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# Case Study: Impact of Instructional Coaching on Science Teachers' Inquiry-Based Instruction in Rural Schools<sup>1</sup>

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## **Introduction**

One of the major implications of the Next Generation Science Standards is to pull together inquiry and practice, and recognize the role of engineering (National Research Council, 2013). Although the new standards will allow students and teachers to focus more on learning ideas related to science and engineering (NRC, 2013), it now demands science teachers to change their beliefs and teaching practice again. However, as many studies have reported, it is very difficult to achieve significant and sustainable shifts in teacher beliefs and teaching practice due to a number of issues including their unfamiliarity with how the change is practiced, inadequate preparation in science, or simply not understanding what the required change is (Asay & Orgill, 2010; Capps, Crawford, & Constas, 2012; Kazempour, 2009).

Embedded professional development supported by an instructional “coach” is a promising strategy for addressing the need for change in science education (Bransfield, Holt, & Nastasi, 2007; Habegger & Hodanbosi, 2011; Lotter, Yow, & Peters, 2013). Research has shown that teachers successfully implement new teaching strategies learned in the most common professional development format – a summer workshop – about 15% of the time. However, if the PD also includes instructional coaching, successful implementation reaches 85% (Cornett & Knight, 2009). Incorporating instructional coaching as a major part of teacher PD has been expanding rapidly in school districts and educational institutions across the United States in science education (Bransfield et al., 2007; Lotter et al., 2013). However, little research has been conducted to (1) identify the impact of PD when combined with instructional coaching, (2) describe how instructional coaching works, or (3) explain how an individual teacher changes his/her beliefs and practice in teaching science.

This paper draws on empirical data from a specific case as part of a larger study, Coaching Science Inquiry (CSI) in Rural Schools. One of the goals of this study was to determine the value added from coaching over what could be learned from a PD alone. With in-depth analysis of a single case, that of teacher Kara who participated in the CSI study, this paper will describe how the teacher implemented what she learned from PD without instructional coaching. Next, the differences in the teacher’s beliefs and practice during and after instructional coaching and how the instructional coaching made a difference will be presented. We applied the Vygotsky Space to analyze an empirical case that is described in detail with interviews as well as observational and archival data (Gallucci, DeVogt Van Lare, Yoon, & Boatright, 2010; Harré, 1984).

### **Theoretical Framework: The Vygotsky Space**

We adapted the Vygotsky Space as a theoretical framework (Figure 1) to describe teacher Kara’s changes in beliefs and practice teaching a science class as she learned inquiry-based instruction through summer teacher training and instructional coaching. The Vygotsky Space provided us with an explanatory structure that describes the relationship between sociocultural learning events and individual learning that took place during or across the events (Gallucci et al., 2010; Harré, 1984). In this study, the first quadrant (Q1), “Public-Social,” occurs when teachers learn with their peers and coaches with lectures that introduce new ideas of inquiry instruction followed by presentation, discussion, or sharing. In the second quadrant (Q2), “Private-Social,” teachers think about what they have learned, and negotiate it. The movement from Q1 to Q2 is called “Appropriation,” which means teachers accept or reject the strategies that they learn in the

public-social setting of the first quadrant. The third quadrant (Q3) is the “Private-Individual” quadrant, in which the teacher’s thinking is also unobservable as in the second quadrant. The movement from Q2 to Q3 is called “Transformation,” which means teachers internalize the strategies. In the fourth quadrant (Q4), the “Public-Individual” quadrant, the teachers reveal their thinking to the public by speaking or writing (publication) (Harré, 1984).

### **Research Questions**

As part of a larger study, the purposes of this proposed study are to: (a) develop an understanding of the value-added benefit of the coaching component to the study and (b) identify the longitudinal effects of repeated cycles of inquiry instruction on students and the teacher. The following research questions were addressed through the study:

1. What is the value-added benefit of coaching science inquiry over professional development?
2. What is the difference in teachers’ implementing science inquiry between after PD without coaching and after PD with coaching?
3. What is the role that coaching science inquiry plays to improve the implementation of guided inquiry instruction?

### **Design/Procedure**

#### **Background and Context**

The CSI study is a professional development research being conducted through the National Center for Research on Rural Education (R2Ed) at the University of Nebraska-Lincoln. As a part of the CSI study, this proposed study focused on a case of one teacher’s professional learning activities and the instructional coaching supports that appeared to change her instructional beliefs and practice. Kara was in the unique situation of teaching the same material to six different groups of students sequentially throughout the school year. She has taught 7<sup>th</sup> grade science at a middle school in a rural part of her state and was involved in a variety of teacher professional development programs. The CSI professional development program included 8-day summer training about science inquiry instruction and 12 to 16 instructional coaching sessions during the following school year by a CSI instructional coach.

