



---

## Exploring Computer Science Working Papers

---

“Seeing Myself Through Someone Else’s Eyes:”  
The Value of In-Classroom Coaching for  
Supporting Exploring Computer Science  
Teaching and Learning

Authors: Jane Margolis,  
Joanna Goode,  
Jean J, Ryoo,  
and David Bernier

October 15, 2014  
Paper #4

## **“Seeing Myself Through Someone Else’s Eyes:” The Value of In-classroom Coaching for Supporting Exploring Computer Science Teaching and Learning**

**Authors: Jane Margolis, Joanna Goode, Jean J. Ryoo, David Bernier<sup>1</sup>**

In this article we discuss the importance of in-classroom coaching for high school Exploring Computer Science (ECS) educators. While models for in-classroom coaching exist, there has been no model for effective coaching in computer science (CS)---a field that is continually changing, is often missing from high schools, and has traditionally had little pre-service or on-going professional development for teachers. This article addresses the question: *How does in-classroom coaching support computer science teaching and learning?*

Using qualitative methods to analyze observations in Los Angeles Unified School District Exploring Computer Science (ECS) classrooms, teacher surveys, teacher interviews, coaching logs, and coach interviews, the research discussed in this article illustrates the value of having in-classroom coaches who can collaborate and reflect with teachers about current practices, and who can help support new inquiry- and equity-based instructional skills. Teachers note that in-classroom coaching helps to: 1) positively impact changes in pedagogy; 2) enrich teachers’ CS content knowledge; 3) support educators especially in their first year teaching a new CS course; and 4) breaks CS teacher isolation in schools. Two examples from different ECS classrooms served by different coaches are shared to illustrate the ways teacher practice can be impacted over time through coaching.

### **Why In-Classroom Coaching?**

*“A coach with experience has been a life-saver as I have tried to transition from a ‘this-is-how-you-do-it’ instructor to a facilitator of learning experiences. Figuring out the curriculum and the approach on my own would have been a difficult and frustrating challenge.” (1<sup>st</sup> year CS teacher)*

*“The ECS coaching program, believe it or not, was the first one to actually put a live person in my classroom to observe, comment, and suggest areas for improvement. This has had a great impact on my professional development because of the opportunity to see myself through someone else’s eyes.” (4<sup>th</sup> year CS teacher)*

While all educators can greatly benefit from in-classroom coaching, this is all the more true for computer science (CS) teachers. In most states, CS teachers are teaching out of subject as there is no CS teacher certification. As CS instruction

---

<sup>1</sup> Authors would like to acknowledge the extraordinary contributions that went into shaping the ECS Coaching Program and the content of this article: Gail Chapman, John Landa, Solomon Russell, Suzanne Schaeffer.

begins to spread across the country, many teachers will be teaching CS for the first time, and will come from different pedagogical traditions. CS teachers are introducing students to a subject that suffers from underrepresentation of females and students of color and is riddled with biased stereotypes about the abilities of these students. In-classroom coaching is important for supporting teachers in making their classroom environments supportive and engaging for all students. CS teachers are often the only one teaching this subject in their schools, without a department or professional learning community. In-classroom coaches can also help build a CS teachers' learning community.

### **The ECS Program**

ECS is an introductory foundational CS course for all high school students. ECS was first piloted in the Los Angeles Unified School District (LAUSD) during the 2008-09 school year, and since then has expanded nationwide to 12 states, including partnerships with Chicago and New York City public schools.

The ECS curriculum consists of six units that introduce students to the problem-solving at the core of CS and introduces students to the practices of doing computer science. Providing a broad and introductory survey to the field, ECS includes six 6-week units: 1) Introduction to Human Computer Interaction, 2) Problem Solving, 3) Web Design, 4) Introduction to Programming, 5) Computing and Data Analysis, and 6) Robotics. The curriculum is designed around inquiry- and equity-based instructional practices. Assignments are contextualized in issues that are meaningful for a diverse population of students.

ECS is a program that consists of the curriculum and an accompanying ECS professional development program. The teacher PD program models what type of learning space should be created in the classroom—one that is creative, active, participatory, with all teachers participating and engaged. The five key features of ECS PD include: 1) immersion into inquiry; 2) a teacher-learner-observer model; 3) development of professional learning community; 4) focus on equitable practices; and 5) extending the learning of professional development into teachers' classrooms throughout the school year.

The motivation for establishing an in-classroom coaching program for LAUSD CS teachers was based on research showing that in order for teachers to master new curricula or educational approaches, they need continuous technical assistance and support *in the classroom* (Bess, 2007; Michael, 2002; Feldens & Duncan, 1978; Borg, Langer, & Kelley, 1971; Good & Brophy, 1974). With research showing that, for example, even after high quality professional development, implementation of new teaching practices peaks around only 5% (Joyce & Showers, 1996), various coaching methods have been developed. Coaching methods have taken various forms in educational contexts—including Peer Coaching, Cognitive Coaching, Literacy Coaching, Instructional Coaching, etc. (Cornett & Knight, 2008)—yet while techniques may differ, nearly all coaching methods recognize the critical role of in-classroom observation and reflection with the general goals of:

- 1) Building communities of teacher professionals who continuously study their craft.

- 2) Developing a shared language and common understanding of teacher practice that supports the continued growth and improvement of curriculum and instruction.
- 3) Providing a structured way for teachers to follow up on training seminars and workshops toward the implementation of new curricula or teaching skills. (Showers, 1985)

### ***The ECS Coaching Program***

The ECS coaching [program](#) is a vehicle through which the ECS curriculum and PD is extended and connected to classroom practice between PD sessions while facilitating the professional growth of individual teachers as well as the growth of a teacher professional learning community. ECS coaching takes the learning that happens in PD (around the curriculum, inquiry-based pedagogy, and equity) and extends the dialogue as teachers enact the curriculum in their classrooms. Coaches make classroom visits and arrange for time to have reflecting conversations with the teachers.

Our ECS coaches are educators with computer science backgrounds who are able to build trust with other teachers, help facilitate reflection around teaching practice and focus on inquiry, equity and CS concepts in the classroom. They bring a skill set of being sensitive observers and listeners of both students and adults. We encourage our ECS coaches to attend an on-going series of Cognitive Coaching workshops (explained later in this article).

