

Evolution and Impact of Instructional Coaching for Exploring Computer Science Teachers in a Large Urban District

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Abstract— As states and districts adopt policies and programs to broaden participation in computer science, there is a growing need to effectively develop and support more computer science teachers. Instructional coaching is a form of professional development that districts can implement to provide ongoing support to teachers. In Chicago, a recent policy change made computer science a high school graduation requirement. The district adopted the Exploring Computer Science (ECS) curriculum and professional development program as the primary means for fulfilling the requirement. As part of the district's effort to consistently offer equitable computer science experiences for all students, an emphasis was placed on supporting ECS teachers through coaching. Over the past five years, the district developed, implemented, and refined an instructional coaching model for ECS teachers. The coaching model continues to scale up across the district, with over 50 teachers participating in the 2019–2020 school year. The coaching team also adapted the model in response to the shift to remote learning during the COVID-19 pandemic. In this paper, the authors share details of the ECS coaching model in Chicago, its impact, and lessons learned from the past five years of implementation.

Keywords—computer science, instructional coaching, high school education

I. INTRODUCTION

Recent efforts in the movement to bring computer science (CS) to all students have focused on expanding access to and broadening participation in CS courses for underrepresented student populations, including students who identify as female, Black, or Latinx. Equally important as providing access to CS courses are efforts to help educators develop an understanding of equity issues within CS as well as an understanding of specific teaching practices and strategies that create more equitable CS classrooms [1, 2, 3].

Over the past decade, Chicago Public Schools (CPS) has embarked on a major initiative called *CS4All* to broaden participation in computer science. The goal of *CS4All* is to provide a compelling and relevant CS experience for all students in CPS, where the majority are Latinx (47%) or African American (36%) [4]. A major step toward this goal occurred when the Chicago Board of Education approved a policy in 2016 that made one year of CS a graduation requirement for all high school students. The district adopted

the *Exploring Computer Science* (ECS) curriculum as the means for ensuring that all high schools offer an introductory CS course for students. Equity is a core component of ECS, both in terms of broadening access to CS through enrollment in the course itself and in terms of creating an equitable, culturally responsive space within the ECS classroom. The ECS curriculum is coupled with a year-long professional development (PD) program for teachers, which seeks to “address CS content, pedagogy, and belief systems (including stereotypes about which students can excel in CS)” [5]. Within the first cohort of students in CPS to graduate under the new policy in 2020, more than 14,000 students completed one year of computer science. That year, there were 233 ECS teachers in Chicago Public Schools.

The Department of Computer Science in CPS, in collaboration with the Chicago Alliance for Equity in Computer Science (CAFÉCS) [6] (a research-practice partnership), spent the past several years developing and refining approaches to supplement the professional development of new ECS teachers. This supplemental PD was seen as critical for supporting new ECS teachers, many of whom had no prior experience or education in CS. Research has shown that novice CS teachers’ perceptions of equity are often ill-defined [7] and they have varying perspectives about what types of practices help to create equitable, inclusive classrooms [8]. Additionally, the district had previously identified (through surveys of teachers and students) that many teachers were abandoning parts of the ECS curriculum as well as some of the strategies and practices that were intended to help create more equitable and inclusive classrooms. As a result, the district saw an opportunity to engage these teachers and reinforce the key equity strategies and practices of ECS through the development of an integrated, scalable coaching model. At the same time, the district was shifting to a new teacher evaluation system (a modified version of the Danielson Framework for Teaching), which had a heavier emphasis on student-centered classrooms and inquiry-based teaching [9]. The Department of Computer Science was able to leverage this shift as further support for the need for coaching. At the beginning of the project in 2016, the department identified three goals: 1) Establish a robust coaching model for sustained support for teachers who are new to teaching ECS, 2) support the professional development of additional ECS teachers, and 3) broaden participation in computing.

Decades of research have consistently shown that instructional coaching is an effective form of teacher

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professional development [10, 11, 12, 13]. However, as noted in a recent meta-analysis of the effects of instructional coaching, there are challenges to maintaining effectiveness when coaching programs are implemented at a larger scale [11]. Furthermore, studies of coaching in CS are relatively sparse. In a study of school support visits for K–8 teachers, Hill and Fanscali examined coaching as one of the supports offered, but the participants in the study were teaching limited hours of CS [14]. Another study of K–8 CS coaching, specifically focused on coaching models designed to support teachers in meeting the needs of students with disabilities, found that co-planning and co-teaching were essential to the success of the models [15]. In a qualitative study of coaching specifically for ECS teachers, Margolis, Ryoo, and Goode found that coaching helped to strengthen inquiry and equity-based teaching practices [16].