#### **Data**

For this case study, we collected various data that include observational videos from four different timeframes, student inquiry knowledge and attitudinal surveys from the six different groups of students who were taught by Kara in six different sessions during the 2012 school year, four semi-structured interviews in which she articulated the meaning of these experiences, and an interview with her coach (Table 1).

#### **Data Analysis Procedures**

With the framework, Vygotsky Space, we began our analysis with a description of Kara’s teaching, which we observed in the taped video she provided to us before the summer training. Following the snapshot, we separated the data of Kara’s case study into four different phases of (1) during the summer institute, (2) after summer institute and before the instructional coaching, (3) during the coaching, and (4) after the coaching.

## **Preliminary Results**

### **Phase 0: A Baseline of Kara’s Science Instruction Video, Before the Summer Training**

In the classroom instruction video taken in the previous school year of the CSI study, Kara began the class by distributing a worksheet with the instruction of an experiment about various materials. The overall evaluation of her inquiry instruction by the Teacher Inquiry Rubric (TIR) was estimated at Level 2 – that is, “Developing Inquiry,” in which teachers provide direct, didactic inquiry (lecture or demonstration) instruction. It seemed to be typical hands-on activity, and she might have thought this class as an inquiry class as indicated in her interview a year later, when she said, “I used to think that inquiry is hand-on activities, but it really isn’t” (the fourth interview, after the coaching).

### **Phase I: Summer Institute**

Drawing on the Vygotsky Space model, we describe the summer institute as a Public-Social event provided as a learning opportunity (see Figure 1). During this institute, new information regarding science inquiry instruction was introduced and communicated in the form of lectures, modeling, activities, and etc. In this phase, learning was expected to occur as Appropriation, where Kara considered new ideas appropriated from the Public-Social to the more Social-Private domain of her learning – that is, accepting or rejecting them in terms of her current knowledge and beliefs. In her first interview, Kara’s appropriation was clearly related to her experience as a teacher, in that her consideration of these new ideas was made in reference to her classroom-based practice. She said of the summer institute in general, “I got the impression this summer the way we went through the PD provided was truly how inquiry works. I had an idea and now I know something completely different... it gave me an opportunity to see from my resources some of the glitches.”

### **Phase II: After the Summer Institute and the First and Second Teaching of the Unit before the Coaching**

Kara taught the unit to the first group of students two months after the summer institute. As shown in her interview, changes in beliefs and practice in teaching appeared to be occurring in her first and second classroom instructions when she taught the CSI inquiry unit. She remarked: “the topic of inquiry was one thing, but actually teaching using the method of inquiry, that’s two different things. What I now understand [is that] inquiry isn’t just a topic, it is a process and a method.” Up to this point, however, Kara’s statements about inquiry were not specified and not different from the ones after the summer training. In the model, learning in this phase was supposed to be transforming the shared sociocultural endeavors into the individual arena. The concept of Transformation is essential to demonstrating the interdependence of social and individual processes. However, the Transformation did not seem to occur until this point.

### **Phase III: Being Coached**

During the time that Kara taught the units to the third group of students, she was being coached by an instructional coach. As Kara implemented new practices, the coaching sessions allowed for dialogue about questions and concerns as they arose, and encouraged her to think about her own practice. The coach guided teacher Kara to see how she was teaching and what she was missing during the instruction that enhanced her metacognitive awareness that she appropriately adapted what she learned. Kara described that through the coaching interactions, connections between the conceptual understanding of inquiry and pedagogical action were made. The transformation as learning was apparent in the interview, like “Now that I’ve gone through the coaching, all that summer professional development really makes sense now and I kind of understand where it was going and how things were done.” Even an inquiry instruction was effectively internalized through the coaching and teaching together, as shown in this quote: “To me, inquiry is guiding the students to self-discovery guiding [the students] to discover or rethink to draw out of their knowledge about [photo synthesis] how it works and how we can test it.”

### **Phase IV: After Being Coached**

Since Kara was coached, she taught the same unit three more times during about five months. In the fourth and the last interview, she showed more confidence in teaching science inquiry. She stated,

I was at a meeting and we had some people from publishers and they talked about inquiry, you know, inquiry is this and that... Well, I think “no.” Because they said inquiry has to be hands-on activity. But inquiry, what I see, does not have to be hands-on because I also used to think ok, inquiry is hands-on activities, but it really isn’t. It doesn’t have to be hands-on and it has to be good questions so I see it as self-discovery.

From her statements above, we can assume Kara’s learning progressed beyond transformation, as she revealed her thinking to the public by speaking (Publication).

### **Contribution to the Teaching and Learning of Science**

Although we have not yet analyzed all of Kara’s classroom implementation, through the analysis of her interview, the preliminary results suggest how teachers’ changes initiated from a PD program can be effectively sustained. As shown in the results, the learning did not move beyond Appropriation effectively through the teaching practice by teacher Kara herself. We, however, found that the Transformation seemed to occur during the coaching that provided her with many reflective opportunities. For example, she said that coaching is valuable because the coach does the following:

- a) Points out things that Kara did not see on her own that need to be improved and what she needs to keep doing;
- b) Suggests what she needs to do for students’ learning;
- c) Provides her with an overview of the lesson unit and inquiry instruction; and
- d) Helps her to have better and explicit understanding of inquiry instruction.