The first several coaching visits are spent gathering information about what a teacher wants to work on with a coach, educating teachers about the coach's role (as someone there to support teacher growth, *not* evaluate), and establishing relationships of trust and open communication. For those teachers who have a conference ([planning](#)) period following their ECS class, coaches stay and conduct reflection conversations with teachers. Coaches typically engage in one or more of the following activities with teachers:

- **Reflecting** (Reflecting with teachers about how a lesson went, a challenge, etc.)
- **Planning** (Planning a future lesson, project, unit together)
- **Observing** (Taking notes for the purpose of recognizing themes or giving feedback)
- **Sharing Resources** (Sharing materials to support teacher growth, instruction, etc.)
- **Demonstrating/Modeling a Lesson** (With the intention of teaching teachers content, a pedagogical strategy, etc.)
- **Co-Teaching** (Collaboratively led class discussions, teaching)
- **Analyzing Student Work** (Examining student work together and discussing how these artifacts do or do not meet teachers' goals)
- **Visiting other ECS Teachers** (Coaches set up visits between ECS teachers at different schools)
- **Goal-Framing Conversations** (Coaches discuss: the teacher's general professional goals, the coach's goals, the teacher's goals for her/his class,

indicators for when the students have met those goals, and what it might feel or look like in the classroom when those goals are met)

The ECS coaching program incorporates Peer and Cognitive Coaching strategies and techniques. Peer Coaching consists of professional colleagues collaborating to reflect on their practices, refine new skills, and improve their teaching practices. Teachers experiencing Peer Coaching over a 6-week period were much more likely to use what they learned at professional development than those teachers who did not receive coaching (Showers, 1982). A follow-up study with these same teachers six months later and, despite a break in coaching, showed that those teachers who originally received the 6-week coaching continued to use the skills learned in professional development while those without coaching did not incorporate new skills (Baker, 1983). Truesdale (2003) also showed that over a 15-week period, teachers who received Peer Coaching increased their transfer of skills learned at a professional development session whereas teachers without coaching lost interest or stopped using the skills from that session. Furthermore, teachers who develop professional relationships with other teachers—by engaging in practices such as lesson planning together, pooling experiences, discussing teaching etc.—apply new skills and strategies more frequently than those who work alone (Baker & Showers, 1984). Peer Coaching has also been shown to positively impact student achievement: students performed significantly better on recall tests in the classrooms of teachers with high-transfer rates of new skills through professional development and coaching in comparison to students in classrooms with teachers who did not receive coaching (Showers 1982; 1984).

Cognitive Coaching's goal "is to produce self-directed persons [teachers] with the cognitive capacity for high performance, both independently and as members of a community" (Costa & Garmston, 2002, p. 16). In order to achieve this goal, Cognitive Coaching "uses tools of reflective questioning, pausing, paraphrasing, and probing for specificity...[as teachers] develop expertise in planning, reflecting, problem-solving, and decision-making" (Costa & Garmston, 2002, p. 13). This is achieved through a series of careful planning and reflecting conversations between coach and teacher—that take into account the diversity of teacher personalities, philosophies, learning styles, and stages of development. (See Appendix for description of Cognitive Coaching conversation models)

Various studies describe that Cognitive Coaching has had a positive impact on teachers. Regarding reflective thinking, Moche (1999, 2000/2001) found that those who received Cognitive Coaching demonstrated significant growth in reflective thinking on the Reflective Pedagogical Thinking Instrument (Simmons, Sparks, Starke, Pasch, & Colton, 1989) than those who did not receive coaching or who only attended a discussion group. While one study contradicted Moche's findings (Edwards, 1993), various other studies illustrate increased teacher reflection due to participation in Cognitive Coaching (Edwards & Green, 1999; Slinger, 2004; Smith, 1997). Furthermore, teachers receiving Cognitive Coaching reported significantly higher job and career satisfaction than those without coaching (Edwards, 1993; Edwards & Newton, 1995; Edwards, Green, Lyons, Rogers & Swords, 1998; Mackie, 1998).

Beyond research illustrating the positive impact of both Peer and Cognitive Coaching on teacher professional development, its importance in supporting the growth of a professional community is particularly salient when one considers that many CS teachers are isolated in their schools. Over two-thirds of ECS teachers are the *only* CS teacher at their schools. The ECS coaching program has been able to support a teaching community with coaches serving as ‘colleagues’ who would otherwise exist if there were multiple ECS teachers at a school. Coaching visits provide opportunities for reflective conversations focused on ECS teacher practices around inquiry, equity, as well as ECS content and curriculum.

### **Research Methods**

The coaching program research we discuss in this paper occurred during the 2010-13 school years. We investigated how ECS teachers experienced coaching. Our research question was: “What was the influence of coaching on ECS teachers?”

Data sources included teacher surveys (that were collected on an annual basis at the end of every school year), teacher interviews, coaching logs describing visits to teachers’ classrooms, coach interviews, and classroom observations of teachers who received coaching during the 2011-12 school year.

Surveys were collected on an annual basis since the ECS coaching program began in 2009. At the end of every school year, teachers were given the opportunity to answer a variety of survey questions regarding their experiences with coaching. There were a total of five surveys collected between 2009-2013 with questions referencing coaching activities: four end-of-year surveys and one coaching survey. These surveys are listed below:

| <b>Survey Year</b>               | <b>Total # of Respondents</b> |
|----------------------------------|-------------------------------|
| 2009 End of Year Teacher Survey  | 14                            |
| 2010 End of Year Teacher Survey  | 18                            |
| 2011 End of Year Teacher Survey  | 17                            |
| 2012 End of Year Coaching Survey | 13                            |
| 2013 End of Year Teacher Survey  | 23                            |

Over the years, a total of twenty-four individual teachers completed these end of year and coaching surveys.

Teacher surveys and interviews were analyzed for key themes and codes in the constant comparative method in which assertions made by themes and codes were continuously tested against confirming and disconfirming evidence and adjusted accordingly with multiple passes through the data corpus (Erickson, 1998)

The themes were focused on ECS core competencies: 1) CS content (including computational practices and the problem solving that is the heart of computer science), 2) inquiry-based learning, and 3) equity teaching practices.

