Investigating How Computer Science Teachers and Instructional Coaches Navigated Remote Professional Development During COVID-19: Implications for Instructional Coaching, Teacher Learning, and Qualitative Inquiry in (Post?)-Pandemic Times

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Abstract

This paper investigates how Chicago Public Schools (CPS) computer science (CS) teachers and instructional coaches navigated remote professional development (PD) during the pandemic. In March 2020, The Chicago Alliance for Equity in Computer Science (CAFÉCS) – a long-standing research-practice partnership (RPP) between university computer science faculty, educational researchers, and CPS teachers and administrators – designed PD to support Exploring Computer Science (ECS) teachers with remote and hybrid instruction. The "NEXT" PD series consisted of remote workshops for teachers, one-on-one and small group instructional coaching opportunities for teachers, and a Coaching Professional Learning Community (PLC) to support instructional coaches' professional growth. Based on our analysis of qualitative data collected during and after the PD series, we found that the coaching team focused on reinforcing ECS instructional strategies and increasingly centered their efforts on improving teacher engagement and wellbeing. Teachers primarily valued the relational aspects of PD, including collaboration with other teachers and personalized support from instructional coaches. Despite the project's initial focus on the COVID-19 context, we found that the pandemic and remote learning environment amplified, rather than created, the PD challenges experienced by teachers and coaches. Findings suggest that districts should invest in developing a sustainable CS instructional coaching program to provide flexible and personalized support to CS teachers with varied PD needs.

Investigating How Computer Science Teachers and Instructional Coaches Navigated Remote Professional Development During COVID-19: Implications for Instructional Coaching, Teacher Learning, and Qualitative Inquiry in (Post?)-Pandemic Times

In 2016, Chicago Public Schools (CPS) became the first district in the U.S. to establish Computer Science (CS) as a high school graduation requirement (Barrow et al., 2020). This policy pressed CPS to not only rapidly recruit CS teachers and train other content teachers to teach CS, but also to develop multiple and differentiated professional development (PD) opportunities for CS teachers with varied professional backgrounds and experiences (McGee et al., 2022). Since effective teacher PD is associated with improved student outcomes (Darling-Hammond et al., 2017; Desimone & Garet, 2015) and teacher retention (Nguyen et al., 2020; Shub & Maaz, 2021; Smith & Ingersoll, 2004), maintaining a robust system of CS teacher PD is imperative to the district's goal to ensuring equitable access to CS education. Yet, COVID-19 and the rapid transition to remote instruction threatened to halt the district's progress in training new CS teachers and increasing high school students' access to equitable CS instruction.

As schools nationwide shifted to remote instruction in March 2020, the Chicago Alliance for Equity in Computer Science (CAFÉCS) – a long-standing research practice partnership (RPP) comprised of university computer science faculty, educational researchers, curriculum designers, and CPS teachers and administrators – developed the "Navigating Remote ECS Teaching" (NEXT) PD series to support Exploring Computer Science (ECS) teachers with remote and hybrid instruction. Drawing on qualitative data, this study investigates how CS instructional coaches and teachers in CPS navigated remote PD and teaching during the pandemic. We found that, consistent with their original goals, the coaching team emphasized several key instructional strategies and supported teachers in translating those strategies to the

remote learning environment; in addition, responding to their noticing of teachers' needs, the coaching team increasingly centered their PD design efforts on improving teacher engagement and wellbeing. Teachers primarily valued the relational aspects of PD, including collaboration with other teachers and personalized support from the instructional coaches. Finally, our analyses showed that the pandemic and remote learning contexts amplified, rather than created, the PD challenges experienced by teachers and coaches, while also providing opportunities to innovate with different PD and coaching structures.

This study makes several contributions to research, policy, and practice. First, this study contributes to research on CS teachers' experiences with remote PD during COVID-19 (Crick et al., 2021a; Goode et al., 2020; Mouza, Mead, et al., 2022; Skuratowicz et al., 2021) and illustrates how the pandemic created a window of opportunity for PD innovations to develop. Second, leveraging recent research on effective professional development (Darling-Hammond et al., 2017; Desimone & Garet, 2015; Short & Hirsh, 2020) and an ecological perspective on teacher learning (Ehrenfeld, 2022), this paper demonstrates the analytic utility of situating teacher PD within multiple, interacting contexts and suggests that future research on the effects of exceptional circumstances like the pandemic should account for preexisting institutional conditions and crises. Finally, findings indicate that teacher PD could be designed to focus both on content and teacher wellbeing and provide multiple opportunities for teachers to build community during and beyond contexts of crisis.

This paper is organized as follows. We first present our literature review discussing key themes from the research on CS teacher PD and findings from the emerging line of research on CS teacher PD in the context of COVID-19. Next, we present our conceptual framework combining insights from research on effective teacher PD across content areas and an ecological

framework for analyzing teacher learning. We then describe our methodology and data sources, carefully situating the researchers' positionality within the context of the study. Finally, we present our findings and discuss their implications for research, policy, and practice.

Literature Review

In this section, we overview relevant research on CS teacher professional development before and during the COVID-19 pandemic and PD associated with the ECS curriculum.

Expansion of CS Education and Teacher Professional Development

Over the past decade, school districts, states, the federal government, and external organizations have made a concerted effort to increase students' access to CS education (Barrow et al., 2020). Such efforts, including the Obama administration's CS For All initiative and new state and district policies positioning CS to fulfill high school graduation requirements, necessitated the recruitment and training of new CS teachers (McGee et al., 2022; Yadav et al., 2016). One of the most common barriers to expanding students' access to CS education reported by school and district leaders is the lack of qualified CS teachers or funds to train other teachers to teach CS (Barrow et al., 2020; Bruno et al., 2022). Given the relatively small number of teacher candidates graduating with a CS teaching license, non-CS teachers are often asked to teach CS courses. Thus, efforts to expand students' access to CS education rely on recruitment of and ongoing PD for CS teachers, particularly those without CS backgrounds.

Recent studies have documented the substantial increase in CS teacher PD programs over the past decade and common challenges and affordances of expanding PD opportunities to CS teachers. Ni and colleagues' (2021) recent literature review of 41 different PD programs and professional learning communities (PLCs) for CS teachers found that CS PD programs exhibit many of the characteristics of effective PD for other content areas, such as content focus, active

learning, and opportunities for feedback (Darling-Hammond et al., 2017; Desimone & Garet, 2015) with additional features specific for CS education. For example, studies have emphasized the importance of focusing on CS content knowledge and pedagogical content knowledge (PCK) and providing teachers with contextualized follow-up classroom support in implementing new strategies (Mouza, Codding, et al., 2022). Other specific design features of CS PD programs are highly collaborative in nature and include the teacher-learner-observer model, pair programming, lesson design contests, and lead teacher model (Ni et al., 2021). Additionally, though they range in size and structure, PLCs for CS teachers have been found to increase teachers' self-efficacy and collaboration, empower educators as decision-makers and co-creators of CS curriculum, strengthen teachers' PCK, and provide support and a sense of community for CS teachers (Dogan et al., 2016; Ni et al., 2021).

CS PD programs employ a range of PD formats, including in-person, hybrid, and remote (Ni et al., 2021). One CS teacher PD program working to provide different formats for teacher PD is Exploring Computer Science (ECS), a widely-used, introductory CS program consisting of a yearlong course curriculum and extensive teacher PD. ECS is inquiry-driven and emphasizes problem solving, computational practices, and modes of inquiry associated with CS over specific syntax or tools and was designed to provide all students, especially those from historically underrepresented backgrounds in STEM fields (e.g., women, Black, and Latinx students), with an introduction to the field of CS (Goode et al., 2014; Goode & Margolis, 2011). One specific design feature of ECS PD is the teacher-learner-observer model, which involves small groups co-planning and co-teaching an assigned lesson, other participants acting as students, PD facilitators serving as silent observers, and everyone having time to debrief, reflect, and replan based on feedback and discussion (Goode & Margolis, 2011).

The ECS teacher PD program involves a summer institute, quarterly workshops, and a follow-up summer workshop (Goode et al., 2014). Prior to the pandemic, ECS PD programs and PLCs were experimenting with virtual and hybrid models. One study of an online ECS PD program noted a surprising result of "the excitement teachers expressed for being part of a national learning community of teachers, even when more local teachers might be available for collaboration" (Goode et al., 2020, p. 57). The authors posit that this remote PD option is especially needed to reach CS teachers across large geographic areas, such as rural communities.

CS PD Challenges

Many of the PD and PLC structures developed for the CS context (e.g., pair programming, lead teacher model, and lesson design contests) are considered "innovative" forms of PD, in that they engage teachers in collaborative, active, and contextualized learning (Darling-Hammond et al., 2017; Ni et al., 2021). However, the recent expansion of CS education also created unique challenges for training the rapidly growing cadre of CS teachers. One such challenge is the potential for CS teachers to be the only CS teacher within their schools (Goode et al., 2020; Yadav et al., 2016). Patrick and colleagues (2023) refer to teachers who are the only ones in their schools or districts with a specific teaching assignment as "instructionally isolated" and often lacking access to meaningful collaboration and community. Their analysis of statewide administrative records and survey data in Tennessee found that 40 percent of career/technical education teachers in the state are instructionally isolated within their schools, compared to English Language Arts (10%) and math (12%). The potential for CS teachers to be instructionally isolated highlights the importance of CS PD, and especially PLCs, to not only teach CS content and PCK but to also build community among CS teachers (Ni et al., 2021).

