me understand the inquiry approach and its implementation.

Coaching changed my instruction in ways that benefit student learning.

Coaching improved my teaching skills.

Coaching encouraged self-reflection.

Coaching identified student outcomes and teaching strategies to support outcomes.

Coaching provided valuable feedback.
Overall, how would you rate the coaching you received as part of the CSI project?

4.87
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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