II. ECS INSTRUCTIONAL COACHING IN CHICAGO

Coaching for ECS teachers was piloted during the 2016–17 school year. Five pilot coaches participated in a coaching PD workshop and three of the coaches then engaged in coaching during the year. The model was implemented in the 2017–18 school year with a small number of teachers and expanded in subsequent years. The following sections provide additional details about the evolution of the coaching model.

A. Coach Professional Development and Pilot Coaching

The project began with professional development conducted by Gail Chapman, one of the developers of ECS, for the coaches at the beginning of the 2016–17 school year. An emphasis was placed on supporting teachers through a process of questioning to help guide teachers to recognize and develop their own pedagogical strategies for the classroom. This approach was based on the ECS professional development debrief process. The coaches developed and piloted a coaching protocol which consisted of a pre-classroom visit conversation with the teacher, the visit, a post-visit debrief, and documentation of the visit. The coaches intentionally used the term “visit” instead of “observation” to reinforce to teachers that the purpose was not evaluative.

All coaches during this first year of the project were part-time, dedicating only part of their time to coaching while still maintaining a full teaching load. Coaches conducted one coaching cycle for each teacher during the school year, coaching a total of seven teachers. The process for scheduling coaching visits was done by staff in the Department of Computer Science in CPS, in communication with the coaches and teachers.

For each visit, coaches conducted a brief pre-visit phone conversation with the teacher. The conversation focused on the area of need designated by the teacher in an interest form that they completed prior to receiving coaching. For the visit, the coach observed the entire class period, taking notes without interacting with the teacher or students. The classroom visit served as an opportunity for the coach to observe instructional choices and student experiences. After the class period ended, the coach and teacher debriefed about the experience, with the coach using questioning to promote a more reflective teacher mindset regarding lesson decisions and instruction. The post-visit debrief allowed the teacher to unpack what happened through questions and prompts by the coach. Finally, there was

an agreement for further contact, either with another visit, a check-in through email, or a phone call.

B. Implementing the Coaching Model

For the 2017–18 school year, the Department of Computer Science in CPS hired one of the part-time coaches from the previous year as a full-time coach (third author) for ECS teachers. This full-time coach also conducted professional development for the part-time coaches. The protocol remained the same: a pre-visit planning call, the visit, a post-visit debrief, and documentation.

The full-time coach worked with 13 first-year ECS teachers, while the four part-time coaches worked with two teachers each. The full-time coach averaged 3 to 5 coaching visits per teacher each semester, while the part-time coaches averaged 2 to 3 per semester. Part-time coaches were constrained by their own teaching and school schedules as well as the teachers’ schedules, which limited the number of interactions and led to gaps in support. As a result of these constraints, a decision was made to shift the model to only full-time coaches.

C. Expanding and Refining the Model

In the 2018–19 school year, a second full-time coach (fourth author) was hired to support ECS teachers, and part-time coaching was discontinued. Two full-time coaches allowed the Department of Computer Science to increase the number of ECS teachers supported and to serve a greater variety of schools in terms of location, socio-economic status of the student body, and type of high school (e.g., selective schools and neighborhood schools). Each coach worked with 18 to 20 ECS teachers and averaged six coaching visits per teacher each semester.

The professional development for coaches changed during this year to make coaching more of a partnership. The coaches engaged in the Jim Knight model of coaching [17], which led to a shift in the approach to coaching from a more facilitative approach based largely on the ECS PD model to a dialogic model of coaching in which the coaches partner with teachers to identify goals and teaching strategies while also sharing their expertise with teachers. Additionally, in the refined model, the coaches and teachers focused on student learning goals rather than teacher lesson goals.

The coaches also began scheduling meetings with school leaders and teachers at the start of the year to ensure that they understood the expectations and commitment for coaching. The coaching protocol was expanded to include goal setting, video recording of lessons, modeling lessons, collecting and analyzing real-time student classroom data, and peer teaching visits to other schools. To capture the new activities, a log was developed for coaches to complete after each interaction. The coaches logged over 150 interactions each.

For the 2019–20 school year, the two full-time coaches worked with over 50 teachers and logged over 440 coaching interactions. As a result of the COVID-19 pandemic in the spring, the district moved to remote learning for the remainder of the year. In-person coaching was no longer possible, and the coaches continued connecting with teachers through remote coaching. The coaches also continued to engage in PD based on the Jim Knight model of coaching. The coaching protocol was

revised to include school team meetings as well as relationship-building meetings with teachers, classroom culture and climate visits, and learning walks (brief visits to colleagues' classrooms).

