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Designing Professional Learning Workshop for Shaping Teachers' Learning Pedagogical Content Knowledge in Computational Thinking

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Abstract: The study focuses on understanding the discourse, interaction, and problem-solving relating to pedagogical content knowledge (PCK) demonstrated by teachers in one professional training workshop on Computational Thinking (CT) and its implementations in classrooms.

Introduction and theoretical framework

While the application of Computational Thinking (CT) to both student's educational experiences and teacher's professional development has been wide (Liu et al., 2022), the discussion on how best to support professional development the process and outcome of such professional development have been scarce (Sengupta et al., 2018). The present study focuses on a single training workshop for teachers in a longitudinal CT professional development project to understand:

1. How did the teachers engage in a professional development workshop featuring design thinking?
2. How did the interactions between teachers and the workshop facilitator shape teachers' pedagogical content knowledge?

Introduction and theoretical framework

Context

The workshop that the present study focused on had two stages: 1. Conceptualizing with teachers the implementation of CT in classrooms through discussion; and 2. Engaging teachers in CT-embedded group projects to experience CT in practice. A facilitator was present throughout, but the teacher participants remained actively engaged. The workshop lasted approximately two hours.

Data sources and analysis

Qualitative observational data was videotaped. One dyad (two teachers) was selected based on their high willingness to implement CT yet both experiencing challenges in doing so. Their self- and other-directed behaviors in workshop were coded, with emergent codes of teacher's engagement pattern presented in Table 1.

Table 1
Code Scheme for Teachers' Engagement Pattern to Instruction

	Positive Engagement	Negative Engagement	Disengagement
Immediate	Eye-Contact or Nodding	Engage in distractions	Disengaged from the facilitation
	Answering Questions	Engage in actions/interactions that are discouraged by the facilitator	Ignoring additional instructions
Delayed	Providing additional examples	Using key concepts for slight sarcasm	Disengaged from the facilitation
	Paraphrasing key concepts		

Results

RQ 1. Three levels of engagement patterns in the workshop were identified (i.e., positive engagement, negative engagement, and disengagement) that are either immediate or delayed (Table 1), providing six distinct types. When engaged, the participants showed a moderate level of positive engagement toward the instructions, which aligned with the intention of the facilitator's instructions. However, instances of negative engagement and disengagement were also present, indicating times when the teachers' responses mismatched the instructor's intention or expectation. A notable distinction can be drawn between the two stages of the workshop. In the conceptualizing stage, participants showed mostly positive engagement or disengagement, but both at a mild level, indicating boredom, instead of intense satisfaction or dissatisfaction toward the content. However, during the practical ideation stage where participants were given a CT-embedded group task to complete, the level of engagement drastically increased. Specifically, both immediate and delayed positive engagement were demonstrated up-prompted by the participants, showing an active effort both to communicate and reflect on the CT concepts introduced.

RQ 2. A few features from the teachers' interaction stood out to challenge the effectiveness of the workshop on shaping teachers' knowledge. First, although teachers mentioned key concepts naturally during their group project ("we are *empathizing*", "What type of learning is this? *Kinesthetic* where you would have to touch things?"), these comments were made as social tools to lighten up the mood through humor and sarcasm, instead of for learning and conceptualization means. This speaks to both the challenges for the teachers to internalize new concepts, as well as their misunderstanding of the key points. Second, teachers held near exclusively pessimistic views about their students when providing anecdotal classroom experiences as examples ("my kids would cry". This again shows that teachers found implementing CT in the classroom to be challenging and were reluctant to change. Third, at no point in the workshop did any of the teachers asked follow-up questions or mentioned potential hesitation they may have toward the facilitation, despite them clearly having faced challenges in implementing CT in classrooms in the past. Any question that was raised was about the in-the-moment technical or logistical problems that they have for the workshop, instead of conceptual ones that speak to the core intention of the workshop. This shows that, even if shown positive engagement, the teachers rarely engaged with the concepts at a deep level.

Discussion and scholarly significance

Overall, the findings from the present study support that: 1. Teachers generally positively engaged in the professional development workshop, while 2. Their depth of engagement where relatively shallow. In other words, the discourse, interaction, and problem-solving demonstrated by the teachers showed that the workshop may not have fully prepared them to develop CT-related PCK and implement them in classrooms.

The challenge of integrating CT has long been present, with past research pointing to the technical difficulty of the computing tools as a key factor (Ketelhut et al., 2020). The present study, though, provides an additional layer to this challenge by indicating how the type and depth of engagement from the teacher participants are also critical. This becomes especially poignant given the rapidly changing and ever more diverse world that the teachers today teach in, where computationally literacy and accessibility must coincide.

While the present study was able to identify engagement as a key factor in effective CT professional development projects, future work can be done related to how best to design a project that supports positive and deep engagement from teachers and translates to a successful implementation of CT in classrooms.

References

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