Coaching logs were also reviewed for key themes and codes and compared with ideas shared in teachers’ reflections on coaching visible in both teacher survey and interview data. In this way, reflections made by coaches or teachers could be compared.

### **Impact of ECS Coaching Experiences**

#### ***What did Teachers Report as Helpful about Coaching?***

Teachers responded positively to coaching support as shown in the ratings from the end of year surveys (see Table 1 below) in which teachers found coaching mostly “helpful” or “very helpful”:

**Table 1:** *How would you rate your overall experience with ECS coaching?*

|                  | Not<br>Sure | Not at all<br>Helpful | Somewhat<br>Helpful | Mostly<br>Helpful | Very<br>helpful |
|------------------|-------------|-----------------------|---------------------|-------------------|-----------------|
| 2010-11 (n = 17) | 6%          | 6%                    | 12%                 | 6%                | 71%             |
| 2011-12 (n = 13) | 0%          | 0%                    | 0%                  | 15%               | 85%             |
| 2012-13 (n=22)   | 0%          | 9.5%                  | 4.8%                | 9.5%              | 76.2%           |

When teachers were asked to describe what was specifically helpful about coaching, their responses focused on the following four themes:

- 1) Coaching positively impacts teacher pedagogy
- 2) Coaching supports teachers’ CS content knowledge
- 3) Coaching is particularly valuable for first-year ECS teachers
- 4) Coaching breaks the isolation CS teachers’ experience at their schools

These findings are described in greater detail below.

#### ***Shifts in Pedagogy: “Stepping Up the Quality of My Teaching”***

*“I think that all teachers can benefit from coaching...I feel that the ECS coaches made me reflect on my teaching and stepped up the quality of my teaching.”*

In the 2011 and 2012 surveys, teachers were asked, “If you have made any changes in your teaching practice due in part to coaching and collaboration with coaches, please provide examples of changes you have made.” Seventeen of the twenty-four teachers across the two surveys described shifts in pedagogy over time. In fact, when asked to rate coaching’s impact on *teaching practice*, most teachers reported “a lot” or “more than a little” change:

**Table 2: Reported Changes in Teaching Practice as a Result of ECS Coaching**

|                      | Not sure | Not at all | Only a little | More than a little | A lot |
|----------------------|----------|------------|---------------|--------------------|-------|
| <b>2011 (n = 17)</b> | 6%       | 0%         | 18%           | 24%                | 53%   |
| <b>2012 (n = 13)</b> | 8%       | 0%         | 0%            | 46%                | 46%   |

Teachers described how their **inquiry-based teaching methods** developed with the support of coaching. As one teacher explained two years in a row: “I learned that I don't have to sound like I know everything” and “I have been encouraged to have my students engage in more inquiry-based and discovery learning through modeling and suggestions.” Instead of being the only source of knowledge in the classroom or a “go-to” person for answers, this teacher emphasized learning pedagogy that supported students in actively seeking answers to their inquiries themselves.

Similarly, another teacher explained, “Instead of expecting myself to know all the answers, I emphasize inquiry amongst my students so that they can see how things work.” Recognizing that coaches have supported the transition into inquiry-based teaching, another reflected: “My role has grown to be more of a facilitator and project manager. I have tried to foster self-motivation.”

Another inquiry-based method that six teachers recognized improving as a result of coaching was practicing support of **student collaboration**. For example, one teacher wrote:

*“I now feel comfortable having student[s] pair share, create collaborative opportunities that result in each teaching collaborating or supporting the team, and creating opportunities for students to engage. It was hard at the beginning, but with the coaching support it's becoming second nature and the students seem to enjoy my class more. I am also finding that my students tend to be more engage[d] on the task”*

Teachers described that coaching helped them in developing “team spirit,” “Allowing the students to work together, and being less afraid of cheating,” learning “better grouping of students,” organizing “participat[ion] in groups during the first units of the ECS course, are changes that I have made in my practice, directly as a result of the ECS coaching,” and “Get[ting] them talking among themselves about the topics at hand.”



Seven teachers also noted that coaching improved their practices in engaging students in CS by making clear connections to everyday life, supporting “Ideas for student projects that are more relevant” and “mak[ing] connections throughout the units and to show students how the ECS curriculum can be applied to their everyday lives.” As a teacher explained, coaching resulted in him “Inclu[ding] assignments that require the students to reflect on their family’s history, and on important decisions that they face during their high school experience. Specifically, they document their family’s history on a website, and build Scratch programs that involve the user in making decisions about personal and/or cultural issues that the ECS students feels are important.”

In fact, teachers expressed how “coaches bring more strategies, more knowledge on the concepts to work on and are a liaison between the curriculum writers and us in case we need clarification.” Teachers also noted that the coaching program influenced their professional growth by increasing their confidence in the classroom. As one teacher explained, “[The coach] has been one of my biggest supporter[s] and her belief in me, made me take the risk that other wise I would have not taken.” Another teacher noted “[The coaching program] has increased my confidence and expanded my repertoire of teaching strategies.”

### ***Coaching Improves Teacher CS Content Knowledge***

Teachers also reported that coaching impacted their **understanding of CS content**. For example, the table below shows teachers’ responses in 2012-13 regarding changes in CS content knowledge due to coaching:

**Table 3:** *To what extent has your knowledge of computer science increased because of ECS coaching?*

|                  | Not at all | Only a little | More than a little | A lot |
|------------------|------------|---------------|--------------------|-------|
| 2012-13 (n = 13) | 8%         | 8%            | 31%                | 54%   |

ECS teachers have a wide range of backgrounds and previous CS knowledge when they begin teaching the class and therefore the specific CS content that teachers reported gaining a better understanding of due to coaching support varied significantly. For some teachers, coaching helped support teachers’ review of familiar CS topics. For other teachers, coaching facilitated learning completely new CS content. Five teachers noted that their understanding of robotics and how to teach the robotics unit were greatly improved as a result of coaching. Four teachers noted that coaches helped them with programming (html, Scratch, and programming for data analysis). Other teachers described that coaching supported their CS content knowledge in math-related topics (including problem solving and algorithmic thinking), CS vocabulary, and data analysis, related to CS.

