Challenges of a Computer Science Classroom: Initial Perspectives from Teachers

Aman Yadav
Michigan State University
602 Farm Lane
East Lansing, MI 48824
1 (517) 884-2094
ayadav@msu.edu

Sarah Gretter
Michigan State University
602 Farm Lane
East Lansing, MI 48824
1 (517) 353-6393
sgretter@msu.edu

Susanne Hambrusch
Purdue University
305 N University street
West Lafayette, IN 47907
1 (765) 494-1831
seh@purdue.edu

ABSTRACT

In spite of the increasing demand for professionals with computing experience in the workforce, computer science plays only a minor role in K-12 education. To meet the CS10K goal of training thousands of teachers to teach a new CS principles (CSP) course, a multi-pronged approach that targets both computer science teachers and teachers from other content areas is needed. An important step in this direction is to better understand challenges of teaching computing and how we can better support K-12 teachers. In this paper, we present results from a qualitative study that examines challenges computer science teachers face in the classroom.

Categories and Subject Descriptors

• Social and professional topics ~ K-12 education

Keywords

K-12 computer science
Teacher preparation
Qualitative studies

1. INTRODUCTION

In spite of the increasing demand for professionals with computing experience in the workforce, computer science plays only a minor role in K-12 education. In order to address this problem, the National Science Foundation started an ambitious effort to have a new high school computing curriculum taught in 10,000 schools by 10,000 well-qualified teachers by 2017 (CS10K). Training thousands of new high school teachers is a crucial step toward this goal, but also a daunting task. In order to meet the CS10K goal of training thousands of teachers to teach the new CS principles course, a multi-pronged approach that targets both computer science teachers and teachers from other content areas is needed [1]. A recent landscape study on the state of high school computer science professional development provides a significant set of recommendations that could inform what is needed to improve teachers' knowledge to teach computer

science [2]. One of the recommendations is to develop and deploy strategies for existing teachers to become effective CS teachers. A first step in this direction is to better understand what teachers in the classroom are currently facing. In this study, we evaluated the challenges that computer science teachers face in the classroom, as well as their perspectives about teaching high school computer science. Specifically, we addressed the following research question:

1. What are the challenges computer science teachers faces in the classroom?

2. METHODOLOGY

2.1 Participants

Twenty-three high school computer science teachers participated in the study. Participants included 13 males and 10 females. Majority of the participants were Caucasian (N=21) with one Hispanic and one Asian. Participants had an average overall teaching experience of 11.67 years (SD=3.92). With regards to CS teaching experience, there was an average of 8.41 years teaching computer science courses (SD = 4.95). In addition to computer science, majority of the teachers also taught either business education (N=8) or mathematics (N=6).

2.2 Interview

The participants were interviewed using a semi-structured interview protocol that asked them to share their thoughts about teaching computer science and how it compared to teaching any other subject matter. The interview also asked about specifically about challenges in terms of meeting the content as well as pedagogical needs in a CS classroom. The interview was pilot-tested with two computer science teachers to examine the clarity of questions and was changed based on the feedback from the two teachers. Note: the two teachers who piloted the interview were not used in the data analysis.

2.3 Procedure and Data Analysis

We invited computer science teachers to participate in the study via email lists of local and state level computer science teachers. Teachers first completed an online background questionnaire, which took about 5 minutes and was used to collect demographic information. Participants were then contacted to schedule an interview to better understand the challenges that computer science teachers face. All interviews were transcribed and the text

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WiPSCE '15, November 09-11, 2015, London, United Kingdom
ACM 978-1-4503-3753-3/15/11.
<http://dx.doi.org/10.1145/2818314.2818322>

imported into qualitative analysis software called Dedoose, which was used to code the data.

3. RESULTS

Overall, teachers reported facing a number of challenges during teaching computer science, in particular, due to the lack of CS teacher preparation. Teachers in our sample discussed how they have learning either the CS content or how to teach CS content on their own. While there are teachers who have formal background in teaching, they do not necessarily have the CS content knowledge needed to teach CS. On the other hand, there are teachers who have industry experience in programming, but do not have any teaching background to effectively deliver CS lessons. These teachers discussed how they have self-taught themselves to meet the demands of teaching CS. For example, one teacher stated

"When I decided I would teach programming, then I got books and I did self-teaching things."

Teachers also discussed how sometimes students themselves take control of their learning and think through the problems in class.

"I remember one time I struggled for two hours trying to figure something out, so I introduced it as a problem and didn't tell them I didn't know the answer.... and the kids figured it out and we moved on."

Additionally teachers also discussed how being a computer science teacher at the high school can be a lonely enterprise as there is typically only one CS teachers in each school. This presents challenges when developing materials for the classroom as one teacher highlighted:

"Grading is very hard in computer science. Coming up with materials and you are alone. If you have a question, if something doesn't work you are on your own."

Another teacher stated that in spite of a number of online communities for CS teachers, there is no one you can walk up to and brainstorm ideas. This teacher said

"It is a challenge. A big challenge. I know there's a lot of communities, internet communities and such. But somehow having someone face-to-face that you talk to or work with is just not there."

Given these challenges, the teachers highlighted a need to form a community of practicing CS teachers in order to address their isolation within schools. Specifically, teachers stated that such a community would provide them with opportunities to share ideas about approaches to delivering CS content, share practical examples, and develop collaborative relationships. For example, one teacher stated:

"Just being able to talk with other teachers, computer science teachers and interact with them. To see how other people are

using things in the classroom. Get ideas on stuff to do, ways to present the information in a new way. It was the kind of thing that I thought, 'oh, if I could just get all the teachers up', then they could see, 'oh wow, you can actually use Scratch programming for a lot of things and it's not just something stuck down in the computer lab.'"

4. CONCLUSION

Century (2014) argued that there is a need for systematic understanding of computer science teaching and learning [3]. Results from this study highlight that computer science teachers face a set of challenges that are unique to teaching it at the high school level. The findings from this study support one of the challenges highlighted by the "Building an operating system for computer science education" (OS4CS) – teacher isolation. The OS4CS report highlighted that "CS teachers don't have colleagues close by to share ideas, information about the discipline, or provide instructional support and coaching," which can affect motivation; hence, making it difficult to improve computer science instruction. As teachers in our study reported and is also recommended by the OS4CS report, there is an imperative need to support existing computer science teachers through online and face-to-face community of practices that would allow them to collaborate and engage to improve computer science instruction with each other. The current study used interviews as a first step to examine teachers' perspectives of teaching high school computer science and challenges they face in the classroom. We need to build upon this work to better understand how we can support computer science teachers in the classrooms and improve instructional quality in computer science classrooms [2].

5. ACKNOWLEDGMENTS

We would like to thank all the teachers who participated in this study. This work is supported by the National Science Foundation under grant number 1502462. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

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