Another unique challenge unique to the CS context stems from the rapid expansion of CS education and small number of licensed CS teachers, resulting in teachers from various other content area teachers being assigned to teach CS (Bruno et al., 2022; Goode et al., 2020; McGee et al., 2022; Yadav et al., 2016). For example, after enacting the graduation requirement, CPS tripled the number of new CS teachers it added each year with a greater number of teachers becoming CS teachers through PD compared to those who earned CS endorsements (McGee et al., 2022). The volume of teachers coming from content areas outside of CS increase the likelihood of CS PD or PLC involving participants with a wide range of needs and expectations for PD (Bruno et al., 2022).

Overall, prior to the pandemic, the rapid expansion of CS education in the U.S. created a demand for new CS teachers and, relatedly, an increase in CS PD programs. Despite the many successes and innovations of CS PD and PLC models, the relatively new field of CS education confronts persistent challenges of working with instructionally isolated teachers and teachers with a wide range of CS backgrounds and PD needs.

CS Teacher PD During COVID-19

While the pandemic had an unprecedent impact on schooling, the timing of the pandemic collided with the increasing momentum of the CS For All movement and emergence of new state and district policies requiring students to take CS. To meet the demand for new CS teachers, districts continued providing PD throughout the pandemic in virtual formats. As previously discussed, virtual CS PD programs were not new, and research shows that virtual PD programs can be effective in increasing teachers' CS content knowledge, PCK, efficacy, and sense of community (Goode et al., 2020; Ni et al., 2021). Studies of remote CS teacher PD during the pandemic found that virtual PD increased teachers' knowledge and confidence and that teachers

valued many aspects of the virtual PD, such as exchanging curriculum ideas, tools, and resources and opportunities for professional collaboration and networking, and learning CS content (Crick et al., 2021b; Mouza, Mead, et al., 2022; Skuratowicz et al., 2021). Despite the stress and uncertainty of the pandemic, a study of remote PD designed for elementary teachers around infusing computational thinking (CT) found that proactively addressing teachers' technological issues, creating "shared physical experiences" (e.g., mailing teachers materials, props, personalized water bottles, and snacks ahead of time), infusing combination of individual and group activities, and giving teachers agency to move to different "rooms" created an engaging and positive PD experience for participants (Skuratowicz et al., 2021). Further, a study of CS teachers across the globe found that CS teachers, more so than other content-area teachers, had significantly more positive attitudes toward the shift to online teaching; however, CS teachers also raised concerns about their abilities to effectively teach about technology in an online setting and broader concerns about their increased workload (Crick et al., 2021a).

Emerging studies of CS teacher PD during the pandemic have shown the effectiveness of remote CS PD programs to overcome some of the disruptions caused by the pandemic and improve teachers' efficacy and content knowledge. At the same time, research on the teacher workforce in the context of COVID-19 has documented increases in teacher burnout, stress, working hours, intentions to leave the profession, and actual turnover (Bacher-Hicks et al., 2022, 2023; Diliberti et al., 2021; Diliberti & Schwartz, 2023; Gicheva, 2021; Goldhaber & Theobald, 2023). Because many CS teachers are drawn from other subject areas, broader teacher workforce trends are inextricably linked to the future of expanding CS education. While studies of CS teacher PD during the pandemic focused primarily on the design features of PD and teachers' immediate perceptions of PD, we know less about how CS teachers and PD providers

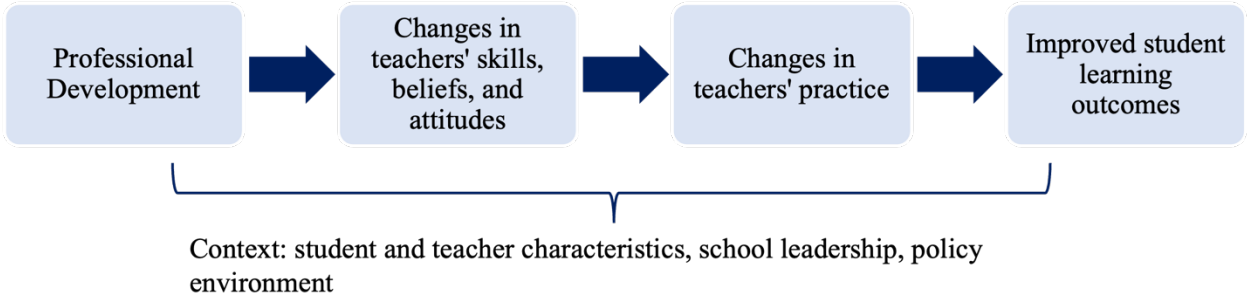
experienced remote PD within the context of the pandemic, their school and district contexts, and within the broader context of rapid growth in CS education in the U.S.

Conceptual Framework

To investigate the intersection of CS teacher PD and the COVID-19 context, our conceptual framework combines insights from research on effective teacher PD and a novel framework emphasizing the multiple, intersecting contexts of teacher learning. Effective PD refers to "structured professional learning that results in changes in teacher practices and improvements in student learning outcomes" (Darling-Hammond et al., 2017). According to a framework commonly used to analyze the impact of teacher PD, shown in Figure 1, PD ultimately leads to improved student learning outcomes by fostering shifts in teachers' knowledge, skills, beliefs, and attitudes and subsequent changes in teachers' practice (Desimone, 2009; Desimone & Garet, 2015).

Figure 1

Typical Framework for Analyzing Professional Development Impacts



Combining insights from recent literature (Darling-Hammond et al., 2017; Desimone, 2009; Desimone & Garet, 2015; Short & Hirsh, 2020), we identified and defined nine core components of effective teacher PD (see Table 1).

Table 1

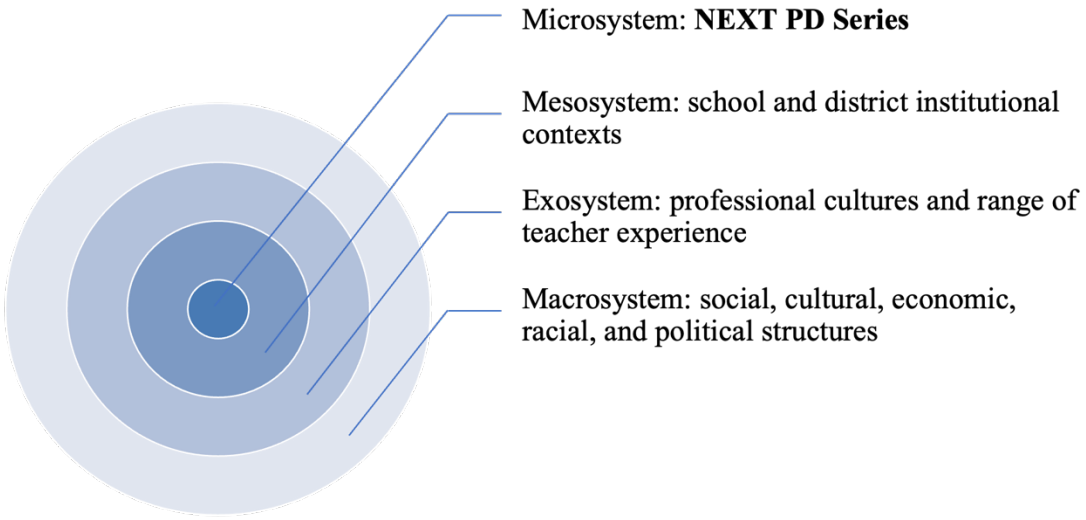
Core Components of Effective Teacher Professional Development

Component	Definition
Content Focus	Intentional focus on discipline-specific content, curriculum, and pedagogy
Active Learning	Opportunities for teachers to design, practice, get feedback on, and experience teaching strategies that they will use with students
Coherence	Content, goals, and activities are consistent with school and district curricula and goals, teacher knowledge and beliefs, students' needs, and school, district, and state policies
Sustained Duration	Activities that are ongoing throughout the school year and provide teachers with adequate time to learn, practice, implement, and reflect upon new strategies
Collective participation	Supports teacher collaboration and provides opportunities for groups of teachers from the same grade, subject, or school to participate in PD activities together and to build an interactive learning community
Modeling of Effective Practices	Includes curricular and instructional models that provide teachers with a clear vision of what practices and materials look like, including lesson plans, unit plans, sample student work, observations of peer teachers, videos, and/or case studies
Opportunities for feedback, coaching, and reflection	Provides access to coaching and expert support related to content, evidence-based practices, and their individual needs
Focus on equitable instruction	Develops teachers' understandings of how to prioritize and promote equitable instruction through high expectations for students, culturally relevant instruction; builds teachers' empathy for students, challenges their beliefs about what students can do
Change Management	Support individual and organizational change by treating teachers as learners, addressing individuals' concerns and group challenges when implementing new instructional materials, and providing opportunities to discuss and troubleshoot issues

Given the unique and unprecedented set of circumstances created by COVID-19, and the challenges associated with the rapid expansion of CS education over the past decade, we leverage an ecological framework to situate our analysis of the NEXT PD series within multiple context(s). Ehrenfeld (2022) argues that the typical PD model (i.e., Figure 1) overlooks how multiple contexts, and the interactions of those contexts, shape teacher learning, and applies Ecological Systems Theory (Bronfenbrenner, 1992) to PD research. This ecological perspective draws attention to multiple contexts of teacher learning, the interconnectedness of these contexts and teacher learning activities, and how teacher learning in PD is shaped by different phases of teacher learning trajectories (Ehrenfeld, 2022). As shown in Figure 2, we situate the NEXT PD series in its immediate context (microsystem), the school and district institutional context and remote instruction policies (mesosystem), the context of teachers' professional backgrounds and experiences with PD, and the broader sociopolitical context (macrosystem), including the pandemic, economic uncertainty, and protests in Summer 2020 against racial injustice.