Data shows that ECS coaching supported teachers’ CS knowledge in additional ways: One teacher explained, that, “in the coaching sessions I was able to

ask questions and receive clarification on the concepts that I did not understand.” Another said, “I consider myself as a decent CS knowledgeable teacher, but there is always something new to learn and having the ECS coaching provides me the opportunity without waiting for a PD or in case I need clarification after a PD.” This was echoed by a teacher who reflected, “Coaching has helped fill in the gaps when I have been faced with unfamiliar topics...Through coaching, several of us were able to learn these things together.”

### ***The Need for Coaching, Especially for First Year CS Teachers***

Many teachers noted that coaching was important for all teachers, but particularly useful for new CS teachers.

For example, one teacher explained, “[N]ew ECS teachers can benefit a lot from coaching in their first year or two. For many (such as me), there is a steep learning curve for much of this material. It helps a lot to have a resource such as a coach who can share helpful information, answer questions, and provide other types of help.” Another teacher emphasized the value of coaches connecting new teachers to the community, stating, “Particularly for the newer teachers, the coaches provide a connection to the greater program...The coaches provide moral and academic support and provide answers to our questions and doubts.” As two first year teachers reflected, “As a beginner, I still need more technical knowledge to expand our ECS program here” and “[T]he support I have gotten through ECS coaching has helped me get through a difficult first year in the program.” This was emphasized by another teacher who wrote, “It was motivating to see the passion and excitement the ECS coaches had for this ECS program. I hope the coaching program continues next year, especially for the new ECS teachers.”

Overall teachers agreed that coaching highly impacted their ability to successfully teach CS at their schools. As one teacher noted, “We can't wait for PD to be offered to clarify ideas, objectives and other issues that might come up during the year.”

### **“We are not Alone”: Coaching Breaks CS Teacher’s Isolation**

In the 2012 coaching survey, teachers were asked: “How would you characterize the impact of ECS coaching on your professional growth?”

Teachers reflected that coaching impacted their professional growth by **breaking teacher isolation** in their classrooms and schools. Almost all teachers were, and continue to be, the only computer science educators in their schools. ECS teachers rarely have the sort of collegial support of a peer teaching group on-campus and often feel isolated in their professional efforts. As one teacher stated, “[Coaching] has been very valuable. The opportunity to interact with knowledgeable individuals who are involved with the ECS curriculum (and other ECS teachers/classes) has been very helpful. At my school, I’m the only person teaching this type of material.”

Through our experiences over the last three years we have seen that coaches play an instrumental role in fostering a sense of community among CS teachers. Coaches have been the representatives of our ECS project as they interacted with

teachers on a daily basis as well as intentionally connecting teachers to each other by facilitating peer observations and the sharing of best practices and resources for teaching. Through providing meaningful support to teachers they have engendered much good will and trust and a strong sense of connection to the ECS community. The coaches have helped teachers to feel welcome and invested in the ECS program which has promoted openness and support from our teachers for the larger ECS program when we have had professional development or sought their help with surveys, etc. In a sense the coaches have been at the front lines of our work to support teachers in the same way that teachers are at the forefront of supporting students.

### **Case Studies of Two In-Classroom Coaching Experiences**

One of the “arts” of coaching is meeting each individual teacher where they are in their professional and personal trajectory, yet focusing on programmatic priorities for the course being taught. The following two case studies present examples of how in-classroom coaching impacted teacher practice and growth, especially around inquiry-and equity based pedagogy.

#### ***Case 1: Supporting Inquiry-Based Questioning and Teaching with Coaching***

Carl<sup>2</sup> is a certified math teacher and teaching ECS was his first experience teaching a computer science class. Carl grew up in the local predominately low-income African-American community and went to high school at the school in which he was teaching. Brian coached Carl during his first year teaching ECS during which Carl initially struggled with inquiry-based teaching methods for facilitating student problem-solving processes.

After this first year of year of coaching, when we asked Carl whether he made any specific changes to his pedagogy due to ECS coaching, Carl said he saw personal growth in “using the inquiry model that is suggested by the ECS curriculum. I’ve engaged students to give me the solution to various problems with less directing as I would usually give for them to arrive at a solution, which gets them talking among themselves about the topics at hand.” Noting that he struggled with inquiry-based teaching at the start of the school year, Carl explained:

“[I use inquiry-based pedagogy] more now than when I first started doing ECS. I have students tinker with different things. For instance, with the html unit, ‘let’s see how it works.’ They tell me how it works, they tell their friend how it works. It goes that route. So, they’re able to talk among themselves, ask questions and it’s not me giving them the answer. It’s them questioning themselves, questioning the resources available to them in the particular unit. More so now than what I first started. This is new to me. The technology isn’t

---

<sup>2</sup> All names have been changed to protect the privacy and identity of teachers, coaches, and research participants.

new cause I've been tinkering that for years, but as far as teaching it, that's new."

In an interview, Carl explained that, as the year progressed, he began utilizing specific strategies learned through ECS professional development support, such as highlighting specific software program tools, asking leading or probing questions, encouraging students to try various strategies to solve problems, suggesting possible ways to solve problems rather than giving students solutions, and directing students to resources they could use in their projects.

Supporting Carl's personal reflections on his teaching practice, researchers observed that Carl's inquiry-based teaching skills had improved significantly by the end of the school year. In the beginning of the year, and after building trust with Carl, the coach Brian reflected that there were three main objectives that he believed would help support Carl's teaching: 1) understanding the importance of scaffolding the learning through following the order of the curriculum, 2) clarifying lesson objectives, and 3) asking inquiry-based questions vs. telling students the answer. Visiting the classroom in February, the coach wrote:

Carl walked around the classroom trying to help students with their assignments. When he would walk around trying to answer questions he would take the mouse and keyboard as a means for helping...A typical interaction would be a student asking, "How do I get this character come in at this new scene?" Carl would then use the mouse, as he would say things like "you're going to have to use a XYZ block." A couple of times I noticed him sitting down next to a student at the controls and trying to figure out the project for himself while the student looked elsewhere. (Brian; 2/13/12)

The coach arranged time for extended reflective conversations with Carl. They discussed the goal of students thinking through the problems themselves, which included allowing students to use their own mouse/keyboard rather than having Carl take over their computers. The coach also arranged for Carl to visit other teachers' classrooms, observing how students were encouraged to do their own thinking. Second semester Brian also co-taught a lesson with Carl so he could "see" some of the things they had been talking about in their conversations.