D. Adapting the Model for Remote Learning

The 2020–2021 school year started with remote learning for all students due to the COVID-19 pandemic. In the late spring, schools partially reopened, with a mix of in-person and remote instruction. To help teachers with this challenging shift, the coaching team developed several additional strategies for supporting ECS teachers. These included a Coaching Café, a Teachers' Lounge, weekly virtual office hours held by the coaches, and a peer coaching model based on the Goals, Reality, Options, Will, Tactics, Habits (GROWTH) framework [18]. The Coaching Café provided informal but structured twice-monthly one-hour discussions for teachers (similar to a professional learning community) that were focused on pedagogical topics (equity practices or instructional strategies). The Teachers' Lounge was designed to provide opportunities for small groups of ECS teachers to collaborate with the coaches on best practices and teaching strategies regarding specific ECS lessons and CS concepts. The coaches selected topics for the Teachers' Lounge based on their experience working with teachers and identified lessons and projects that teachers frequently struggled with. Teachers who participated in the peer coaching activity partnered with another ECS teacher and met biweekly or monthly to discuss their practice, using the GROWTH framework to guide their collaborative work.

These additional supports for teachers were developed in response to teacher feedback indicating that they wanted more opportunities to work with and learn from their colleagues. The supplemental supports were particularly important during the year of remote learning because substantially fewer teachers were interested in receiving one-on-one coaching.

Additionally, the instructional coaches developed and implemented, in partnership with ECS developers, a year-long PD workshop series specifically designed to support veteran ECS teachers dealing with remote instruction. This series included a two-day workshop before the start of the school year and quarterly workshops during the year. The focus of this workshop series was primarily to reinforce the foundational equity practices and inquiry strategies that teachers use in their classrooms and to guide teachers in adapting these practices to a remote teaching environment.

III. ASSESSING PROGRAM SUCCESS

A. Data on Coaching Interactions

The coaching team tracked interactions with teachers during the 2018–2019 and 2019–2020 school years. These data show how the program continues to scale up in the district. In the 2019–2020 school year, the coaches worked with 54 teachers across 34 different high schools (Table 1). The type of these interactions varied. Common interaction types included planning sessions with teachers, classroom visits, and post-visit debriefs (Figure 1). The "Other" category included, for example, discussions focused on resources for remote learning, end-of-year reflections, and planning for the next school year.

Coaching interactions often included one or more areas of focus, which were driven by the teachers with guidance from the coaches. The two most common areas of focus for the coaching interactions were student engagement (56%) and CS content (47%). Equitable classroom culture (15%) and effective collaboration (14%) were also somewhat common areas of focus. These areas of focus were consistent with the previous year of coaching log data, in which keeping students engaged was the most cited area (35%), followed by CS content (15%) and establishing an equitable classroom (12%). This suggests that ECS teachers consistently need support in these areas.

Despite equitable classroom culture being less frequently an area of focus than several other areas, the coaches reported that equity serves as a foundation for their coaching and is interwoven throughout their work with teachers. The coaches also noted that as teachers gained more familiarity and comfort with the content of the course, they were often better prepared to focus on pedagogical strategies related to equity.

TABLE I. COACHING INTERACTIONS BY YEAR

	2018–2019	2019–2020
Number of Teachers	38	54
Number of Schools	28	34
Interactions per Teacher (Range)	1 to 26	1 to 50
Total Number of Interactions	335	441

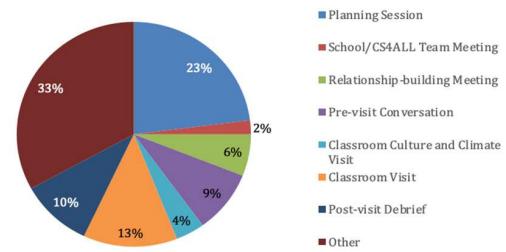


Fig. 1. Coaching Interactions by Type, 2019–2020

B. Teacher Feedback on Impact of Coaching

In addition to collecting data on coaching interactions, the team also administered a an end-of-year survey to the teachers who received coaching. A sample of 15 teachers responded (28%). An indication that the coaching was well-received by teachers was the percentage of respondents who indicated that the support they received had a positive impact on their computer science instruction. As shown in Figure 2, 73% of respondents "strongly agreed" and the remaining 27% "agreed" that coaching had a positive impact. Additionally, a high percentage of teachers "agreed" or "strongly agreed" that time spent on coaching was worthwhile (94%).

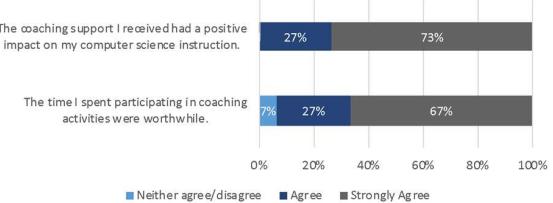


Fig. 2. Teacher Feedback on Coaching Support

Respondents were asked to identify the coaching area of focus in which they made the most progress. The majority of teachers (53%) indicated that they made the most progress in learning CS content. Several teachers made the most progress on effective collaboration.

