# Computational Thinking as a Computer Science Education Framework and the Related Effects on Gender Equity

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## ABSTRACT
This submission describes my current status in implementing a dissertation study around the themes of gender equity, computational thinking, and teacher practice. The scholarly and social context for the study is presented, reviewing some of the work related to gender equity and computer science over the past decade. Computational thinking provides a framework for computer science education centered on the learning of mental skills and "big ideas" of the field. The effect this framing has on female students' performance and interest in computer science is unclear. Establishing any possible benefits would be instructive for researchers, as would isolating teacher practices that support any possible benefits for equitable interactions.

## Keywords
Computational thinking, gender equity, secondary education

## 1. PROGRAM CONTEXT
I have recently completed my third year of study in the Educational Psychology and Educational Technology doctoral program at Michigan State University. I have successfully completed all of my coursework and comprehensive/qualifying exams. I will be proposing my dissertation study in the Fall semester of 2016 and expect to defend my dissertation in the Fall semester of 2017. My prior research has been focused on issues related to computational thinking, creativity, and computer science education. I am currently developing my literature review and honing my core research questions. I hope to subsequently develop my research methods and measures more fully, with plans to begin fieldwork in Fall of 2016.

## 2. CONTEXT AND MOTIVATION
My research examines how a computational thinking approach toward the teaching of computer science at the secondary level can influence female students' interest in computer science. Gender inequity has been known to be a critical problem within computer science, along with other STEM fields. It would be helpful to both secondary teachers and educational researchers to identify practices within the secondary classroom that may affect female students' interest and success in pursuing computer science in their future studies and careers.


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There is a continuing need for practical advice on how teachers' classroom practices and curricular choices can aid in retaining female students in computer science. Considering the efforts over the last decade to institute forms of computational thinking within various age levels and disciplines, it is worth investigating whether these efforts have a gender-based difference in their effectiveness. Empirical research regarding these effects could inform both classroom practice and further research regarding computational thinking and gender.

Research shows that students' motivations for engaging in computer science courses can differ by gender [9]. Considering the recent focus on expanding access to computer science education, such as seen in "CS for All" and the efforts of Code.org, the importance of equitable access to these resources becomes more urgent. The existing work of computer science educational researchers has already called for reframing existing practices to appeal to a more diverse audience and to reflect more closely the work of computer scientists in multiple contexts [6]. Computational thinking could possibly be another lens for reframing these practices. Rather than providing only a difference in context, the curriculum can be reframed along the "big ideas" of computer science, similar to the AP Computer Science Principles or Exploring Computer Science framework.

The main focus of this research is to provide actionable recommendations for teachers of computer science. The increase in funding and focus on computer science education will likely create an influx of students into computer science at the secondary level and below, with some educators working with the subject matter for the first time. This presents an opportunity to address teacher practices before they become entrenched and habitual for new instructors.

## 3. BACKGROUND & RELATED WORK
The literature regarding computational thinking has often focused on how the cognitive skills used within computer science can be developed and used within multiple subjects and grade levels [3, 5]. One could interpret the concept of computational thinking as an introduction to computer science concepts, without using programming as the central phenomenon around which computer science is taught.

Given the existing research regarding computer science and equity [1, 6, 8], computational thinking may be able to add another set of curricular recommendations for teachers. Male and female students can attain similar levels of computational

thinking, although initial results suggest that females students may need more time to develop these skills [2]. Similar to the work of the Exploring Computer Science curriculum [4], focusing on the larger principles may increase female students' interest in computer science during secondary school.

Adding to this, Goode, Margolis, and Chapman [4] state that curriculum alone is not enough to have an impact on student learning. Teacher practice in the classroom has a direct effect on how any curriculum is portrayed to and interpreted by learners. In regards to equity, teacher practice can play a role in encourage equitable interactions that strengthen students' learning. Identifying these practices and establishing their effectiveness can provide useful guidance for teachers.

## 4. STATEMENT OF THESIS/PROBLEM

My main research question is:

- Does presenting a broad perspective of computer science curriculum around computational thinking ideas and practices have a positive effect on female students' level of interest in computer science?
- Which specific practices of computer science teachers, encourage equitable interactions between teacher-student and student-student groups?

At this time the dissertation is still under development in its early stages. I expect to generate further research questions to add to the project as it progresses. Attending the ICER doctoral consortium would allow me to further refine these questions and their related methods with the input of other consortium attendees and faculty present.

## 5. RESEARCH GOALS & METHODS

I expect to develop a week-long unit of study for students in a secondary computer science course. This lesson would focus on the computational thinking skills being developed alongside the programming statements. A classroom with the subject taught in the standard manner will serve as the control. Along with measuring students' pre-post levels of interest in the chosen CS topic and CS overall, the class sessions will be recorded for subsequent qualitative coding related to teacher practices and student interactions with both peers and the instructor. I will employ a coding strategy similar to that of Lewis and Shah [7] in their study of pair-programming interactions and its relation to equity. As for the measuring of skills, this will be measured via formative quizzes and programming assignments, with analysis done between genders.

The outcomes of these methods are twofold: First, we can establish whether using computational thinking as a curricular frame increases girls' interest in computer science and whether the methods have any effect on the learning of the programming skills. Second, we can discover through the qualitative coding how the interactions differ between the computational thinking and control classroom, and whether specific teacher practices can be tied to these interactions. Establishing the efficacy of these methods, along with actionable recommendations for teachers, are the end goals

## 6. DISSERTATION STATUS

As part of my practicum study, I have already completed a study of in-service teachers' conceptions of computational thinking as a framing for computer science curriculum. This dissertation builds upon that work by investigating whether the teachers' positive impressions of this approach translate into measurable benefits for the learners. The work on the proposal has begun, with the literature review and research questions being further developed and refined. Additionally, I have assisted in the revisions of a study regarding gender equity in computer science, particularly as it relates to gender-based perceptions of the practice of computer science. By the time of the ICER conference, I expect to have my proposal ready, using my time at the doctoral consortium to solicit feedback from consortium attendees and leaders.

## 7. EXPECTED CONTRIBUTIONS

To contribute to the research community for computer science education, I want to establish whether there are any gender-equity ramifications for the use of computational thinking as a computer science curriculum framework. If the effects are found to be positive, I hope to offer initial observations regarding how the interactions are affected by this framing and specific teacher practices that support equitable interactions.

## 8. REFERENCES


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