At the end of the school year, during the Robotics unit, Carl's teaching practices had gone through a noticeable change. During a robotics unit design challenge, students were working on programming the robot to move in a square. Carl was working one-on-one with a female student, Deborah, and when she tested the robot's movements, it moved in a circle instead of a square. Deborah asked, "Why is that?" Instead of just giving her the answer, Carl replied, "Let's try to troubleshoot." Deborah played with her robot's program and re-tested it. Carl watched and summarized what he saw by saying, "What's it doing? Going forward, then turns, then goes forward again. Let's think about what's happening. What's it supposed to do?" After a moment, Deborah said, "It's supposed to go forward, turn, go forward, turn..." Carl offered, "Let's take a look at the program." Looking over her program together, Deborah explained how she wanted the robot to turn while using her hands to visualize its motion. After tweaking the program, she asked Carl, "Is it

like that?" Carl replied, "Would it be four turns?" Together they walked through each step of her programming script and then Carl said, "Let's go ahead and test it out."

This time the robot moved forward for a few feet, made a slight left turn, moved forward a few feet, and then repeated this process four times. When it finally stopped, it did not make a complete square. Deborah remembered seeing an option to change the degrees of the wheel saying, "Could we change the degrees cause...?" Carl replied, "It's the degrees on the wheel, not the turn. Try it again." They watched the robot move through its program again and Deborah suggested that they could try two rotations on the turn and Carl agreed. Deborah fluidly adjusted each of the turning blocks in her program and re-tested the robot. This time, the robot made left turns on the first two occasions and then made 360-degree turns on the second two. Carl inquired, "So what was different about the last two turns?" Deborah replied, "I dunno." Carl suggested, "It could be the steering." After which Deborah quickly made some final adjustments to her program, figuring out how to improve the steering through her motion and turn blocks. This final time the robot moves in an almost perfect square shape.

Carl's interactions with Deborah exemplify how, while inconsistent and sometimes providing answers for students, his inquiry-based teaching skills did improve. Rather than telling Deborah the answer to all her questions, he more often would ask her questions that guided her to test out various solutions on her own. Occasionally, he summarized or synthesized what she had already completed, helping her think through what she had accomplished without telling her what to do next. He also encouraged Deborah's troubleshooting and exploration of her robotics program by looking through her program with her and encouraging her to arrange her programming blocks in the software program on her own.

## ***Case 2: Improving Student Collaboration and Peer-to-Peer Learning***

Unlike most ECS teachers, Eduardo began teaching the course *without* having attended the summer professional development. A technology coordinator at Eduardo's high school had attended the professional development with the intention of teaching ECS himself, but then was pulled into other responsibilities at their school once the year began. As a result, Eduardo was asked to teach ECS. Eduardo's coach—Caroline—began working with Eduardo from the start of the 2009-10 school year, providing access to resources, answering questions, offering content support, and nurturing Eduardo's pedagogical growth as he embarked on introducing inquiry instructional practices while at the same time stepping outside his usual traditional math-content comfort zone.

When asked about specific changes in teaching made as a result of coaching, among the many things he highlighted, Eduardo described improving "grouping of students." A review of the coach's logs reveal that Caroline explicitly worked on this pedagogical practice with Eduardo and observed him grow in the same way.

At the start of the school year, Eduardo struggled with developing collaboration structures in his classroom. In October, Caroline noted in her logs that Eduardo might benefit from reflecting on: "forming working groups; encourage more collaboration among students; introduce example of explicit roles w/in the

group (e.g. timekeeper, 'cop', reporter, director, etc.)" (10/15/09). The coaching team made the suggestion to Eduardo that he create an assigned seating chart to facilitate more positive student-to-student collaboration. Not long after these observations and coaching efforts, Caroline noted improvements in teacher-mediated collaboration and student-to-student interactions in Eduardo's classroom. Caroline observed:

- "Once a student completed their version of least expensive route, teachers encouraged other team members to also look over team-member's result to provide feedback" (11/6/09);
- "Teacher is more comfortable with supporting students' group work. We spend some time encouraging students to move and sit in proximity of their current assigned groups and that the work is divided among the team members" (11/6/09);
- "The students are assigned seating that reflects the suggestion [another coach] made a few weeks ago. The classroom is more 'calm' and the students are focused on the work at hand...Students are collaborating; asking each other questions and receiving feedback/assistance from their fellow students" (12/3/09).

These efforts to support Eduardo's growth in facilitating meaningful peer collaboration in his classroom continued into the following 2010-11 school year. Caroline discussed these reflection questions with Eduardo at the start of the school year:

- What might you do to keep students who have completed their assignments engaged?
- How might you facilitate team work?
- What type(s) of support to provide so team leaders know what/how to do? (9/22/10)

Caroline saw clear growth in Eduardo's teaching practices over time with her coaching visits over his first two years teaching ECS. Caroline observed over time that "Students were very engaged with final project whereas at one point, [Eduardo's school] was the 'counterexample' for 'engagement; Once a student had completed the final project, sometimes spent time distracting other students; physical layout of room allows students to 'hide'" (2/3/11); "Students were focused on their work, helping each other, and completing creative engaging Scratch projects" (2/10/11); "Students who have completed their own project get practice articulating their understanding with other students" (4/4/11).

Eduardo highly valued his interactions with Caroline, who he described as his "biggest supporter" which allowed him to "take risks" that he would not otherwise be comfortable taking. When reflecting on his experiences with coaching, Eduardo noted: "The coaching model has been like the professional development that I long for as a starting teacher...I have benefited from the support and the advice given by my coach."

