Paper Title Prospective High School Computer Science Teachers' Perceptions of Inquiry Pedagogy and Equity

Author(s) S. Megan Che, Clemson University; Eileen T Kraemer, Clemson University; Murali Sitaraman, Clemson University

Session Title Technology, Instruction, Cognition, and Learning: A Survey of Research

Session Type Poster Presentation

Presentation Date 4/7/2019

Presentation Location Toronto, Canada

Descriptors Computer Applications, Culturally Responsive Schooling, Technology

Methodology Qualitative

Unit SIG-Technology, Instruction, Cognition & Learning

DOI 10.302/1444296

Title

Prospective High School Computer Science Teachers' Perceptions of Inquiry Pedagogy and Equity

Abstract

This paper investigates prospective computer science teachers' perceptions of the concepts of inquiry and equity, and how these concepts changed or developed over the course of a week-long professional development (PD) experience. Initial results indicate that teachers' meanings for inquiry were, even at the start of the PD, well-informed. Teachers' perceptions of equity were more uncertain at the start of the PD but developed over the course of the week, resulting in more teachers' exhibiting an asset-based approach to equity as well as greater confidence in implementing equitable practices.

Objectives or purposes

Though computer science teaching in k-12 settings is increasing, and more states are developing k-12 computer science standards while formalizing credentialing processes for prospective computer science teachers, relatively few research studies have yet begun to investigate k-12 computer science education (Yadav & Berges, 2016).

The purpose of this paper is to share initial findings from a week-long computer science professional development experience designed to orient teachers to content and methods for engaging high school students in an introductory-level computer science course. This professional development experience is part of a larger, NSF-funded project that aims to prepare teachers to teach computer science courses to high school students through a culturally-responsive approach, and to contribute to our understandings of Pedagogical Content Knowledge for Computer Science (PCK-CS). Because inquiry and equity are central pedagogical constructs for teachers, the research questions that frame this particular paper include: (1) what are teachers' initial understandings of equity? (2) what are teachers' initial understandings of inquiry? and (3) how did these understandings change from the start to the end of the week-long professional development?

Perspective(s) or theoretical framework

Shulman (1986) argued for a particular form of knowledge essential for teaching a subject area. Pedagogical content knowledge (PCK) encompasses not only a deep understanding of the content of a discipline, but also deep and broad understandings of how students navigate and engage with that discipline, including attendant knowledge about potential cognitive pitfalls and detours students might take as well as effective representations of central disciplinary ideas. In fields like mathematics and science education, our understandings of PCK are well developed and specific, the result of decades of focused research on mathematics and science teaching and learning (Hubweiser et. al., 2013; Yadav & Berges, 2015). However, PCK in computer science (PCK-CS) is relatively nascent; because more children are

engaging in computer science and more teachers are expected to teach computer science, it is important that our understandings of PCK-CS deepen and grow. This paper contributes to these understandings by providing an initial sense of prospective CS teachers' perceptions of two crucial aspects of CS instruction: inquiry and equity.

Our understanding of equity and its influence relative to computer science contexts is informed by the notion and practice of culturally responsive computing. Culturally responsive computing (CRC) branches from culturally responsive teaching (CRT) and, in particular, CRT's three tenets of asset building (in contrast to deficit approaches), reflection, and connectedness; CRC frames these tenets for the specifics of computing education. Scott et al's (2015) first tenet of CRC is that all students are capable of digital innovation; this tenet must drive teachers' interactions and relationships with students. CRC also requires that teachers be continually reflective about their privilege and constraints and how those are connected with our worldviews. Teachers implementing CRC must expect that all of their students are capable of digital innovation, and they must live this belief in their teaching practices by, for instance, maintaining high academic expectations of students.

Methods, techniques, or modes of inquiry

The research processes discussed in this paper were conducted during a week-long professional development workshop, which constitutes part of an on-going support community for teachers who are teaching a computer science course to high school students for the first time. The workshop consisted of 18 in-service teachers from 16 different schools in 11 different districts in a state in the Southeast region of the U.S. 83% of the teachers were female, and 50% identified as African-American. Most of the teachers had taught for ten years or more, but 78% of the teachers had never taught computer science courses. Only two of the 18 teachers had taught an introductory computer science course similar to the focus of this professional development workshop. 89% of the participating teachers' teaching credential was in business, and 56% of the teachers' primary teaching responsibilities were in business, while 33% of the teachers' primary teaching responsibilities were in career and technology education. 94% of the teachers were scheduled to teach an introductory computer science course similar to Exploring Computer Science or AP Computer Science Principles in the next academic year (AY 2018-2019).

Teachers took a pre and a post-workshop survey which included Likert-type as well as open-response items focused on inquiry pedagogy, equity, and computer science content knowledge. This paper reports on teachers' responses to these open-ended response items:

> What does inquiry pedagogy mean to you? If you observed a classroom that was inquiry-based, what would you expect to observe? *(This prompt was given in pre and in post-surveys.)*

What does equity pedagogy mean to you? If you observed a classroom that emphasized equitable practice, what would you expect to observe? *(This prompt was given in pre and in post-surveys.)*

How has your thinking changed, if at all, about what "equality in CS" means to you as a result of this professional development training? Please explain. *(This prompt was given only in the post-workshop survey.)*

The analytical process for teachers' narrative responses to these prompts consists of three team members independent thematic analysis with the goal of constructing labels for patterns in responses—and attaching a label using teachers' own words—as well as operationalizing those labels with details and descriptions teachers provided. Following this independent coding process, the three research team members compared themes and established group consensus on theme labels and operationalizations of themes. In our Results section below, we present initial, tentative theme labels and operationalizations; final consensus themes will be discussed in the final paper.