Figure 2

Ecological Perspective of NEXT Teacher PD Series



Note. Adapted from Ehrenfeld, 2022.

NEXT PD Series

In March 2020, responding to the immediate challenges of transitioning to remote instruction during the emergence of COVID-19, CAFÉCS received a RAPID Collaborative Research Grant from the National Science Foundation (NSF) to support experienced ECS teachers in the remote learning environment. The RAPID project, "Mitigating the Impact of Forced Remote Learning of Exploring Computer Science (ECS) due to COVID-19," was guided by the following questions: 1) How can online PD be designed to support ECS teachers' transition to teaching the course fully or partially online during the 2020–21 school year? 2) How can the instructional coaching model be adapted to support teachers in moving ECS to a remote learning format and to provide remote coaching when school access is restricted?

CAFÉCS designed the "Navigating Remote ECS Teaching" (NEXT) PD series to support experienced ECS teachers with their implementation of equitable and inclusive instructional strategies for the remote learning context, to encourage peer coaching and collaboration among ECS teachers, and to generate strategies for supporting teachers remotely. CAFÉCS chose to focus the grant-funded PD series on experienced ECS teachers given that new ECS teachers were already served by existing PD programming and most CPS students take ECS to fulfill the graduation requirement (Barrow et al., 2020; McGee et al., 2022).

The NEXT PD series consisted of five workshops throughout the 2020-2021 school year, one-on-one and small-group instructional coaching opportunities, and a Coaching PLC to support the instructional coaches' professional growth. The first two-day workshop in August 2020 focused on re-grounding teachers in the ECS philosophy (teaching CS through a culturally relevant, inquiry-based approach), developing instructional strategies to recreate the ECS experience online, and providing teachers with strategies for fostering social-emotional

connections with students. The subsequent four workshops throughout the school year focused on adapting effective instructional strategies for remote instruction and supporting teachers' use of Google suite tools to implement those strategies. Table 2 shows the dates of each workshop and the number of attending teachers. After each workshop, teachers completed a survey with close-ended and open-ended responses about their general satisfaction with the workshop and specific instructional takeaways. Although feedback surveys showed that teachers were generally satisfied or highly satisfied with the workshops, workshop attendance declined over the course of the school year from 22 participants over the summer to 6 participants by the end of April.

Table 2

NEXT Summer and Quarterly Workshop Attendance

Date	Participants
August 24–25, 2020	22
October 21, 2020	15
December 9, 2020	8
March 3, 2021	7
April 28, 2021	6

As part of the NEXT series, teachers had several options for accessing remote instructional coaching: a Coaching Café, a Teachers' Lounge (Google classroom forum), and a teacher peer coaching program based on the Goals, Reality, Options, Will, Tactics, Habits (GROWTH) framework (Whitmore, 2010). The Coaching Café provided opportunities for teachers to engage in informal but structured discussions about different pedagogical topics. The Teachers' Lounge was designed to provide opportunities for small groups of ECS teachers to collaborate with the coaches on effective practices and teaching strategies regarding specific ECS lessons and computer science content.

Finally, to build the capacity of the coaching program and provide coaches with professional support, CAFÉCS created a remote Coaching PLC, comprised of leaders in CS curriculum development and CS education research and instructional coaches (hereafter, the "coaching team"). The coaching team shared responsibilities for designing and facilitating the NEXT workshops and met twice a month for a total of 19 times throughout the school year. During Coaching PLC meetings, the coaching team had several goals: reflect on teachers' feedback from the previous workshop, discuss teachers' needs, plan subsequent workshops, and develop a set of coaching strategies for the remote learning environment.

The design and implementation of the NEXT PD series and data collection were closely integrated. In addition to disseminating feedback surveys given to teachers at the end of each workshop, researchers conducted focus groups and semi-structured interviews (Weiss, 1995) with a total of 13 ECS teachers who participated in various components of the NEXT series. Further, at the end of each Coaching PLC meeting, the coaching team revisited and updated a coaching strategies document. One member of the team summarized the group's discussion into generalized meeting notes to capture the groups' concerns and experiences at a specific time point and share those notes with administrators in the Office of Computer Science and the leadership of CAFÉCS. Individual team members' concerns and comments were generalized to preserve the confidentiality of individual members.

In Fall 2022, the research team developed a technical report to share with funders and CAFÉCS members, based on an analysis of teacher feedback surveys, interviews, focus groups, and notes from the Coaching PLC meetings (Blaushild et al., 2022). Preliminary analyses of these data not only provided a unique snapshot into teaching and learning in the COVID-19 context, but also yielded emergent themes related to how the coaching team understood and

responded to teachers' specific needs during the pandemic and how those efforts were experienced by teachers. These emergent themes sparked several new research questions, which we explore in this paper:

1. How did teachers and coaches navigate remote PD during the pandemic?
2. How did the coaching team adapt PD to address teachers' specific needs during the pandemic?
3. What elements of remote PD were most valued by participating teachers?

Methods and Data

To understand how teachers and coaches experienced grant-supported professional learning opportunities, we analyzed data collected throughout the NEXT PD series (2020-2021) and the subsequent two school years (see Table 3). By extending data collection beyond the year of remote/hybrid instruction, our study provides unique insight into how participants experienced PD during the pandemic, reflections on their professional growth over the past few years, and how the challenges and innovations of the 2020-2021 school year persisted, or not into the post(?)-pandemic context.

Data Collection and Analysis: Phase I

The first phase of data collection took place throughout the NEXT PD series. After the two-day workshop in Summer 2020, all participating teachers (N = 22) completed a survey about their experiences in the workshop, perceptions about equitable instruction in CS, and their concerns about the upcoming school year. In September 2020, the research team conducted two focus groups via Zoom with a sample of teachers who attended the NEXT workshops to gain a deeper understanding of teachers' experiences and to share general feedback from teachers to the

coaching team. Toward the end of the NEXT PD series, the research team recruited teachers for individual semi-structured interviews and conducted an additional teacher focus group.

Due to a low initial response rate for interviews from teachers in spring 2021, the research team continued recruiting and conducting individual teacher interviews into the spring and summer of 2022. These interviews were designed to elicit a retrospective account of participants' experiences with PD during the pandemic, as well as their general perceptions of CS teacher PD opportunities and their professional growth.

To examine teachers' and coaches' experiences with PD throughout the 2020-2021 school year, we compiled teacher interview and focus group data and the Coaching PLC meeting notes into a single project in Dedoose and applied structured codes (Saldaña, 2013) aligned to the project's research questions (see Appendix A). We then used grounded coding (Charmaz, 2006) to explore emergent themes and attend to participants' unique experiences and language. Predictably, preliminary analyses showed that the coaching team designed the NEXT series to reinforce several instructional strategies integral to the ECS curriculum framework. However, our grounded coding surfaced emergent themes related to the coaching team's discussions of teacher wellbeing and ongoing development of coaching strategies to respond to a rapidly changing context (district policies) and COVID related challenges, which motivated our new research questions and the second phase of data collection and analysis.

Data Collection and Analysis: Phase II

To delve deeper into teachers' and instructional coaches' PD experiences and adaptations during the pandemic, we reanalyzed previously collected qualitative data and conducted additional interviews with instructional coaches and teachers, as shown in Table 3.

Table 3

Data

Data Source	Timeline of Data Collection	Number of Sources
Workshop Feedback Surveys	August, 2020 – April, 2021	5
Teacher Focus Groups	September, 2020; April, 2021	3
Teacher Interviews	April 2021 – January 2023	10
PLC Meeting Notes	September, 2020 – June, 2021	19
Instructional Coach Interviews	January-February, 2023	2

Table 4 shows participants' background characteristics and level of involvement in the PD series and research activities. Given the small sample size of instructional coaches, we refer to the coaches using gender neutral pronouns and do not share their demographic information.

Table 4

Description of Participants

	Demographics		*PD Exposure*		*Research Participation*	
Pseudonym	Gender	Race	Workshops Attended	Coaching	Interview	Focus Group
Teachers						
Blake	M	Black	4	X		X
Shawn	F	White	1	X	X	X
Aaron	M	White	5	X	X	X
Simone	F	Black	3	X		X
Kelsey	F	White	4	X	X	X
Joe	M	White	1	X		X
Sarah	F	Black	1			X
Ruth	F	Black	5	X		X
Stephanie	F	White	4	X	X	
Eve	F	Latinx	5	X	X	X
Elena	M	Latinx	0	X	X	
Jay	M	White	0	X	X	
Kyle	M	White	0	X	X	
Sadie	F	White	3	X	X	

Note. Demographic information for teachers was collected by the district.

Our analysis involved a mix of deductive and inductive coding strategies (Miles et al., 2014). We first developed a codebook with deductive codes aligned to the study's conceptual framework. These codes included the nine elements of effective PD we identified in recent

literature (e.g., content focus) and the four different contexts defined in Ehrenfeld's ecological perspective for PD (e.g., macrosystem). After applying these deductive codes to all data sources, we conducted several rounds of inductive coding to capture emergent themes and participants' unique experiences, and systemically applied these inductive codes to our data (see Appendix A). Finally, we used matrices and memoing (Miles et al., 2014) to explore and examine patterns in the data. We paid particular attention to how participants adapted to the challenges of remote instruction and which PD contexts and core components were most salient to participants' experiences.