## Discussion

### ***What Makes an Effective Coach?***

Despite research illustrating the importance of in-classroom mentoring and coaching, many school districts have eliminated coaching because of budget constraints and there are few “guidelines” for how to be a good coach. An in-depth case study of coaching titled “Instructional Coaching: Building Theory about the Role of Organizational Support for Professional Learning” (AERA, June 2010) found that coaches find their work to be “ambiguous, ill defined, and lacking in support.” The researchers asked: “How do individuals learn to be instructional coaches, and how are they supported to refine their practice, especially in the context of instructional reform?” (p. 952).

This case study of one novice coach helped articulate differences between coaching and teaching and has provided important guidelines for our work: Coaching is about recognizing what is (and should be) going on in the classroom, but also it is about *how to influence another adult’s practice* (p.941). What will unlock old habits, belief systems, and influence the adoption of new strategies? What type of learner is the teacher? How can a coach build trust? And, most importantly, where should the focus of coaching be placed?

But, while we can write this now, it took several years of an iterative process of examining what worked, what didn’t, and why, for us to come to our current ECS coaching model. We learned through our years of implementing our ECS coaching program that there must be a clear focus defined for the coaching program and that there is a learning curve for coaches just as there is for teachers. When we conceived of our coaching program, we were persuaded by the educational research about the importance of in-classroom coaching, but had no specific model.

Below we explain some of the major “bumps” in the road, so that other projects can learn from our experience.

### ***The Evolution of the ECS Coaching Program***

In the first year of our coaching program, we got our feet wet, and we did what came “naturally” to the different coaches. While coaching had been traditionally offered in Math and English in the Los Angeles Unified School District (prior to budget cuts that eliminated most coaching programs), no coaching program has existed in CS. We initially focused on getting to know the teachers and their schools in order to establish trust. Many of the ECS teachers were not used to having other adults in their classrooms as coaching efforts in LAUSD never involved CS classrooms.

During the first year without a sufficiently defined coaching model, coaches experienced pressure to become “helping hands” in the classroom. Coaches and researchers alike experienced a desire to help teach students and relieve some of the teachers’ burdens. It was difficult to sit in a classroom and resist “helping” with any immediate tasks, especially in overcrowded classrooms, in situations where technology was malfunctioning, and in classes where the teacher was overworked. Yet we soon recognized that this did not ultimately support teacher professional growth since coaches would not forever be in the classrooms to troubleshoot daily

challenges. We decided that it is more important for coaches to support in-depth reflection on pedagogy for long-term change of practice rather than simply offer immediate technical relief to teachers.

### ***Defining Our ECS Coaching Model***

During the following year, we continued to find our way to clearly articulating the core teaching and learning competencies that we hoped to see in the ECS classroom. By year 3, we crystallized and articulated them as: CS Content, Inquiry and Equity. This in turn helped make explicit for coaches, teachers, and ourselves where coaching should be focused. But, coaches still needed “coaching” themselves---how to best facilitate teacher reflection about their practices, how to model inquiry practices with an adult learner. Participating in the on-going Cognitive Coaching seminars offered at UCLA Center X was a critical step in supporting the coaches' own development as coaches.

We are now able to articulate our model for ECS Coaching: ECS coaching is a vehicle through which the ECS curriculum and PD is extended and connected to classroom practice between PDs while facilitating the professional growth of teachers and of a teacher professional learning community. ECS coaching takes the learning that happens in PD (around the curriculum, pedagogy, and equity) and extends the dialogue as teachers enact the curriculum in their classrooms. Our model is for our ECS PD and coaching teams to identify the key content and pedagogical issues raised by PD, note the themes that unify the different lessons together, reflect on what is happening in the classrooms—all for the goal of figuring out how to help and match our larger PD goals with individual teacher support and growth. The art of ECS coaching involves reinforcing the three strands of ECS (inquiry, equity, and CS content), combined with Cognitive Coaching type coaching skills (see Appendix), within the unique contexts of each individual teacher's classroom. The challenge is to extend the ECS mission and PD learning goals while mentoring adult learners (teachers) who currently have different instructional approaches and years of experience.

### ***Room for Growth for Our Coaching Program***

Our PD program immerses teachers in the inquiry-based learning environment. But, it is in the implementation in the classroom where the hard challenges begin. For instance, a critical component of inquiry-based instruction is question-asking. How do teachers frame questions that place the learning with the students? What type of questions will engage deeper and more critical thinking about a subject? Our ECS research based on one-year of intensive observations of nine ECS classrooms witnessed much variation in teachers' practice around question-asking (See: [www.exploringcs.org](http://www.exploringcs.org)). While question-asking is one of the most important techniques for facilitating guided inquiry, this was not a concerted focus of teacher/coaching reflection sessions. We consider this an area for growth of our own coaching program.

### ***Considering Coaching Online***



Key to what makes our ECS coaching program effective is the fact that coaches are in the classroom observing the practices as they are enacted, taking in the whole class—the teaching practices, the norms of classroom discussion, which students are engaged/or not, and possible reasons why. This is then followed by the critical teacher and coach reflection discussion.

However, this “in classroom” component of our coaching program raises important questions for scaling up. As more and more districts bring ECS into the their schools, it is likely that they may not have the resources for in-classroom instructional coaches. This lack of funding for instructional coaching is impacting other subjects in addition to computer science. As a result, many in our community are considering how to develop an on-line format for in-classroom computer science coaching. Considering the large geographic distances our coaches must travel in LA, we are sympathetic to investigations of this kind. But, while we believe there can be excellent webinars and on-line resources for PD, we are still struggling with how to create a virtual addition to face-to-face coaching. For example, we experimented with a teacher videotaping his classroom, but found it difficult to illustrate the full classroom environment with an in-place video camera. Further, there was a time delay: the teacher filmed the classroom one day, coaches watched it the next day, and there was a reflection meeting on the third day. The problem is that so much time transpired (three days is a long time in the life of a teacher), that it was hard to reengage what happened during the day the classroom was filmed. Holding office hours on-line may be another possibility to explore.

Yet, teaching is an art that must take into account *multiple dimensions of reality all going on at the same time*. Content knowledge, cultural setting, psychological learning factors, all contribute to the teaching and learning, and all must be observed, analyzed, interpreted and responded to in a holistic fashion. It is a challenge to recreate this virtually, but we are committed to working with others in our CS education community to try to figure out how the essential effective elements of in-classroom coaching that we have discussed in this article can be scaled up, using the technology we have in creative and intelligent ways.