Data sources, evidence, objects, or materials

The sources of data for this paper include 16 different narrative responses to the open-ended pre-workshop survey prompt about inquiry pedagogy, 16 different narrative responses to the post-workshop survey prompt about inquiry pedagogy, 16 different narrative responses to the pre-workshop survey prompt about equity pedagogy, 17 different narrative responses to the post-workshop survey prompt about equity pedagogy, and 14 different narrative responses to the post-workshop survey prompt about equality in CS.

We additionally collected quantitative, Likert-type teacher responses to items designed to gauge teachers' understandings and implementation of inquiry and equity pedagogy. These responses are currently under analysis and will be formally presented in the final paper; informal indications from these items are included in the Results section below.

Results and/or substantiated conclusions or warrants for arguments/point of view

Our initial findings relative to the first research question, teachers' perceptions of inquiry pedagogy, indicate that teachers expect questioning (from both students and teachers), active student engagement (with the teacher as more of a facilitator than a 'teller'), discussion, collaboration, and analysis. Teachers expected—in both pre and post surveys—to see student-centered classroom spaces where teachers facilitated discussions, posed questions, and engaged students through collaboration and analysis. We saw only minor amendments in teachers' perceptions of inquiry pedagogy as evidenced in their post-survey responses, which included one teacher's use of the specific phrase 'active learning' as well as one teacher noticing that inquiry pedagogy is conducive to each student. In the pre-

survey, for instance, one teacher commented, “I envision the teacher following up questions from the students with more questions.” Another teacher proposed that, “Inquiry pedagogy means to have the students find the answer to a problem through research and questioning.” Finally, a third teacher explained that they “would expect to see lots of questioning and discussion.”

Our initial results relative to the second research question, teachers’ perceptions of equity, indicate that several teachers (three) stated in the pre-workshop survey that they were unsure of the meaning of the term. Of the teachers who felt sure enough to hazard a soft definition, the responses tended to highlight the ways in which education was (or should be) the same, or the ways in which people are different. Many teachers responded that students having the same or equal opportunity for learning (and teaching) was an indicator of equity; another variation on this theme of same or equal were teachers who stated that if students were given equal work, or had the same opportunity to learn the same information, then that was equity. One teacher mentioned that when students take an equal part in their learning and instruction, then that might be equity. On the other hand, many teachers noted that students have diversity in their backgrounds, their race, their learning experiences and abilities, and even in their definitions of success. For these teachers, equity would mean that instruction is responsive to these differences. In the post-workshop survey, the word ‘all’ was even more strongly emphasized; teachers commented about including “all students”, “reaching all students”, and “engagement of all students”.

Upon first glance, it seemed to us that teachers had not changed meaningfully in their perceptions of equity. However, their confidence in using equitable practices to support student learning (which was a 4-point scaled item from ‘not at all confident’, to ‘somewhat confident’, to ‘confident’, to ‘very confident’) went from an initial value of 2.0 in the pre-workshop survey to a value of 2.9 on the post-workshop survey, which was a change from “somewhat confident” almost to “confident” in the span of the workshop. To understand why teachers reported feeling more confident in equitable practices, our research team analyzed teachers’ narrative responses to the question of how, if at all, teachers’ thinking about equality in CS had changed. Six of the fourteen teachers included some variation of the assertion that all students are capable of engaging in computer science in their response to this question, and an additional seventh teacher asserted that equity is “also about looking for talents in students.”

Scientific or scholarly significance of the study or work

This research contributes to our understandings of prospective middle/high school computer science teachers’ perspectives of two critical pedagogical constructs: inquiry and equity. The teachers in this workshop initially had a deeper and broader understanding of inquiry pedagogy than we had anticipated they might have; teachers’ understandings of equity were not as solidified as their understandings of inquiry pedagogy. Teachers’ initial understandings of equity, though, were still more

informed and more activated that we had expected prior to the workshop. Over the course of the week, teachers' notions of equity changed more than their notions of inquiry, and all participants responded that their understandings of engaging pedagogy and equity had increased. Our study indicates that teachers were initially well informed about inquiry pedagogy and had some ideas about equity and the importance of culturally responsive approaches, but that teachers' notions of equity, in particular, developed over the course of the week. Teachers' beliefs that all children are capable of engaging in computational thinking and that computer science should be accessible for all students were confirmed and legitimized through the professional development. This finding is affirming for computer science educators working to advocate for the idea, and actions arising from the idea, that all children harbor talent in computational thinking and that part of the teachers' responsibility is to seek out this talent and develop the potential in every student.

References

Carlsen, W. (1999). Domains of teacher knowledge. In Examining Pedagogical Content Knowledge (pp. 133-144). Springer Netherlands.

Hubwieser, P., J. Magenheim, A. Mühling & A. Ruf. (2013). Towards a conceptualization of pedagogical content knowledge for computer science. In Proceedings of the Ninth Annual International ACM Conference on International Computing Education Research (pp. 1-8). ACM.

Scott, K.A., K. M. Sheridan, and K. Clark. (2015). Culturally responsive computing: a Theory revisited. In Learning, Media and Technology, 40(4): 412-436.

Shulman, L. S. (1986). Those who understand: Knowledge growth in teaching. *Educational researcher*, *15*(2), 4-14.

Yadav, A., Berges, M., Sands, P., and Good, J. (2016). Measuring computer science pedagogical content knowledge: An exploratory analysis of teaching vignettes to measure teacher knowledge. In Proceedings of the 11th Workshop in Primary and Secondary Computing Education (pp. 92-95). ACM.