Researcher Positionality and Reflexivity

The authors of this paper were involved in different aspects of designing and studying the NEXT PD series and entered the data collection and analysis processes at different stages. The first author joined the research team after the PD series and initial data collection had taken place and was a relative "outsider" to this research context (Young Jr., 2004). Using structured coding aligned to the RAPID grant's research questions and grounded coding (Charmaz, 2006) not informed by any personal or professional experience in CS education field, the first author identified several emergent themes for the team to explore in future data collection and analysis.

The second author joined the research team later in 2021 and was involved in data collection activities during spring and summer of 2022. Her involvement in this process with the third author and the two former research team members who conducted the interviews in spring 2021 helped her become familiar with the structure of the NEXT PD series and learn more about the context of the study. In addition, her ongoing work in another project with CS teachers in CPS (Blazquez et al., 2023) brought important perspectives to the discussions about this study's findings and implications. Thus, contextual insights provided by the second author helped shape

the data analysis led by the first author, as well as the next round of data collection and the writing of multiple drafts of the paper. In close collaboration, the first and second authors regularly discussed emerging themes and new directions during data collection and analysis, sharing extensive memos with insights and suggestions to advance the research. The third and fourth authors were members of the RAPID NEXT project team during the planning and implementation of the program and were relative "insiders" to the research context. They were not directly involved in the coding of the data but provided input on the coding frameworks and member checking on details of implementation of the program.

To overcome potential issues of reflexivity stemming from these different perspectives and entry points into the project, we discussed analyses, findings, and implications in regular meetings and compared descriptive and analytic memos to inform our analyses and interpretations of the data. These varied perspectives amplified our analysis by prompting each research team member to consider and develop novel insights.

Limitations

Low teacher response rates in the spring of 2021 prompted the researchers to continue recruitment and data collection into 2022 and early 2023. Although this extended recruitment allowed for the research team to include more teacher and instructional coach perspectives, their accounts may be less detailed than data captured closer to the PD series. However, we use workshop feedback surveys, taken by teachers immediately after each workshop, and the Coaching PLC notes, taken immediately after each bi-monthly meeting, to triangulate teachers and coaches' retrospective interview accounts. Further, while interviews are not designed to capture individual's situated behaviors or in-the-moment accounts, they are uniquely positioned to capture individuals' meaning making, imagined scenarios (e.g., ideal professional

development programming), and cultural scripts (e.g., perceptions of equitable CS education; Lamont & Swidler, 2014). Moreover, the individual interviews prompted teachers to reflect on their experiences with remote PD during the pandemic and more broadly about their professional growth and experiences with PD throughout their time teaching CS.

Our study documented the declining participation in the NEXT workshops, the coaching teams' challenges with teacher engagement, and several participating teachers' discussions of why they did not attend a particular PD. However, due to the selection bias issue of which teachers opt into research activities, we do not have a full picture of non-participating teachers' reasons for not engaging or gradually disengaging from CS teacher PD during and beyond the pandemic. Although PD programs provide useful opportunities to recruit teachers for research, future studies should seek to include CS teachers who do not attend PD to understand their needs and potential barriers to accessing PD.

Findings

In this section, we elaborate on our findings. We found that, while the primary goals of the NEXT PD series were to reground teachers in key ECS instructional strategies, the coaching teams' primary PD adaptations and teachers' most salient takeaways from remote PD were relational. The coaching team increasingly centered teacher wellbeing as an explicit goal of instructional coaching and PD workshops and devised multiple opportunities for teachers to engage with coaching and PD. Teachers primarily valued opportunities for collaboration and community-building with other CS teachers, sharing instructional strategies and resources with other teachers, and the personalized instructional support and emotional support provided by coaches. Finally, while the macro-level impact of COVID-19 disrupted teaching and learning on an unprecedented scale, many of the challenges surfaced by teachers and the coaching team

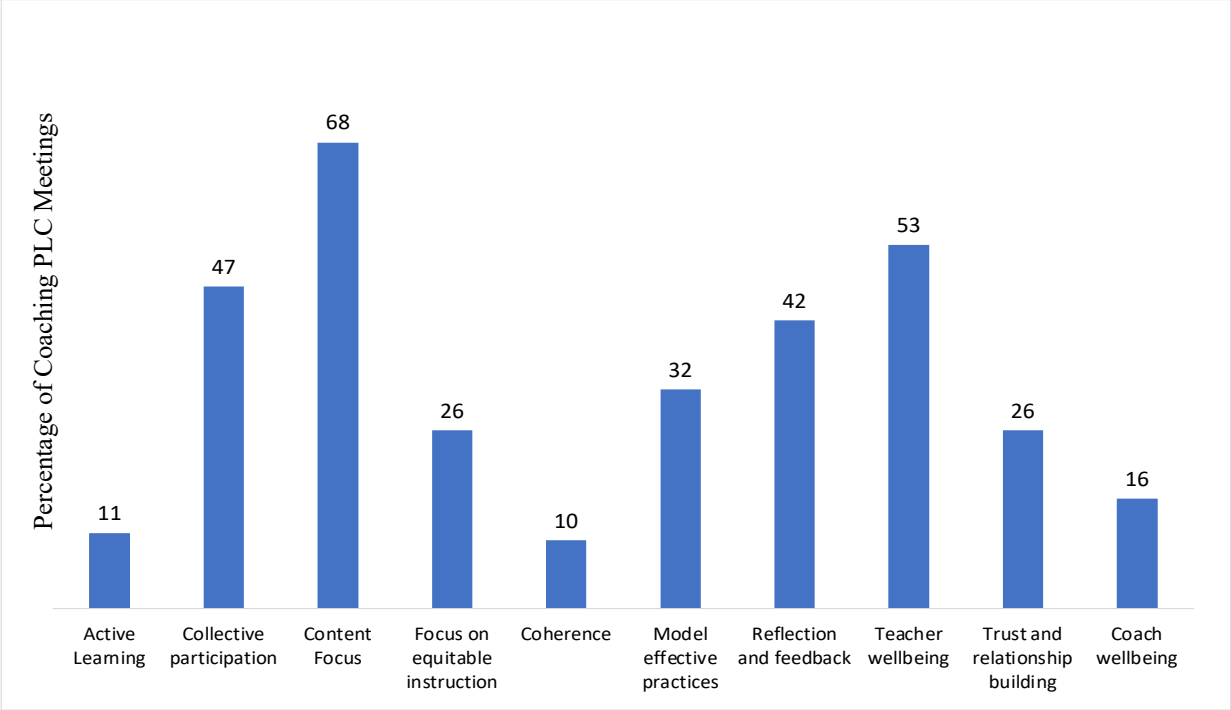
stemmed from their school and district institutional contexts, which predated, though may have been exacerbated by the pandemic. While the remote learning context created opportunities for innovation with new PD structures, preexisting challenges in the institutional environment may inhibit the expansion of those innovations.

Centering Instructional and Emotional Support through PD

Consistent with the original goals of the RAPID grant, the coaching team primarily designed the NEXT series to help teachers implement the ECS curriculum remotely. However, as shown in Figure 3, the coaching team also frequently discussed teachers' wellbeing.

Figure 3

Topics Covered in Coaching PLC Meetings



Focusing on a Narrow Set of Instructional Strategies. As the district rapidly transitioned to remote instruction in March 2020, one of the instructional coaches reflected feeling "a little bit of panic" because they had no prior experience teaching lessons virtually.

However, throughout the 2020-2021 school year, the coaching team committed to (re)grounding teachers in the ECS philosophy and supporting teachers in translating key ECS teaching strategies to the remote learning environment. In an interview, the coach explained:

> We're still going to do journaling. We're still going to do think-pair-share in like the web unit or the programming unit… they're still going to do pair programming. They're going to work with a partner. It's just that managing it or how you set it up might look differently… And so once we had it like, 'Okay. Yeah, that's right,' then we felt a little bit more empowered [laughs]. (Instructional Coach)

Teachers' feedback on the two-day summer workshop in August 2020 was largely positive, with all 22 teachers indicating that they were "satisfied" or "highly satisfied" with the workshop. 95% of participants reported that they agreed or strongly agreed that they had a "greater understanding of inquiry-based strategies as a result of participating in ECS PD." In open-ended survey responses, teachers shared that discussing strategies in small groups (breakout rooms), peer reviewing each other's lessons, experiencing activities from the "student perspective" in the online environment, and working with new resources as a group were beneficial to their preparation for the 2020-2021 school year. Teachers also reported that the summer workshop informed their own approach to teaching remotely by introducing them to "a lot of resources to help facilitate lessons remotely that I will be using this fall" and that "it was good to get concrete examples of how to teach each lesson." One teacher reflected on how the workshop helped them realize that "we don't need to change the curriculum, just figure out how to use different tools to carry out the lessons with students."

Responding to feedback raised in post-workshop surveys at the first two teacher focus groups conducted in September 2020, the coaching team realized they needed to change how

they framed and presented instructional strategies to teachers. Planning for the quarterly workshops, the coaching team noted that, when introducing an instructional strategy, they would provide teachers with a pre-reading or some other evidence to provide external validation of the importance of the strategy. They also planned to model the instructional strategy during workshops and coaching sessions and follow up the modeling with a discussion about how participants engaged in the strategy as learners (Coaching PLC meeting notes). Later in the school year, the coaching team formalized this idea into one of their instructional coaching strategies:

> LESS is MORE. We need to keep focused on the one central goal of a PD session… and let that one goal drive the activities. With that, the activities need to be limited in scope to ALLOW time for modeling of effective questioning and elicitation of response/engagement. (Coaching PLC Meeting Notes, February 24, 2021)

By focusing on one key strategy at a time, the coaching time aimed to convey the importance of these strategies to students' success in ECS and provide teachers with enough time to implement and reflect on these activities.

