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# Resonant Learning: Tracing Teacher Growth Through a Longitudinal CS Research-Practice Partnership

Nitasha Mathayas, University of Illinois at Urbana-Champaign, mathaya2@illinois.edu
Chrystalla Mouza, University of Illinois at Urbana-Champaign, cmouza@illinois.edu
Santiago Ospina-Tabares, University of Illinois at Urbana-Champaign, so27@illinois.edu
Hilary Mead, University of Delaware, hmead@udel.edu
Lori Pollock, University of Delaware, pollock@udel.edu

**Abstract:** This longitudinal study examines one elementary teacher's sustained engagement in a computer science (CS) focused professional development (PD) project to understand how she integrated CS into her lessons over three years. Analysis of interviews and lesson plan materials using TPACK and teacher professional growth frameworks demonstrates that she integrated CS instruction with increased task complexity and relevance to students over time. Implications for PD design and sustained teacher engagement follow.

## Introduction

This longitudinal study examines one teacher's computer science and computational thinking (CS/CT) professional growth within a research-practice partnership (RPP) to understand how she integrated CS/CT into her lessons over time and what motivated her sustained engagement with the project. Despite the growing importance of CS education, qualified CS teachers remain scarce, with minimal professional development (PD) opportunities at the elementary level (Ahadi et al., 2024; Code.org, CSTA, ECEP Alliance, 2024). Driven by this need, CS4DE was an NSF funded RPP active from 2020 to 2025 aimed at enhancing educators' capacity to teach CS/CT in elementary grades in one Mid-Atlantic US state (Mouza et al., 2022). The project involved an annual summer PD grounded in the framework of Technological Pedagogical Content Knowledge (TPCK or TPACK) (Mishra & Koehler, 2006) followed by classroom implementation support by the research team during the school year. During the tenure of this project, some teachers consistently returned each year and participated in the study.

In this paper, we present our analysis of one teacher, referred to by the pseudonym Yvonne, to examine what she learnt from participating in the PD and how she implemented her learning within her school context. Grounded in established frameworks of TPACK and teacher professional learning, as outlined in the following section, we investigate the evolution of her professional practices and seek to answer two research questions: (a) In what ways did Yvonne's understanding of CS/CT-integrated instruction change over time? and (b) What external contexts supported her sustained engagement with the project?

## Theoretical frameworks

This study was guided by two frameworks: TPACK-CS/CT (Mouza et al., 2025) and the *Interconnected Model of Professional Growth in an Organizational Context* (henceforth called PGOC) (Hayes et al., 2024) which together address the knowledge and professional learning of the teacher that can come from PD. TPACK-CS/CT refers to the knowledge teachers require to integrate computational literacy into content area teaching. This framework expands TPACK by characterizing CS/CT knowledge for K-12 teaching. For example, in the pedagogical knowledge (PK) domain, it outlines CS/CT-Specific PK with examples like CS unplugged instruction, pair programming, and knowledge of CS teaching materials such as the CSFirst curriculum. In PGOC, teacher learning takes the form of dialogic reflection, where teachers process teaching experiences through reflection to connect pedagogical insights to classroom outcomes. Notably, PGOC attends to local organizational contexts, such as school principal support or a teacher's access to quality curriculum, that can enable or constrain teachers' instruction. In this study, PGOC enhanced our data analysis by helping us interpret how school contexts shaped Yvonne's engagement with CS4DE.

## Case study analysis

Yvonne was a Chinese language and technology teacher at a private elementary school in a Mid-Atlantic U.S. state. She attended three consecutive summer institutes (2022, 2023 and 2024) and received school-site support during the academic year. The dataset includes nine documents. In 2022, we collected one document: her summer-institute lesson plan. In 2023, we collected five documents: her summer-institute lesson plan and interview, plus her implemented lesson plan, interview, and field notes from the school year. In 2024, we collected three documents: her implemented lesson plan, interview and field notes from the school year. We employed a hybrid deductive and inductive coding (process Miles et al., 2019) to analyze the data, coding it in alignment with

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TPACK-CS/CT. Coding was conducted in cycles while refining the process until interrater reliability of 80% was achieved in tests conducted using Dedoose software. PGOC was then applied to interpret the Context/Environment codes from TPACK coding to understand how school systems influenced Yvonne's instruction. The main themes from our analysis are presented below.

## Findings

### In what ways did Yvonne's understanding of CS/CT-integrated instruction change over time?

To compare codes across the years, we calculated the mean TPACK-CS/CT code frequencies by the number of documents collected per year and found mixed patterns (Table 1). Specifically, the number of excerpts coded for equity-oriented PK, CS/CT-Specific PK, CS/CT-Specific TK, and context increased, while the frequencies of the remaining codes varied. These patterns suggest a shift in the content of Yvonne's documents toward equity-oriented CS/CT pedagogy. On exploring coded excerpts more closely, we saw that Yvonne consistently integrated Chinese dialog into Scratch projects, and increased instructional complexity each year involving more CS/CT-specific technological and pedagogical knowledge (e.g. pair programming, unplugged activities) and equity-oriented pedagogical strategies (i.e., culturally relevant pedagogy). Together these shifts made the content more rigorous and more relevant to students.

**Table 1**
*Mean Code Frequency Per Document (n) Collected.*

| Code name | 2022 (n=1) | 2023 (n=5) | 2024 (n=3) |
|---|---|---|---|
| Equity-Oriented Pedagogical Knowledge (PK)* | 2 | 2.2 | 3.3 |
| CS/CT – Content Knowledge (CK) | 5 | 3.2 | 1.3 |
| CS/CT Specific Pedagogical Knowledge (PK)* | 4 | 4.2 | 5 |
| CS/CT Specific Technical knowledge (TK)* | 0 | 1.6 | 3.7 |
| Context/Environment* | 0 | 0.2 | 1.7 |

*Codes marked in * indicate increase. Only relevant codes are presented in the table.*

### What external contexts sustained her engagement with the project?

On reviewing excerpts coded with Context/Environment (Table 1), we found that Yvonne drew on support from her school principal and the PD team in ways that gradually increased her confidence and sustained her involvement with the PD. Her principal first encouraged her to attend the PD in 2022 and continued to support her efforts each year. In following years, Yvonne utilized PD school-site support to get feedback on her lesson plans, then borrowed robots for classroom use, and arranged for university students to teach more technical CS topics to her students. By 2024, she described how this incremental growth strengthened her confidence: "Each year I think I learn more and become more and more confident, and that made me want to come back." Overall, her ongoing relationship with her principal and the PD team strengthened over time and helped sustain her engagement with the project.

## Conclusion

Our preliminary findings suggest that PD design that combined a summer institute with follow-up school-site support can contribute to one teacher's sustained engagement. Organizational support and localized feedback also enabled the teacher to strengthen practice systematically over time toward equity-focused, integrated lessons. In other words, resonance between the PD and school context supported long-term engagement. Continued research can help identify factors that contribute to successful RPPs across diverse teaching contexts.

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