

Middle School CS Teachers' Perceptions of Standards-focused PD

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Abstract: Standards can support access to quality instruction. We examine how a standards-focused professional development (PD) approach can supplement traditional curriculum-based CS PD to improve teacher capacity. Using a case study approach, we explore two teachers' perceptions of standards-focused PD and its effects. Findings indicate that teachers did not initially view standards as essential to their teaching but those who persisted through PD eventually advocated for making standards-focused PD compulsory for all CS teachers.

Introduction

The "Computer Science for All" initiative posits that CS education will drive social mobility and economic competitiveness in the 21st century. This movement promotes CS standards as a means to support improvement in both CS curriculum and instruction. Even though 39 US states have adopted CS standards based on the K-12 CS Framework and the CSTA standards, CS's newness as a K-12 subject, uneven CS implementation, the broad scope of the standards (Basu et al., 2022), the loose alignment of available curricula with standards, and the lack of accountability in use of standards during instruction limit the potential of these standards to guide curriculum choices and instructional quality. In order for CS standards to influence curriculum and instruction, similar to other established disciplines such as Mathematics and Language Arts, CS standards will need to be interpreted uniformly and comprehensive teacher professional development (PD) provided for effective use of standards.

The current study explores how standards-focused PD can support middle school CS teachers by empowering them to use CS standards to strengthen instruction. Unlike conventional CS PD, which focuses on how to implement a particular curriculum (Ni et al., 2023), we focus on PD around five standards in the Algorithms and Programming strand that is meant to complement, rather than replace, curriculum-specific PD. We investigate two research questions: 1. *How do teachers perceive and react to standards-focused PD and professional learning resources?* and 2. *How do standards-focused PD and professional learning resources influence teachers' CS content knowledge and self-efficacy for teaching CS and using formative assessments?* We aim for our study to enrich the literature on CS teacher education and standard-focused CS professional learning.

Study Context and Description

Prior to the standards-focused PD, we developed a set of educative resources unpacking five middle school CS standards into granular learning targets (LTs) and offering practical examples of each LT and potential student challenges. We also developed a set of standards-aligned formative assessment tasks and rubrics. The assessments were tested with students via cognitive interviews and refined. These professional learning resources were shared with teachers before the PD sessions. Over a three-month period, we facilitated three virtual PD sessions (two hours each). For each PD, we began with a close reading of the CSTA standard, a mapping to the state CS standards, and the scope of the standard. Next, we presented a decomposition of the standard into fine-grained LTs and discussed examples of what these LTs would look like in different programming languages (Scratch, Python, and JavaScript). Teachers then reflected on these activities by identifying the correspondence between CS lessons and specific LTs and which LTs they had covered or planned to cover in their courses. Next, teachers discussed examples of common student challenges related to the standard and engaged with examples of formative assessment tasks for selected LTs. They practiced using the rubrics to identify potential student challenges, and discussed how the challenges might be addressed. After each PD, teachers reviewed the resources, selected and administered some of the formative assessment tasks in their classes, and evaluated students' responses.

We began our study with six teachers, but only two were able to commit the time to learning about CS concepts and formative assessments. We use a case study approach that focuses on these two teachers, Dina and Rose (both pseudonyms), who participated in the entire PD series and used multiple formative assessments with their students. Both are White, female, middle school CS teachers in the same district in the Midwestern US with over 20 years of teaching experience. We leveraged several data sources – PD recordings, PD exit surveys, semi-structured teacher interviews, and teacher responses to a PCK survey before and after the study – and conducted a selective coding process to generate themes related to teachers' perceptions of the standards-aligned PD.

Findings

Theme 1: Teachers initially viewed standards as irrelevant but grew to value them after attending PD.

We found that all participating teachers, including Dina and Rose, came to PD unfamiliar with CS standards and did not initially consider them relevant to their CS teaching. Dina and Rose told us they did not pay attention to CS standards because report cards focused on digital literacy standards, and teachers are not accountable for CS standards. But, after our PD sessions, they felt prepared to better anticipate and address student challenges.

Theme 2: Teachers only learn how to facilitate CS curricula and do not learn CS content through their curriculum-specific PD; hence, they want standards-focused PD to emphasize the underlying CS concepts more and want to spend more time with each standard. Drawing a comparison with other CS PD sessions, Rose elaborated, “The only other training I’ve gotten is in Code.org ... Code.org does such a nice job, whether it’s teaching the standards or not, of breaking things down to very easy baby steps. So, I feel I can deliver those lessons in a meaningful way to my kids, but that doesn’t necessarily mean that I know anything about CS. They (code.org) were very very different because you’re trying to teach a broader field of CS, and Code.org is trying to teach you how to, you know, it’s an app, how to use it and make your thing.”

Theme 3: Teachers were unaware of the learning objectives for lessons in their curriculum and sought assistance on when to use formative assessments. Teacher asked us to suggest junctures in the curriculum where different assessments might be useful because of their lack of awareness of how lessons mapped to learning objectives. Dina expressed dismay at the lack of CS learning objectives provided by her district. She advocated for using learning objectives as a basis for selecting a curriculum rather than teaching whatever the chosen curriculum covers. She hoped her district would make standards-focused PD compulsory for all teachers.

Theme 4: Teachers valued the standards-aligned formative assessments and rubrics but also found them time consuming. Dina and Rose found it enlightening to see practical examples of formative assessment in CS and felt the assessments helped students think about the CS concepts more deeply. The teachers also valued the rubrics which they felt shifted the perspective from grading to diagnosing student challenges. However, they recognized the need for making formative assessments more feasible.

Theme 5: Improved teacher PCK and self-efficacy for teaching algorithms and programming concepts and using formative assessments. Across our three PD exit surveys, Dina and Rose strongly agreed that they acquired a deeper grasp of the CS standards from the PD and felt equipped with the resources to engage in the PD. Both teachers reported improved self-efficacy in using formative assessments and diagnosing students’ CS understanding from pre to post study, but they reported challenges in selecting relevant formative assessments. Dina also reported a considerable increase in confidence for teaching algorithms. **Improved content knowledge.** Based on the PCK survey, we found that both Dina and Rose showed improvement on their understanding of CS concepts such as variables, ability to evaluate students’ code, and ability to align CS activities with granular LTs. However, both teachers still had challenges with some CS content such as nested conditionals and indicated that they found the PCK survey challenging though they took less time on the post-survey than the pre-survey.

Conclusion

In this paper, we explore how two middle school CS teachers perceived standards-focused PD and professional learning resources provided to them to supplement their district provided curriculum-specific PD. The teachers were initially skeptical but grew to appreciate the standards’ relevance to their teaching. Engaging with standards-focused PD not only supported their own content knowledge and ability to interpret the standards, but also increased their confidence and awareness of the importance of having students engage deeply with concepts in unplugged settings. We acknowledge the limitations of our study, such as our small sample size, focus on a limited number of CS standards, and working with teachers from the same district who both used the same CS curriculum.

References

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