### **Conclusion**

Our research studying the enactment of the ECS program in the classroom over the years, has raised the importance of in-classroom support for CS teachers who are often teaching a new subject, changing their pedagogical practices--transitioning into inquiry and equity based instruction. Our research has also found that this support is especially true for first year teachers, but is extremely useful for more veteran teachers as well. The support required is time-intensive, is focused on the whole classroom, and carries a cost as well.

The findings from the research we have done on the value of in-classroom coaching are a contrast to and juxtaposed to alternative strategies being presented for scaling up: on-line virtual strategies (that we have discussed above) and models of programs (such as Microsoft TEALS) that brings outsider software professionals into the classroom “using a team-teaching model in which software engineers volunteer to educate teachers in coding literacy so that teachers can gain the technical competency to continue teaching the computer science classes

themselves.”<sup>3</sup> Many of these latter-type programs run the risk of not supporting the inquiry and equity based instructional pedagogy that has shown to be so critical for broadening participation in computing. They are based on the assumption that education is content alone, minimizing the importance of instructional practices that assure equitable and engaging instruction for all students.

We are concerned, as our community of CS educators engages in a big push to expand CS education across the country, that the drive for expansion numbers may drown out attention on the quality of the pedagogy in the classroom, and to the support that teachers need from a inquiry and equity focused coaching and learning community. This is the slow and steady work that is hard to quantify, hard to turn into numbers, and yet is ultimately needed for deep and sustainable results for broadening participation in computing, assuring that the knowledge of computer science is accessible and engaging for all students.

## APPENDIX A – Coaching Models

### Cognitive Coaching Conversations

The charts below—taken from Costa and Garmston’s (2002) book *Cognitive Coaching: A foundation for Renaissance Schools*—illustrate the framework for leading lesson planning as well as reflection conversations with teachers. The left-hand column describes desired cognitive thoughts and processes, while the right-hand column describes sample questions asked by the coach during these conversations.

Chart 1: Planning Conversation

| <b>If the desired cognitive thought/process is to:</b>   | <b>Then the coach might ask:</b>   |
|--|--|
| <b>Describe</b> (state the purpose of the lesson)  | What outcomes do you have in mind for your lesson today?                                       |
| <b>Envision</b> (translate the lesson purposes into descriptions of desirable, observable student behaviors)         | As you see this lesson unfolding, what will students be doing?                                 |
| <b>Predict</b> (Envision teaching strategies and behaviors to facilitate students’ performance of desired behaviors) | As you envision this lesson, what do you see yourself doing to produce those student outcomes? |
| <b>Sequence</b> (describe the sequence in which the lesson will occur)   | What will you be doing first? Next? Last? How will you close the lesson?                       |
| <b>Estimate</b> (anticipate the duration of activities)  | As you consider the opening of the lesson, how long do you anticipate that                     |

<sup>3</sup> <http://www.microsoft.com/about/corporatecitizenship/en-us/youthspark/ComputerScience/teals/>

|  |  |
|--|--|
|  | will take?   |
| <b>Define</b> (formulate procedures for assessing outcomes by envisioning, defining, and setting success indicators) | What will you see students doing or hear them saying that will indicate to you that your lesson is successful? |
| <b>Metacogitate</b> (monitor his or her own behavior during the lesson)  | What will you be aware of in students' reaction to know if your directions are understood?                     |
| <b>Self-Assess</b> (identify a process for personal learning)  | As a professional, what are you hoping to learn about your own practices as a result of this lesson?           |
| <b>Describe</b> (depict the data-collecting role of the observer)  | What will you want me to look for and give you feedback about while I am in your classroom?                    |

Chart 2: Reflecting Conversations

| <b>If the desired cognitive process is to:</b>  | <b>Then the coach might ask:</b>   |
|---|--|
| <b>Assess</b> (express feelings about the lesson)   | As you reflect on your lesson, how do you feel it went?  |
| <b>Recall and Relate</b> (recollect student behaviors observed during the lesson to support those feelings) | What did you see students doing (or hear them saying) that made you feel that way?   |
| <b>Recall</b> (recollect their own behavior during the lesson)  | What do you recall about your own behavior during the lesson?  |
| <b>Compare</b> (draw a comparison between student behavior performed with student behavior desired)         | How did what you observe compare with what you planned?  |
| <b>Infer</b> (abstract meaning from data)   | Given this information, what do you make of it?  |
| <b>Draw Conclusions</b> (assess the achievement of the lesson purposes)                                     | As you reflect on the goals for this lesson, what can you say about your students' achievement of them?  |
| <b>Metacogitate</b> (Become aware of and monitor their own thinking during the lesson)                      | What were you thinking when you decided to change the design of the lesson?<br>OR<br>What were you aware of that students were doing that signaled you to change the format of the lesson? |
| <b>Infer from Data</b> (draw hypotheses and explanations from the data provided)                            | What inferences might you draw from these data?  |
| <b>Analyze</b> (examine why the student behaviors were or were not achieved)                                | What hunches do you have to explain why some students performed as you had hoped while others did not?   |

|  |  |
|--|--|
| <b>Describe Cause and Effect</b> (draw casual relationships)   | What did you do (or not do) to produce the results you obtained?   |
| <b>Synthesize</b> (make meaning from analysis of the lesson)   | As you reflect on this discussion, what big ideas or insights are you discovering?   |
| <b>Self-Assess</b> (construct personal learnings)  | What personal learnings did you gain from this experience?   |
| <b>Apply</b> (prescribe alternative teaching strategies, behaviors, or conditions)                             | As you plan future lessons, what insights have you developed that might be carried forth to the next lesson or other lessons?  |
| <b>Evaluate</b> (give feedback about the effects of this coaching session and the coach's conferencing skills) | As you think back over our conversation, what has this coaching session done for you? What is it that I did (or didn't) do that was of benefit to you? What assisted you? What could I do different in future coaching sessions? |

(Costa & Gamston, 2002, pp. 398-399)

