Proposal for Far West ASTE

Title of Presentation:
High School Teacher Task Analysis of Lesson Plans to Identify Opportunities for Computational Thinking in Data Analysis

Preferred Presentation Format:
In ranked order from most preferred to least preferred. We would be willing to present in any of the formats offered.

1. Oral Presentation
2. Roundtable
3. Poster
4. Ignite

Short Abstract (2 to 3 sentences - max 75 words): This study examines the perspective of high school science teachers in the use of two lesson planning tools: a task analysis tool used to identify opportunities for data practices and computational thinking (CT) and a decision tree tool used to predict student responses to CT activities. The findings demonstrated that teachers were able to effectively decompose lessons to identify CT during data analysis and to adjust lessons to increase student-centered CT instruction.

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Challenge within science teacher education. The science disciplines are increasingly becoming computational (Augustine, 2005; Bailey & Borwein, 2011; Foster, 2006). Infusing computational thinking (CT) principles within data practices in high school science investigations can provide students with a type of metacognitive or mental guide for making decisions. However, integrating CT instruction into curriculum can be overwhelming for teachers, unless adequate supports or tools are provided to guide instructional efforts away from a traditional linear lesson plan structure (John, 2006). The purpose of this study was to examine the perspective of teachers in their use of two unique lesson planning tools used to (a) identify opportunities for data practices and CT in lessons [task analysis tool] and (b) predict the variety of student responses to CT activities in lessons before lessons are put it practice in the classroom [decision tree tool].

Theoretical framework. The study was framed by the Elements of Desimone's (2009) Core Conceptual Framework for Professional Development. We structured the teacher learning experiences with Element 1 in mind: content focus, active learning, coherence, collective participation, and duration. Element 2 of Desimone's framework helped us to examine teacher professional knowledge, skills, attitudes, and beliefs across the learning experiences. Element 3, change in classroom instruction, is the main focus of the present study. Element 4, improved student learning, will be a future focus for this work. The conceptual framework for the integration of data practices and CT began with five science data practices identified by Weintrop and colleagues (2016), which were cross-walked with Wing's (2006) conception of CT practices by the authors (Authors, in press): decomposition, pattern recognition, abstraction, algorithmic thinking, and automation,.

Methods. Phenomenography was the chosen research design so that we could identify the qualitatively different ways in which people experience, conceptualize, realize and understand various aspects of a phenomena (Martin et al., 1992), in this case the teachers' use of the two unique tools. Various data sources from 20 teachers included questionnaires of CT knowledge and application, efficacy, values and beliefs of teaching CT, lesson plan artifacts, and teacher interviews before and after a summer institute focused on infusing CT into science lessons.

Findings. Preliminary findings show that the teachers found the task analysis tool helped them to clarify the purpose of the lessons they were creating, the amount of student-centered instruction, and the opportunities for specifying which CT practices were being used in the data analysis. During the summer institute, teachers noticed that some of their established lessons were heavily teacher-centered when they used the tools. Teachers also reported that the decision tree tool helped them to think primarily about students' reactions to instruction, rather than focusing on teacher presentation information. Teachers reported they will be using the information from the decision tree tools as a checklist to determine the extent to which they know when students' misconceptions form during science investigations. They reported that they plan to systematically design redirection for future lessons from the information they gather during implementation using the decision tree tool. Future analysis will map the elements of Desimone's framework to the use of the tools as well as student outcomes.

Description of the presentation. Presenters will explain the research rationale, design, and findings, as well as the specific task analysis and decision tree tools. Examples of teacher identification of data practices and associated CT from the task analysis and the use of the decision tree during implementation will be discussed. The presentation will help science teacher educators design tools to help teachers think deeply about student engagement and will help researchers refine a tool that can capture explicit teacher decisions about lesson design.

References

Augustine N.R. (2005). *Rising above the gathering storm: Energizing and employing America for a brighter economic future*. National Academies Press: Washington, DC.

Bailey, D. H. & Borwein, J. M. (2011). High-precision numerical integration: Progress and challenges. *Journal of Symbolic Computation, 46*, 741-754. Doi: 10.1016/j.jsc.2010.08.010

Desimone, L. (2009). How can we best measure teacher's professional development and its effects on teachers and students? *Educational Researcher, 38*(3), 181-199

Foster, I. (2006). 2020 computing: A two-way street to science's future. *Nature, 440*(7083), 419.

John, P.D. (2006). Lesson planning and the student teacher: Rethinking the dominant model. *Journal of Curriculum Studies, 38*, 483-498. Doi: 10.1080/00220270500363620

Martin et al. (1992). Displacement, velocity, and frames of reference: Phenomenographic studies of students' understanding and some implications for teaching and assessment. *American Journal of Physics*, *60*, 262-269.

Weintrop, D., Beheshti, E., Horn, M., Orton, K., Jona, K., Trouille, L., & Wilensky, U. (2016). Defining computational thinking for mathematics and science classrooms. *Journal of Science Education and Technology*, *25*, 127-147. Doi: 10.1007/s10956-015-9581-5

Wing, J. M. (2006). Computational thinking. *Communications of the ACM, 49*(3), 33-35. Doi: 10.1145/1118178.1118215