Teacher Wellbeing and Engagement. In addition to focusing on a narrowed set of instructional strategies, the coaching team increasingly discussed and attempted to address teachers' wellbeing. In an interview, one instructional coach reflected on their main priority at the beginning of the 2020-2021 school year:

> I believe just teacher wellness. Number one, making sure they were okay and their families were okay. And just allowing them the opportunity or just having that safe space to even share with us maybe what they were going through, you know, at that particular time. So really being a good listener, I feel, was extremely important and valuable. And it

> was just – yeah, just having that space to do that, and to also just have someone who could understand and who was willing to come inside their classroom and to really see what was happening. (Instructional Coach)

During the winter and spring meetings, PLC meetings increasingly focused on teachers' and coaches' emotional needs, especially as CPS began to plan for the return to in-person instruction in 2021. The PLC meeting notes documented how the instructional coaches were aware of teachers' growing anxiety about returning to in-person instruction. For example, during an early December Coaching PLC meeting, the team recorded this observation in their notes:

> There is a noticeable combination of fatigue and worry. CPS leadership is wrestling with the idea of returning to in-person learning after holiday break while simultaneously continuing with remote teaching and learning; there is no perfect solution and it's taxing for teachers to manage both audiences at once. (Coaching PLC Meeting Notes, December 2, 2020)

This general observation surfaced throughout PLC meetings in January and February 2021, with the coaching team noting how teachers appear "very exhausted and stressed" and that "all feels very overwhelming."

By early January 2021, CPS began incrementally reopening schools for in-person instruction, a decision met with mixed responses from parents and community members and intense opposition from the Chicago Teachers Union (CTU) (Koumpilova, 2021). High schools were the last to reopen in April, 2021, given the additional challenge of managing crowded hallways during transitions (Kunichoff, 2021). Since students were given the option to return to in-person instruction or continue learning remotely, teachers were required to simultaneously

deliver instruction in-person and virtually. The coaching team noted these changes during informal observations:

> Teachers and students are back in school to some extent–not a lot of concrete data to report but informal observations by the instructional coaches indicate small numbers of students actually present in school classes (1–5 students, often) and the teacher is present and working with in-person and online students at the same time. (Coaching PLC meeting notes, April 20, 2021)

The PLC meeting notes show the coaching team's awareness of how the uncertainty around the district's return to in-person instruction affected teachers emotionally and the coaches' commitment to keeping this source of stress in mind when planning for professional development and coaching. Looking ahead to the final workshop, the team discussed their priorities of infusing the strategy of pair-programming into the workshop but also keeping teacher wellbeing front of mind. In the spring, the PLC notes included this discussion point: "If we can do something constructive and at the same time emphasize that survival is the number one goal… What are some ways we can help each other with this and acknowledge that perfection is not the goal?" (Coaching PLC meeting Notes, April 9, 2021).

While the pandemic created unprecedented challenges for teachers' mental and physical health, focusing on teacher wellbeing was not new for the instructional coaches. In an interview, one instructional coach described their takeaways from attending a PD centered on instructional coaching as partnership (Knight, 2010) and switching to a "dialogic model" of coaching:

> One of the things that was high on our list was, first, you know meeting the teacher, learning about them, and trying to build that trust. And there are sometimes where, you know, I would go to a school and with the intent on, okay, we're going to learn – we're

> going to focus on the binary numbers lesson and think of some strategies to get students more engaged… [but] I ended up in the session just letting the teacher talk and we didn't talk about binary numbers. We talked about, you know, what's happening in the school or with them… sometimes I felt like a therapist [laughs]… and [as coaches] we were completely okay with that. (Instructional Coach)

This example shows how instructional coaches, prior to the pandemic, understood their roles as encompassing both instructional and emotional support for teachers and adapting their coaching strategies to teachers' specific needs.

In addition to addressing teacher wellbeing during the unprecedented context of the pandemic, the coaching team confronted declining participation in NEXT workshops (from 22 teachers in August 2020, to 6 teachers at the final workshop in April 2021) and declining response rates from teachers to emails throughout the year. Concerned about not reaching enough teachers, the coaching team devised several ways of communicating with and providing instructional support to teachers, including newsletters, virtual classroom visits, virtual one-on-one check-ins, and small group coaching sessions.

Since teacher feedback on post-workshop surveys was generally positive, it is possible that teachers' declining attendance indicated something other than not finding the workshops helpful to their practice (e.g., other time commitments or lack of childcare). One teacher explained:

> We just get so overwhelmed, you know, as teachers. … we just have so much going on, and so much to do constantly. And so, it's you know, it's like nice during summer, you meet some people, you talk to them. But when the school year really gets going, you

> know it's just a couple emails here and there, and then optional sessions that I don't even really feel like I have the time for. (Kyle, ECS teacher)

Throughout the Coaching PLC meetings, the coaching team acknowledged that despite participating teachers' positive feedback about workshops or surveys, there were still many teachers who, for whatever reason, were not engaging with instructional coaching or PD.

PD Innovations. To address the challenges of engaging and supporting teachers with remote instruction, the coaching team devised several innovative strategies, some of which persisted beyond the 2020-2021 school year. For example, noticing a lack of teacher interest in one-on-one meetings, the instructional coaches developed the Coaching Café for small-group virtual coaching sessions. The Coaching Café was designed around two goals: 1) discuss an instructional strategy or a challenging upcoming lesson and model an instructional strategy; and 2) provide teachers with a space to ask coaches or other teachers questions about their practice. Although the coaches were not completely satisfied with teacher engagement in virtual PD opportunities, they noted that the Coaching Café helped improve teacher participation in coaching. Participation improved even further when money left over from the grant allowed coaches to provide stipends for teachers who attended PD. After seeing increased buy-in from teachers who were being compensated for attending after-school PD, one coach explained feeling "very strongly that after we saw the increase in participation, like, yeah, they should be paid for that if they're going to do that, if we're going to do it after school."

Another PD innovation developed by the coaching team during remote instruction and coaching was virtual classroom visits, an idea that had been discussed but never enacted. Prior to the pandemic, CPS purchased video equipment and a cloud service to allow teachers to record their instruction and share videos with their coaches, but few teachers took advantage of the

opportunity. However, during the pandemic, teachers became more open to the idea of virtual classroom visits by their coaches, which allowed the coaches to address several preexisting PD challenges. Before COVID-19, the coaches noticed that teachers were often reluctant to schedule in-person meetings given the time commitment, and in-person classroom visits often required coaches to drive from one end of the city to another to meet teachers at different schools. Virtual visits became a more efficient and logistically easier option for coaches to observe classroom instruction and meet with teachers and increased teachers' willingness to meet with coaches.

Virtual classroom visits, coupled with Coaching Café, also helped coaches understand teachers' challenges in the remote environment. As one coach explained:

> Although we were instructional coaches, we had never taught virtually before, you know. So it was an opportunity for us to grow and to see how things were developing and happening in their space. And as a result of that to be more solution oriented around how can we best support them in this space… just having a pre-conversation with them, coming inside their virtual classroom space, looking at different ways of engaging students in that space, which looks different than engaging them in-person… And then just having those debrief conversations with teachers after our visit and just hearing what is going well for them, hearing what their concerns and challenges, what the barriers are, and just being a means of service and support for them. (Instructional Coach)

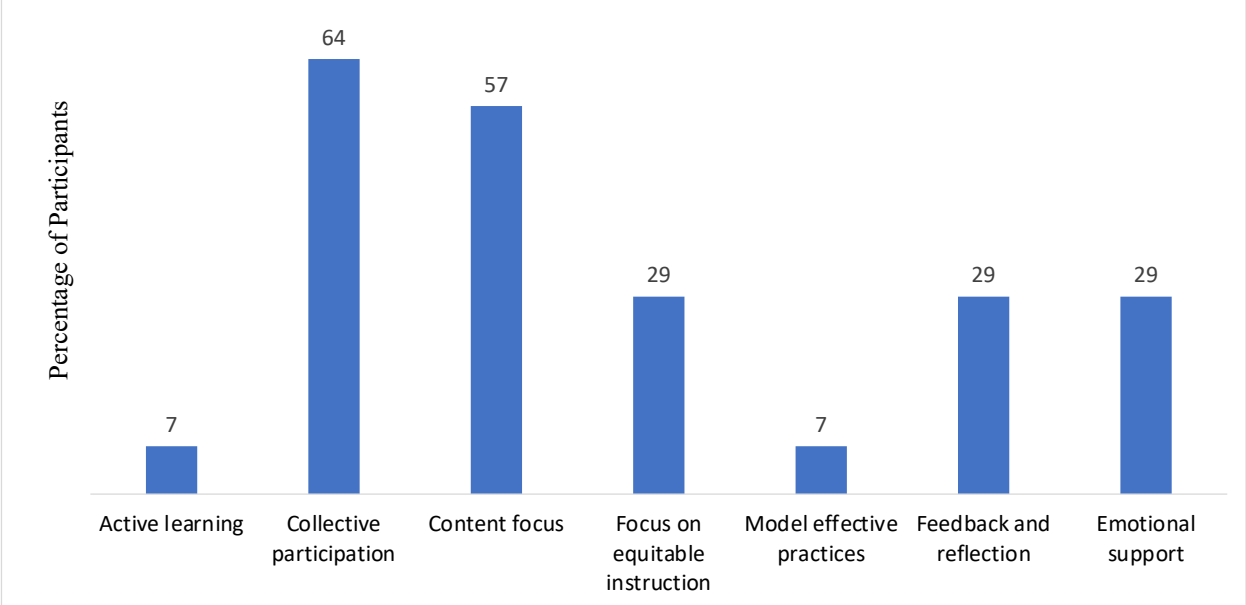
Although CS teachers and coaches confronted numerous and unexpected challenges during the pandemic, remote instruction created a window of opportunity for the coaching team to devise new ways of engaging teachers in PD and building their own skills as instructional coaches.

