

Pathways to Teaching K12 Computer Science: Implications of a Pilot Study of Ten States

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Abstract

While the U.S. government tracks teacher certification, this tracking is limited to initial certification. However, many computer science (CS) teachers did not initially certify in CS but in another subject. As a result, there is a data gap involving pathways to CS teacher certification, pathway requirements, and the number and characteristics of teachers who pursue each pathway. This gap in the data landscape may be an impediment to the goal of expanding CS education: a lack of understanding of these pathways may inhibit recruitment, retention, and ensuring that the pathways adequately prepare educators to support student learning.

To address this gap, we have begun a project to map the pathways to CS teacher certification. This poster describes our initial phase of data collection. The dataset combines content analysis of state websites and other state documents with interviews. We have gathered data about each pathway to teaching CS and its requirements.

Our findings from this phase suggest some important implications for CS education. First, we explore possible adjustments to the extended CAPE codebook, which also serve as an enumeration of themes that emerged from our analysis that are not common in other CS education research. We also explore how the requirements for CS certification pathways have important implications for CS professional development and curriculum providers, CS education researchers, and certification pathway providers and state-level decision-makers. We briefly outline our future work, which includes expanding data collection to more states and to the count and demographics of teachers in each pathway.

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1 Further Information

The U.S. federal government releases the Title II report each year, providing data on initial teacher certification. However, many CS

teachers achieve certification via a route other than initial certification; for example, a math teacher might earn an add-on license to teach CS by taking a CS content exam. While the states track information about these pathways to certification, there is no comprehensive national-level data tracking for all pathways to CS certification. A better understanding of the national landscape of CS teacher certification – including changes over time – is an important component of efforts to ensure that all K12 students have access to high-quality CS instruction [6]. This poster is part of a larger project that is piloting the collection of data for pathways to CS teacher certification in the U.S.; it describes the piloting of data collection for ten states – and the implications of our findings.

We selected ten states to pilot test our data collection efforts. These states were chosen to represent a variety of approaches to and levels of development of CS teacher certification efforts: we include, for example, Minnesota, which does not yet have a CS license, as well as Georgia, which has both a standard CS license as well as a more limited ‘micro-endorsement’ [3]. We gathered data about CS teaching pathways via (1) content analysis of publicly-available documentation about CS teacher certification and (2) interviews with those with expertise about CS teacher certification in each state, eventually interviewing representatives of nine of the ten states in the data set.

Data gathered for each CS certification pathway included the pathway name; pathway category (i.e., initial certification via an institute of higher education, other initial certification, add-on to an existing certification, authorization to teach, for out-of-state certificate holders, and other); and whether the pathway is currently offered, has a time limit, and permits teaching in all grade levels and all CS courses. We also tracked requirements for each pathway (e.g., college degree, coursework, CS content exam). Note that we tracked *explicit* requirements only; for example, out-of-state certification pathways do not always specifically require a college degree, although it is likely that most candidates have one.

Our content analysis and interviews identified 82 different pathways to CS teacher certification across the ten states. There are many similarities across states (e.g., pathways for out-of-state educators to get an in-state certification), but there are some differences as well, such as Washington state’s multiple alternative routes to certification for e.g., paraeducators and career changers. This poster focuses on the implications of our findings for various issues related to CS education: (1) the extended CAPE codebook, (2) CS professional development and curriculum providers, (3) CS education researchers, and (4) certification pathway providers and state-level decision-makers.

(1) *The extended CAPE codebook*. The CAPE framework [2] is commonly used to analyze CS education efforts, with the extended



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CAPE framework [4, 5] articulating sub-components and categories of the CAPE framework to systematically describe factors relevant to CS education. Given the previous lack of comprehensive national-level data about CS teacher pathways which motivated this project, we examined our findings regarding CS teacher pathways across ten states to determine whether they suggest any alterations to the extended CAPE framework. In general, we conclude that the framework is robust enough to capture most facets of state CS teacher pathways, despite some variation across states in the pathways and their requirements. However, the following changes to the extended CAPE framework could be considered based on this project:

- “Capacity → Human Resources → Professional Development” has different subcategories for “in-service” and for “pre-service” teachers. It may be appropriate to add another subcategory for in-service teachers in another subject area (who are in the process of earning CS certification and are therefore “pre-service” for CS).
- There is currently “Capacity → Human Resources → Professional Learning Networks/Communities;” given that some alternative certification programs follow a cohort model, it may make sense to add “Pre-service Learning Networks/Communities”
- Many alternative certification programs include a mentored teaching experience. It may make sense to add “Capacity → Human Resources → Mentors for Novice/Pre-service Teachers.”
- “Capacity → Human Resources → Teachers” does not have a subcategory for pedagogy. Some certification pathways have pedagogical requirements, either via exam or coursework. (There is pedagogical content knowledge under “School Environment, Culture, & Ideology Supporting CS Education Implementation,” but certification requirements are distinct from school environment.)
- To capture many of the issues related to CS teacher pathways, the addition of “Capacity → Policies → Pathways to Teaching CS” may be helpful.

We note these possible additions to the extended CAPE framework not only for their own sake but also because they suggest themes that emerged from this project that are not widely explored in CS education research (e.g., the situation and needs of an in-service teacher [of another subject] who is a pre-service CS teacher).

(2) *CS professional development (PD) and curriculum providers.* An awareness of our findings may support CS PD and curriculum providers in tailoring their offerings to best support CS teachers. For example, only five pathways to teaching CS specifically require a standardized exam in principles of teaching and learning, while dozens of pathways require a standardized exam in CS content. Our future work will gather data (where it exists) on how many teachers in each state followed each pathway to CS certification. This more granular data will enable CS PD providers to make decisions based on an awareness of what percent of their audience is likely to have evidence of CS content knowledge and/or pedagogy content, and it will enable CS curriculum providers to target supplemental materials to best meet the needs of teachers.

(3) *CS education researchers.* Pathway requirements differ; for example, most pathways require a college degree (some career and

technical education pathways do not [1]), but only a small number of pathways require the candidate to have majored in CS. And many pathways have multiple options to meet requirements; for example, a pathway may require additional coursework *or* passing a standardized exam of CS content. To date, there is minimal research exploring the impact of various pathways or pathway requirements on CS teachers and their students. Our findings will provide the foundation for CS education researchers to study the impact of different pathways and their requirements on CS education outcomes.

(4) *Certification pathway providers and state-level decision-makers.* An understanding of the pathways, their requirements, and the number of CS teachers following each pathway will provide important information for those organizations providing CS teacher certification (e.g., higher education, independent providers) into which pathways offered in other areas might be appropriate to emulate and which pathways draw teachers – including from groups historically underrepresented in computing – into the classroom. Requirements that are relatively rare – such as portfolios and teaching evaluations – might be more widely adopted based on their impacts. A better understanding of the landscape of pathways and their requirements may also be useful when, for example, states decide whether and how to offer in-state certification to those with out-of-state CS licenses.

Our future work on this project will involve expanding the scope of the work so that our dataset includes more U.S. states. Additionally, we will gather data about the number and characteristics (e.g., demographics, prior teaching experience) of teachers who pursue each pathway. (One theme that emerged from our interviews was that some pathways exist ‘on paper’ but are rarely used to gain CS certification.) This additional data will permit a fuller picture of CS teachers in the U.S. and, ultimately, enable the development of research and policies to better support CS teachers and their students.

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