Teachers were also asked how participating in coaching had increased their confidence in implementing ECS. Three themes emerged from this open-ended question: 1) coaching helped with their confidence with the CS content, 2) coaching provided them with a resource for asking questions and getting support, and 3) coaching provided encouragement, particularly for new ECS teachers. A teacher stated, "Coaching has tremendously increased my confidence in implementing ECS. The coaches met me at my skill level and provided the assistance necessary to help me succeed." Another teacher stated, "I am a new teacher and computer science was new to me as well but partnering with my coach made me feel extremely confident that I could teach ECS and that my students would learn."

Teachers also provided an example of implementing something that they learned through coaching. Responses touched on a variety of different areas, including the importance of attending to equity and inquiry in teaching ECS, time management, student engagement and participation strategies, lesson planning/modifications, and collaboration strategies. One teacher, for example, stated:

Along the lines of student engagement and presentations, [my coach] gave me great advice to have students write critiques to each other about their work during gallery walks. I used that practice all year and worked on getting students to provide thoughtful reflections on successes and areas for improvement.

A theme from the survey data was that teachers felt least confident in their ability to implement strategies related to CS content and that this was an area where coaching had been particularly beneficial. This is perhaps not surprising given that many ECS teachers in Chicago are experienced teachers but not experienced computer science educators and therefore may feel more confident with implementing pedagogical strategies associated with the curriculum than with the CS content itself.

IV. LESSONS LEARNED

Throughout the process of developing and refining the ECS coaching model, the coaching team learned several lessons about how to build a successful model.

Provide teachers with a suite of instructional support opportunities. Particularly when providing instructional support in an online format, it was important to give teachers additional venues in which to connect with coaches and peers (beyond one-on-one coaching). The additional opportunities provided during the pandemic (such as the Coaching Café described above) provided time and space for teachers to interact, exchange ideas, and share their expertise. Some teachers who declined to participate in one-on-one coaching participated in these additional supports, thus providing another entry point for the coaches to connect with more teachers.

Coaching should be student-centered, not teacher-centered. The coaching team recognized the importance of emphasizing to teachers that instructional coaching is about partnership and trust and not evaluation. The instructional coaches adopted a

model in which teachers and coaches worked together to develop an achievable goal for their students as the starting point for their work and then matched a teaching strategy to reach that goal, rather than starting from focusing inward and examining their own pedagogical practice. Another key strategy for this student-centered approach was focusing the coaching conversations on the reality of the classroom through video recordings of lessons or other teaching data.

Equity should be integrated throughout the coaching process. For novice CS teachers in particular, issues of equity may not be a high priority as a focus for coaching. Also, given that prior research revealed that CS teachers often struggle to define equity and identify equitable teaching practices [6, 7], teachers may not know what (or how) to ask their coaches for help in this area. The coaching team was able to ensure that the core component of equity was not lost by infusing it into their work with teachers, regardless of the area of focus. For example, a coach can guide a teacher who is focused on improving student engagement toward implementing culturally relevant practices to increase engagement.

Capacity and scheduling logistics are major challenges. Coaching capacity and logistics are two of the primary challenges to doing this work, particularly in a large, urban district. (The schools where the in-person coaching was provided covered almost 200 square miles across Chicago.) The necessary shift to remote teaching provided an opportunity for the coaches to pilot new ways to reach additional teachers and to rethink how to connect with the teachers that they were coaching. Moving forward, some coaching activities will continue to be done remotely (e.g., post-visit debriefs), which will lessen the burden for both the teacher and the coach in terms of scheduling and availability. Additionally, part-time coaching did not work. There were too many logistical barriers to creating momentum and building a strong relationship between the coach and the teacher.

Teachers perceived concrete benefits from participating in coaching. Teachers recognized that coaching had increased their confidence in teaching ECS and that coaching had been particularly beneficial in helping them learn the CS content. Teachers also learned specific strategies and practices through coaching.

V. CONCLUSION

One of the challenges of broadening participation in CS is the need for continual instructional support opportunities for CS teachers. This is particularly important in a large district like CPS, where many CS teachers lack a background or education in CS. CPS has been implementing the ECS coaching model since 2016 and the coaching team has adapted and revised the model over time to better meet the instructional support needs of teachers. Over the past five years, the model has been successful in terms of reaching more teachers in more schools across the district. The experience of the ECS coaching team in Chicago highlights several important lessons for schools and districts to consider when designing similar coaching programs for CS. With a specific focus on reinforcing the equity strategies and inquiry practices that are central to ECS, the coaching model is designed to ensure that all students across the district are provided an accessible, engaging CS experience.

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