Teachers Primarily Valued Collaboration and Community

Above all else, teachers primarily valued the relational aspects of the NEXT PD series, which included opportunities to collaborate with other CS teachers and build a professional community. Figure 4 shows the PD elements teachers described in interviews and focus groups as being the most valuable.

Figure 4

Most Valued PD Elements Described by Teachers in Interviews and Focus Groups



While content focus was also highly valued, many teachers shared that they learned the most about different instructional strategies and resources from collaborating with other teachers.

In addition to the instructional benefits of sharing resources and ideas with other teachers, five teachers discussed gaining a sense of community with fellow CS teachers and coaches throughout the workshops and/or coaching sessions. As one ECS teacher explained:

> It's just being able to hear other people's approaches to problems you're dealing with… And part of it is just the emotional connection of being able to connect with other

> teachers and share the struggle… I remember sitting down to [the last meeting] and being like I just really don't want to do this today but then really enjoying the meeting itself. Like, the hardest part is just like hitting the button to join. But then once you're there, you know, you remember. You're like, I like these people. (Aaron, ECS Teacher)

Notably, many teachers described being the only CS teacher in their schools (i.e., being "instructionally isolated") and thus relied on PD to build community and collaborate with other CS teachers in the district.

Teachers also valued developing strong relationships with their coaches and receiving emotional support during coaching sessions. As one teacher explained:

> I've come into it stressed, like it's been a hard week, I'm not sure what I am going to do. And they would always [be] just kind of very professional, supportive. They would deflate any tension. And they, on more than one occasion, made, like, trips out to [my school] to plan with me… it made me feel like, okay, they are there for me beyond just like a transactional 'I'm your coach.' Like, they developed a lot of relationships. (Jay, ECS teacher)

This teacher's perception of his coach being there beyond a "transactional" relationship shows how the coaching team's extensive discussions about teachers' emotional needs and efforts to lead with empathy were evident to teachers.

While NEXT workshops focused on several key instructional strategies, small-group and one-on-one coaching allowed for personalized support. One teacher explained how she improved her practice by working one-on-one with her coach:

> I had a really, really hard time implementing group work in my classrooms, and so it was actually through guidance mainly from [my coach]. Like, they were, like, okay, explain

> what you have, like, what you have in your classroom. Give me like, a layout. They even came to visit. So it was like with their guidance, I was able to implement some of the strategies that we talked about. Some of the strategies didn't work out so well. So we tried new ones. So it was all about the suggestions they gave me, the ideas. (Elena, ECS teacher)

These responses – receiving targeted support on planning and implementing instructional strategies and individualized support from coaches – were common among teachers in interviews, focus groups, and NEXT workshop feedback surveys.

Interaction of COVID-19 Pandemic and Institutional Contexts

When COVID-19 emerged, it overhauled schooling and created countless challenges for educators, affecting their PD needs, teaching challenges, and capacities to attend PD; these challenges also compelled the coaching team to develop innovate ways of supporting teachers, including small group coaching and remote classroom visits. Nonetheless, despite the unique and unprecedented challenges of a global pandemic, many of the PD challenges raised by CS teachers and the coaching team transcended the COVID-19 context. Although amplified and (re)surfaced by the context of the pandemic, many PD challenges mentioned by participants stemmed from conditions in the school and district institutional context (mesosystem) and broader challenges associated with the CS teacher workforce (exosystem).

CS PD Challenges in CPS. Prior to the pandemic, the CS graduation requirement necessitated the recruitment of new CS teachers and training other content area teachers (Barrow et al., 2020), whose professional backgrounds and PD needs differ (Bruno et al., 2022; Yadav et al., 2016). In the four years following the enactment of CS as a high school graduation requirement in CPS (2016-2020), the district tripled the amount of incoming CS teachers each

year, with more teachers attending PD to teach CS than earning a CS endorsement (McGee et al., 2022). While the increase in CS teachers helped to significantly expand the number of schools offering CS (Barrow et al., 2020; McGee et al., 2022), teachers' PD needs also expanded.

Though teachers held generally positive views of NEXT workshops and coaching, some maintained their critiques that ECS professional learning opportunities do not offer enough "CS content." Some of the survey feedback and teacher focus groups about the summer workshop surfaced a common concern from many teachers about the lack of specific CS content included in the two-day workshop. As one teacher with two years of ECS teaching experience said:

> A lot of the PDs focus so much on the inquiry and equity strands that we don't ever get that third [content] strand… we do need those three strands, but I feel like the PDs a lot of times ignore the CS concept strand because they're like "oh, well you can Google it." (Shawn, ECS teacher)

The coaching team was familiar with this common point of teacher feedback. During the October 28, 2021 PLC meeting, the coaching team noted: "There is always tension between teachers always wanting more 'content' and not wanting to focus on ECS-philosophy instructional strategies (equity/inquiry)." Since the ECS program's philosophy is to teach problem solving, computational practices, and inquiry more so than specific programming languages (Goode & Margolis, 2011), it is unsurprising that the NEXT PD series (and other ECS PD opportunities recalled by teachers during interviews and focus groups) remained focused on key ECS pedagogical strategies.

The coaching team interpreted this common critique from teachers wanting more "CS content" as possibly indicating a lack of confidence on their part, in that they feel more confident with their teaching practice overall but less confident teaching specific CS content. While this

perception from the coaching team might characterize newer ECS teachers, several experienced ECS teachers appeared ready to move beyond what ECS PD provided. In teacher focus groups and interviews, three teachers expressed their desire for PD to accommodate the needs and interests of experienced ECS and motivate newer CS teachers to continue developing their CS content knowledge. They hoped that future PDs could offer support for teachers who are ready for more advanced CS knowledge and want to teach AP CSP, and that workshops could provide opportunities for teachers and facilitators to work through more advanced materials together. As one teacher articulated, designing PDs for teachers who are ready to move forward with more advanced content could "help build the confidence of those teachers to say that I want to do more than just ECS." He continued:

> I think that we really still haven't defined like what is a transition to AP CSP. And a lot of teachers are not going to – if I'm coming from English, to think that I'm going to take a class after ECS is really hard for them to conceptualize because they really haven't gotten a chance to really get into that content and understand the ebb and flow to say I can visualize me going on to the next curriculum. But I don't think we foster that quite enough to get them excited about doing it. (Blake, ECS teacher)

This teacher's sentiment – that some ECS teachers are interested in attending PD that deepens their CS content knowledge and prepares them to teach more advanced CS courses – was shared by other participants and highlights some ECS teachers' desires to engage in more advanced CS teacher PD opportunities. While these challenges predated the pandemic, COVID-19 and remote instruction amplified teachers' feelings of isolation, burnout, challenges accessing PD, and frustrations that PD opportunities did not fit their specific needs or interests.

The coaching team attempted to mitigate some of these challenges surfaced by teachers with innovative PD approaches (e.g., small group coaching and virtual classroom visits). However, despite seeing some success with these newer approaches, the coaching team named several institutional barriers at the district level that could inhibit these innovations from expanding. Chiefly, the coaching team remained small, and the future of the coaching program was often in-flux, a theme that surfaced throughout the Coaching PLC meetings until participants learned of renewed funding for the coaching program into the following school year (2021-2022). Feeling uncertain about the instructional coaching program's future, one coach described a lack of "opportunities to work together as a team," because "we are short staffed, so we don't necessarily have a group of or a team of instructional coaches." They continued that the program had been unable to continue the small group coaching structures that emerged, and were valued by teachers, during the pandemic:

> I just don't have the bandwidth to do all of that and so pretty much what we have done is to, we had to find another way to support new teachers. This year we have almost 50 new teachers… So we've developed the ECS professional learning community… we have some of our veteran teachers and facilitators who are helping to lead those groups… I feel like although we've identified teachers who could be in those leadership roles, it's hard to just throw teachers in the role without training teachers… you still need to build their capacity. They need to have a space to learn, to grow, and to really reflect. (Instructional Coach)

Here, we see instructional coaches grappling with a both district-level issue (insufficient and inconsistent investment in CS instructional coaches) and a common challenge associated with CS4All initiatives (the increase in CS teachers outpacing the means to support them) (Bruno et

al., 2022; Ni et al., 2021; Yadav et al., 2016). Such challenges preceded and transcended the pandemic, despite the many strategies developed by the coaching team during remote PD.

District and Community-Level Challenges. The coaching team's noticing of teachers' stress is consistent with reports of teachers' increased working hours, stress, and feelings of burnout across U.S. schools throughout the pandemic (Diliberti et al., 2021; Gicheva, 2021). However, the uncertainties of the pandemic and the return to in-person instruction were not the only stressors the coaching team noticed and attempted to address. The Coaching PLC notes revealed the team's concern for teachers' feelings of isolation sparked by the pandemic coupled with the trauma associated with recent incidents of community violence. During a Coaching PLC meeting in March 2021, the team noted:

> This has been a dark week for everyone. We have teachers and students who have limited to no connection or interaction, and this is damaging. Not being able to process things is unhealthy. Additionally, two ECS teachers–one local and one national passed away and this has added layers. To experience another shooting/tragedy just adds to the massive loss (layers of loss) for people this year. (Coaching PLC Notes, March 25, 2021)

These observations continued as the team planned the final NEXT workshop for April 28, 2021. The team noted how "this is a very hard time for everyone right now, especially teachers. Being mindful of emotional health is critical." They acknowledged how these circumstances can impact people "differently and we must be respectful of that." In this example, the coaches noticed and attempted to respond to teachers' feelings of isolation and stress sparked by community violence and loss.