### **Contributions to the Interests of NARST Members**

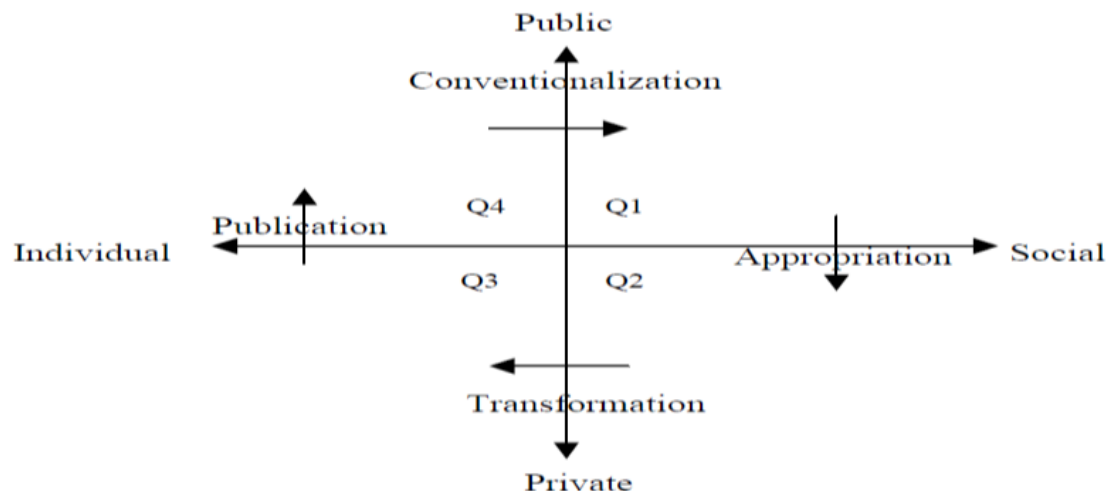
Although this study focused on the case of only one teacher, some implications for a broader audience can be offered. This case study will provide NARST members with insight into the specific aspects of teachers' learning for changes in their beliefs and practice in teaching. The case of teacher Kara cannot describe all aspects of being coached and inquiry teaching practice; however, in-depth analyses in this study can provide an illustration of how coaching makes the things that need to take place for the Transformation as learning. We suggest that successful support for teachers' professional learning leads teachers to effective learning events and to the process of leaning. For example, drawing on the Vygotsky Space, the learning events in each phase can happen more effectively with the coaching even in the phase of Private-Individual. Further analysis of the data produced from this study will show how coaching can promote processes of learning, such as appropriation, transformation, and publication, and how those supports interact across the Public and Private phases of action to facilitate individual learning and collective goals for change.

### Select References

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**Figure 1.** *The Vygotsky Space. Adapted from Gavelek & Raphael, 1996; Harre', 1984.*



**Table 1**

*Data Matrix: Data from teacher Kara, her coach, and her students of six sessions*

Data	Completed time	Analysis Status in July, 2013
Teacher Interview	<b>4 times:</b> Before and after summer institute, after the session when she received coaching, and the end of the school year.	Collected and in analysis*
Coach Interview	<b>1 time:</b> After coaching teacher Kara	Collected and in analysis
Classroom Observation Video	<b>12 Videos:</b> 1 Baseline video before the summer institute, 4 videos after summer institute and before coaching, 4 videos during the coaching, and 4 videos after the coaching	Collected and in analysis
Coaching Sessions Recorded	<b>8 times:</b> Recorded coaching session videos	Collected
Teacher Inquiry Knowledge Test	<b>3 times:</b> Before and after summer institute, and after the coaching	Collected
Teacher Inquiry Belief Survey	<b>3 times:</b> Before and after summer institute, and after the coaching	Collected
Student Inquiry Knowledge Test	<b>12 times:</b> In the beginning and the end of each session for six groups of students	Collected
Student Inquiry Attitude Survey	<b>12 times:</b> In the beginning and the end of each session for six groups of students	Collected
Teacher Assessment of Student Inquiry Skills	<b>6 times:</b> In the end of each session for six groups of students	Collected

\* Will be analyzed by the TIR, PICI, EQUIP, and CDAT<sup>1</sup>

<sup>1</sup> The instruments developed or adapted for coding science inquiry instruction by CSI study. TIR: Teacher Inquiry Observation Rubric, PICI: Partial Interval Classroom Inquiry, Electronic Quality of Inquiry Protocol (EQUIP), and CDAT: Classroom Discourse Analysis Tool