### Works Cited

- Alseike, B. U. (1997). Cognitive Coaching: Its influence on teachers. *Dissertations Abstracts International*, 58(8), 2911. (University Microfilms No. 9804083)
- Baker, R. G. (1983). The contribution of coaching to transfer of training: An extension study. *Dissertation Abstracts International*, 44(11), 3260. (University Microfilms No. 8403713)
- Bess, K. (2007). Coaching Teachers to Help Students Learn. *Education Week*, 27 (15), pp. 22-24.
- Borg, W.R., Langer, P., & Kelley, M.L. (1971). The Minicourse: A new tool for the education of teachers. *Education*, pp. 232-238.
- Cornett, J. & Knight, J. (2008). Research on coaching. In J. Knight (Ed.), *Coaching: Approaches and perspectives* (pp. 192-216). Thousand Oaks, CA: Corwin.
- Costa, A.L. & Garmston, R.J. (2002). *Cognitive Coaching: A foundation for Renaissance Schools*. Norwood, MA: Christopher-Gordon, Inc.
- Dole, J. A. (2004). The changing role of the reading specialist in school reform. *The Reading Teacher*, 57, 462-471.

- Edwards, J. L. (1993). The effect of Cognitive Coaching on the conceptual development and reflective thinking of first-year teachers. *Dissertation Abstracts International*, 54(3), 895. (University Microfilms No. 9320751)
- Edwards, J. L., & Green, K. E. (1999, April). *Growth in coaching skills over a three-year period: Progress toward mastery*. Paper presented at the annual meeting of the American Educational Research Association, Montreal, Canada.
- Edwards, J. L., Green, K. E., Lyons, C. A., Rogers, M. S., & Swords, M. E. (1998, April). *The effects of Cognitive Coaching and nonverbal classroom management on teacher efficacy and perceptions of school culture*. Paper presented at the annual meeting of the American Educational Research Association, San Diego, CA.
- Edwards, J. L., & Newton, R. R. (1995, April). *The effect of Cognitive Coaching on teacher efficacy and empowerment*. Paper presented at the annual meeting of the American Educational Research Association, San Francisco.
- Feldens, M.G.F., & Duncan, J.K. (1978). A Field Experiment Teacher-directed Changes in Instructional Behavior. *Journal of Teacher Education*, 29, pp. 47-51.
- Gamse, B. C., Bloom, H. S., Kemple, J. J., & Jacob, R. T. (2008). *Reading First Impact Study: Interim report* (NCEE 2008-4016). Washington, DC: National Center for Education Evaluation and Regional Assistance, Institute of Education Sciences, U.S. Department of Education.
- Good, T.L., & Brophy, J.E. (1974). Changing Teacher and Student Behavior: An empirical investigation. *Journal of Educational Psychology*, 66, pp. 390-405.
- Knight, J. (2007). *Instructional coaching: A partnership approach to improving instruction*. Thousand Oaks, CA: Corwin Press.
- Mackie, D. J. (1998). Collegial observation: An alternative teacher evaluation strategy using cognitive coaching to promote professional growth and development. *Dissertation Abstracts International*, 59(3), 678. (University Microfilms No. 9826689)
- Michael, M. (2002). Let's Change Staff Development to Professional Learning. *Principal*, 81 (4), pp. 16-17.
- Moche, R. (1999). Cognitive coaching and reflective thinking of Jewish day school teachers. *Dissertation Abstracts International*, 60(2), 300. (University Microfilms No. 9919383)
- . (2000/2001). Coaching teachers' thinking. *Journal of Jewish Education*, 66, 20-29.

Sanders, W. L., & Rivers, J. C. (1996). *Cumulative and residual effects of teachers on future student academic achievement*. Knoxville, TN: University of Tennessee.

Showers, B. (1982). *Transfer of training: The contribution of coaching*. Eugene, OR: Centre for Educational Policy and Management.

---. (1983, April). *Transfer of training*. Paper presented at the annual meeting of the American Education Research Association, Montreal, Canada.

---. (1984). *Peer coaching: A strategy for facilitating transfer of training*. Eugene, OR: Centre for Educational Policy and Management.

---. (1985). Teachers coaching teachers. *Educational Leadership*, 42(2), pp. 43-48.

Showers, B. & Joyce, B. (1996). The evolution of peer coaching. *Educational Leadership* 53(6), pp. 12-16.

Simmons, J. M., Sparks, G. M., Starko, A., Pasch, M., & Colton, A. (1989). *Pedagogical language acquisition and conceptual development taxonomy of teacher reflective thought: Interview and questions format*. Ypsilanti, MI: Collaboration for the Improvement of Teacher Education, Eastern Michigan University.

Slinger, J. L. (2004). Cognitive Coaching: Impact on student and influence on teachers. *Dissertation Abstracts International*, 65(7), 2567. (University Microfilms No. 3138974)

Smith, M. C. (1997). Self-reflection as a means of increasing teacher efficacy through Cognitive Coaching. *Dissertation Abstracts International*, 35(4), 935. (University Microfilms No. 1384304)

Truesdale, W. T. (2003). The implementation of peer coaching on the transferability of staff development to classroom practice in two selected Chicago public elementary schools. *Dissertation Abstracts International*, 64(11), 3923. (University Microfilms No. 3112185)

Wenglinsky, H. (2000). *How teaching matters: Bringing the classroom back into discussions of teacher quality*. Princeton, NJ: Policy Information Center.

### **ABSTRACT:**

This article describes the importance of in-classroom coaching for Computer Science (CS) educators. Using qualitative methods to analyze Exploring Computer Science (ECS) classroom observations, teacher surveys, teacher interviews, coaching logs, and coach interviews, this research answers the question: *How does in-classroom coaching support computer science teaching and learning?* Teachers'

reflections from the Exploring Computer Science (ECS) coaching program in the Los Angeles Unified School District illustrate the value of having in-classroom coaches who can collaborate and reflect with teachers about current practices, and who can help support inquiry and equity-based new instructional skills. Teachers note that in-classroom coaching helped: 1) break CS teacher isolation at schools; 2) positively impact changes in pedagogy; 3) enrich teachers' CS content knowledge; and 4) support educators especially in their first year teaching a new CS course. Two examples from different ECS classrooms served by different coaches are shared to illustrate the ways teacher practice can be impacted over time through coaching.