Overall, the salience of these challenges – teachers' unmet PD needs, instructional coaches' lack of capacity to expand valued PD structures, and trauma associated with

neighborhood violence – shaped teachers' experiences of PD during COVID-19 but were not caused by the pandemic or shift to remote instruction. In that way, teachers' experiences with CS teacher PD were shaped by multiple contexts, including the pandemic (macrosystem), the district and community context (mesosystem), and the range of teachers' CS PD experiences and professional needs (exosystem).

Discussion

This study investigated how teachers and instructional coaches navigated remote PD during COVID-19. We found that, consistent with the aims of the RAPID grant, the instructional coaching team designed the NEXT PD series to reinforce key instructional strategies; additionally, they increasingly noticed and attended to teachers' emotional needs. Teachers reported that focusing on key instructional strategies helped (re)ground them in the ECS framework and build community with and among students in the remote environment. Teachers also expressed feeling emotionally supported by their coaches and gaining a sense of community with other CS teachers throughout workshops and small-group instructional coaching. Notably, we found that even though this study was situated in the context of COVID-19, pandemic-related challenges were less salient to participants than other teaching and PD challenges inherent to the dsitrict and broader CS education contexts. Thus, the pandemic amplified *preexisting* challenges for CS teacher PD throughout CPS. In this section, we discuss implications of our findings for research, policy, and practice.

Investigating Multiple Contexts of Teacher Learning

Leveraging an ecological framework in our analysis (Bronfenbrenner, 1992; Ehrenfeld, 2022) illuminated how multiple contexts of shaped teachers' experiences with and access to CS PD. First, the broader context of CS education – namely, its recent expansion and demand for

new CS teachers – created several PD challenges for CPS teachers. Consistent with the research on CS teacher PD in the past decade (Mouza, Codding, et al., 2022; Ni et al., 2021), many participating teachers were the only CS teachers in their schools and/or did not have CS backgrounds. Thus, "instructional isolation" (Patrick et al., 2023) and wide-ranging PD needs were part of the exosystem shaping CS teacher learning during the pandemic.

Additionally, the local district and community context (mesosystem) shaped teachers' experiences and need to support students through crises long before COVID-19. CPS is one of the largest school districts in the nation (Chicago Public Schools, 2022) and the first to enact a high school graduation requirement for CS (Barrow et al., 2020), making it a unique context to study both the expansion of CS education and PD and how those initiatives were disrupted or not by the pandemic. At the same time, many conditions in the school and district instructional contexts (i.e., the mesosystem shaping CS teacher learning) stem from broader social, economic, and political structures in the macrosystem, such as the short and long-term effects of COVID-19, rising economic and political uncertainty, rising incidents of gun violence, and protests against police killings of Black people in summer 2020.

While this study focused mostly on the pandemic context, our analysis surfaced many challenges that teachers and coaches faced before, during, and after the pandemic. Some of these challenges are tied the conditions and histories of a large urban district characterized by segregation, concentrated poverty, school closures, disenfranchisement, educational inequities, and teacher turnover (Allensworth et al., 2009; Darling-Hammond, 2014; Ewing, 2018; Ingersoll et al., 2018; Ladson-Billings, 2006; Milner & Lomotey, 2014; Papay et al., 2017; Scallon et al., 2021). Although research shows that many teachers desire to work in urban and high-poverty schools, they also face numerous challenges related to school instability and insufficient

resources to meet students' diverse cultural, linguistic, academic, and socioemotional needs (Andrews & Donaldson, 2009; Frankenberg et al., 2010; Kraft et al., 2015; Olsen & Anderson, 2007; Quartz, 2003; Simon & Johnson, 2015). Thus, the pandemic was a unique crisis, but still one of many ongoing crises shaping teachers' working conditions and interactions with students in a large urban school system.

Overall, adapting an ecological framework of teacher learning (Ehrenfeld, 2022) to studying the NEXT PD series illuminated how the intersection of COVID-19 and preexisting conditions in the district and broader CS education field influenced teachers' PD experiences during the pandemic. By adapting this framework into the CS context, our study makes a novel contribution to the literature on CS teacher PD. More broadly, the utility of this framework indicates that future studies of COVID-19 impacts on teaching and learning should consider the multiple contexts of student and teacher learning.

Integrating Teacher Wellbeing into Models of Effective Teacher PD

The challenges of the pandemic, which amplified preexisting challenges in the school and district contexts, brought out the coaching team's concerns for teacher wellbeing and their attempts to address teachers' instructional and emotional needs through PD. Attending to the multiple contexts affecting teachers' experiences, this study illuminated multiple stressors for teachers and coaches that transcended the pandemic context. Given the constant challenges brought to Chicago teachers' physical and mental health by meso- and macrosystem contexts (i.e., gun violence, economic and political conditions, etc.), we suggest that teacher wellbeing should remain a focus in PD and coaching approaches in post(?)-pandemic times. Building on emerging research on remote teacher PD during the pandemic (Crick et al., 2021a; Mouza, Mead, et al., 2022; Skuratowicz et al., 2021), our study highlights the need to account for the

humanistic side of PD, as both teachers and instructional coaches discussed the importance of providing and receiving emotional – in addition to instructional – support.

The Coaching PLC team's frequent discussions of teacher wellbeing raise questions about where an explicit focus on teacher wellbeing fits into the typical model of effective professional development (e.g., Darling-Hammond et al., 2017; Desimone & Garet, 2015). While the Carnegie Corporation's recently published framework for Curriculum-Based Professional Learning (CBPL) acknowledges teachers' emotional responses to change in its Concerns-Based Adoption Model (Short & Hirsh, 2020, p. 35), a focus on wellbeing is not often explicitly part of the effective PD model. Our study highlights the need for PD providers and facilitators to factor teacher wellbeing into the design and implementation of teacher PD, particularly during times of crisis, in which teacher burnout and stress are more prevalent (Diliberti et al., 2021), and where PD has historically caused more teacher stress (e.g., curriculum and policy reforms) (Datnow, 2018; Hargreaves, 2004; Zembylas, 2010).

The various coaching models designed and implemented by the coaching team, and teachers' perceptions of instructional coaching, show that PD should be designed to attend to teachers' emotional and instructional needs. Recent evidence suggests that, across contexts, teachers experienced increased stress, feelings of burnout, and intentions to leave the profession during the pandemic (Diliberti & Schwartz, 2021; Gicheva, 2021; Pressley, 2021; Steiner & Woo, 2021) but that positive working conditions and feeling a "sense of success" with students sustained some teachers' commitment to teaching (Kraft et al., 2021). These emerging findings from the height of the pandemic suggest the need for school leaders, instructional coaches, and PD providers to focus on teacher wellbeing in addition to supporting their instructional improvement.

Additionally, though the need for attention to teachers' wellbeing is more likely to be recognized during times of crisis, we argue that crisis situations amplify, rather than create, the emotional load teachers carry in their day-to-day work (Hargreaves, 1998). While the challenges brought by times of crisis might be shared among teachers, they are also tied to the teachers' individual experiences and identities, and the specific contexts in which they live and work (Hodgen & Askew, 2007; O'Connor, 2008; Schutz & Lee, 2014, 2014). Thus, this study suggests the need to add a focus on wellbeing as part of the effective PD model. Adding systematic ways to address teacher wellbeing to teacher preparation and support is important to ensure that teachers are supported in their work as they face day-to-day challenges (i.e., within the microsystem) that often overlap with other stressors that coexist in their teaching environment (i.e., within the exosystem, mesosystem, and macrosystem). Overall, our findings suggest that PD should be designed to focus both on instruction and teacher wellbeing and provide multiple opportunities for teachers to build community, which is crucial in the context of rising teacher burnout and turnover (Bacher-Hicks et al., 2021, 2023; Diliberti et al., 2021; Diliberti & Schwartz, 2023; Goldhaber & Theobald, 2023).

Investing in Adaptable and Flexible PD Structures for CS Teachers

Our findings provide insight into how PD and instructional coaching structures, particularly those designed to support teachers both instructionally and emotionally, are key aspects of teachers' working conditions that could improve their practice and commitment to teaching during challenging circumstances. Consistent with prior research on CS teacher PD (Goode et al., 2020; Mouza, Codding, et al., 2022; Ni et al., 2021; Pollock et al., 2017), our study showed that remote CS teacher PD could effectively convey CS-specific pedagogical strategies, build community among CS teachers, and provide opportunities for teachers to share resources.

However, interviews and focus groups surfaced teachers' varied PD needs and expectations and that some of their PD needs were unmet. Specifically, some teachers were frustrated by a lack of opportunities to deepen their expertise with programming or learn other areas of CS. Persistent turnover rates in urban schools, the popularity of the ECS course, and continued need for CS teachers indicates that there will always be a need for introductory CS teacher training in CPS. However, our findings suggest that some experienced ECS teachers seek opportunities to expand their knowledge of CS content and teach more advanced CS courses.

Thus, our study indicates that during times of crisis and beyond, CS teachers could benefit from PD opportunities that are flexible and adaptable to their specific needs. The Coaching PLC notes and interviews with instructional showed that the coaches were aware of and able to quickly adapt to meet teachers' needs and benefited from reflecting on their own practices as coaches. Given teachers' needs for differentiated PD and the instructional coaches' capacities to meet teachers' personalized needs, districts should invest the recruitment and training of instructional coaches, developing a cadre of instructional coaching opportunities for teachers, and ensuring that teachers are allotted time throughout the school day and school year to access PD. Though challenging to scale, instructional coaching is recognized as a highly effective strategy for improving instruction and implementing new educational policies (Blazar et al., 2023; Woulfin, 2015, 2018), insofar as coaches are given adequate time and resources to work with teachers (Cummings et al., 2023). As our findings suggest, in times of crisis, coaches who are adept in supporting teachers' emotional and instructional needs can be crucial to teachers' motivation to grow their practice and persist through challenging teaching circumstances.

The availability of instructional coaches for CS teachers in CPS is both timely and critical. Although CPS was a leader in the CS For All movement by becoming the first district in the nation to adopt CS as a high school graduation requirement, other districts and states are rapidly catching up to these policies (Ni et al., 2021; Yadav et al., 2016). This suggests that the need for CS teachers and CS PD will continue to grow, and experienced CS teachers in CPS might find the working conditions, instructional supports, and professional communities in nearby districts more appealing.

Conclusion

This paper presented CS teachers' and instructional coaches' experiences and adaptations to the remote learning environment during COVID-19. In designing and implementing the NEXT PD series to help teachers translate the ECS curriculum online, the coaching team noticed and responded to teachers' emotional needs and developed several innovative coaching models to increase teacher engagement and support. While it is perhaps unsurprising that teachers highly valued the relational aspects of PD during the pandemic, school and district conditions and the ongoing effects of the pandemic on teaching suggest that PD programs and research should explore how PD can be designed to equally support teachers' instructional practice, sense of community, and wellbeing.

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Appendix A

Codebook

I. Structured codes to index major categories or themes, specifically those asked about in interviews:

1. **Impact of NEXT workshops on professional growth:** Includes participants' descriptions of how NEXT workshops impacted (or not) their professional growth.

2. **Impact of coaching on professional growth:** Includes participants' descriptions of how coaching (in SY21 or SY22) impacted their professional growth.

3. **Impact of other professional learning experiences on professional growth:** includes participants' discussions of how other professional learning experiences (e.g., college or master's-level courses; external PD) impacted their professional growth (not NEXT workshops or coaching).

4. **Professional growth since beginning of CS teaching/coaching:** Includes participants' descriptions of how they have grown professional since they began teaching/coaching computer science.

5. **Initial challenges:** Includes participants' descriptions of challenges that they recall facing when they first started teaching (or coaching) computer science.

6. **Current challenges:** Includes participants' descriptions of challenges they are facing *currently* while teaching computer science.

7. **Unmet professional learning needs from NEXT workshops/coaching:** includes participants' discussions of what the NEXT workshops or coaching did *not* include that they would have liked to experience during workshops or coaching sessions
*must refer specifically to what NEXT/coaching did not offer, not general hopes for PD (use code below for that).

8. **Unmet professional learning needs (in general):** includes participants' discussions of additional hopes/needs from professional development in general, not specific to NEXT/coaching (i.e., in response to: "what else might the district have done to support you better?").

9. **Valued PD Elements:** Includes specific PD structures, practices, or activities named by teachers as being valuable to their professional growth.

II. Deductive codes aligned to conceptual framework:

10. **Content focus:** Includes PD's intentional focus on discipline-specific content, curriculum, and pedagogy; this includes a focus on instructional strategies, such as those integral to the ECS curriculum (i.e., inquiry).

11. **Active learning:** Includes PD's opportunities for teachers to design, practice, get feedback on, and experience teaching strategies that they will use with their students; use authentic artifacts, interactive activities, and sensemaking strategies that they will use with their students; *not* passively listening to lectures.

12. **Coherence:** the PD's content, goals, and activities are consistent with school and district curricula and goals, teacher knowledge and beliefs, students' needs, and school, district, and state policies.

13. **Sustained duration:** PD activities that are ongoing throughout the schoolyear and provide teachers with adequate time to learn, practice, implement, and reflect upon new strategies.

14. **Collective participation:** Supports teacher collaboration and provides opportunities for groups of teachers from the same grade, subject, or school to participate in PD activities together and to build an interactive learning community. Includes discussions of sense of community, professional community for safe practice.

15. **Modeling of effective practices:** PD includes curricular and instructional models that provide teachers with a clear vision of what practices and materials look like, including lesson plans, unit plans, sample student work, observations of peer teachers, videos, and/or case studies.

16. **Opportunities for feedback, coaching, and reflection:** Teachers have access to coaching and expert support related to content, evidence-based practices, and their individual needs.

17. **Focus on equitable instruction:** PD develops teachers' understandings of how to prioritize and promote equitable instruction through high expectations for students, culturally relevant instruction; PD includes efforts to builds teachers' empathy for students, challenges their beliefs about what students can do; includes efforts to support students' SEL needs.

18. **Change management:** The PD is designed to support individual and organizational change by treating teachers as learners, addressing individuals' concerns and group challenges when implementing new instructional materials, and providing opportunities to discuss and troubleshoot issues.

19. **Mesosystem:** Includes discussions of school and district institutional contexts, such as policies, norms, and practices (e.g., covid/remote instruction policies)

20. **Exosystem:** Includes discussions of teachers' professional experiences, professional communities, and prior experiences with professional development; includes online (e.g., Facebook) communities if not directly aligned to NEXT workshops/coaching.

21. **Macrosystem:** Includes discussions of social, cultural economic, racial, and political structures, including the neighborhood and school community context, and larger sociopolitical climate.

III. Inductive Codes added throughout analysis to attend to emergent themes:

22. **Teacher wellbeing:** Includes discussions of teachers' emotional and physical health, job satisfaction, sustainability of work, resilience, and feelings of stress, burnout, and secondary trauma.

23. **Professional development challenges:** Includes challenges related to designing, implementing and reaching teachers through PD and teachers' barriers to attending/accessing PD.

24. **Professional development adaptations:** Changes made by PD developers/coaches in response to perceived teacher need or other contextual factors.

25. **Covid-19 challenges:** Includes discussions of instructional or other challenges specifically related to the pandemic (i.e., remote instruction, childcare, having to quarantine).

26. **Trust and relationship building:** Includes discussions of intentional efforts to build trust and relationships with and among colleagues, teachers, and students; coaching as partnership.

Appendix B

Coaching Strategies Developed by Coaching Team (compiled in Coaching PLC notes)

1. Build trust and community as top priority to obtain commitment to PD this year.

2. Focus on listening/needs-sensing and collaboratively designing PD for teachers since we are amid many "unknowns" related to teaching environments, schedules, etc.

3. Keep "eye on the prize" which is identifying ways to ensure the experienced ECS teachers fully understand and practice inquiry and equity-based strategies in their classrooms

4. Regularly organize/prioritize different coaching levels/groups based on visible needs (e.g., general pool of ECS teachers for coaching, PLC, Teachers' Lounge, Coaching Café).

5. When instructing an instructional strategy, provide *evidence* such as a pre-reading during the PD to emphasize our focus on this instructional strategy, provide validation of the strategy, and gain teacher buy-in to the strategy

6. Model techniques (strategies) during coaching/PD, for example to elicit volunteers to talk (could do color-coding, counting off, or popsicle stick).
    a. Model Think/Pair/Share as an instructional strategy during the PD and follow up with a group discussion about the process they engaged in "as learners" and what benefits they see for this type of strategy used with their students.

7. Use Journaling checklists to allow (and scaffold/support) teachers' reflections on instructional strategies

8. Establish NORMS (expectations) for participating in breakout rooms/group activities

9. Have a concrete goal for the teachers that requires they do something between now and the next PD (accountability, productivity, engagement for students)

10. To engage at the start of class/session: set it up, build, make connections between parts

11. Student Care starts with Teacher Care. Weave elements from PLC PD Day into Coaching.

12. Work directly with teachers on three ECS "big strategies" that can and should involve questioning; specifically, how can these strategies be made better by good questioning? (Pair Programming; Think, Pair, Share; Gallery Walk)

13. Empathy continues to be instrumental in coaching and PD for teachers. COVID has caused at least two deaths of faculty in the district, and it hits home for many students and teachers; find out where teachers are in any moment and honor that in addition to providing appropriate support on content and strategies.

14. It is critical to not to focus on pushing through activities more than paying attention to making time for rich student conversation; this is where questioning skills come into play.

15. The choice of technical tool should be driven by the instructional goal, i.e., choose the Right Tool for the Right PURPOSE. Lead with pedagogy and selecting the tool that supports those goals.

16. LESS is MORE. We need to keep focused on the one central goal of a PD session, e.g., authentic questioning strategies to draw out student engagement, and let that one goal drive the activities. With that, the activities need to be limited in scope to ALLOW time for modeling of effective questioning and elicitation of response/engagement.

17. It is critical to highlight the work of teachers to provide support and recognition for their efforts – this also builds community and respect among the larger group of ECS instructors and provides models for new ECS teachers. One strategy for accomplishing this is to FEATURE ECS teachers and facilitators in monthly OCS newsletters.

18. The importance of self-care for coaches is critical. In addition, operating with the mindset of flexibility and adapting to changing circumstances.