Chapter 2
Preparing Pre–Service Teachers for the Future:
Computational Thinking as a Scaffold for Critical Thinking

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ABSTRACT

In this chapter, we explore how our team of professors at East Tennessee State University integrated computational thinking into elementary education courses for pre-service teachers. We lean on current research to understand the definition, purpose, and culture surrounding computational thinking and consider how it may develop students' analytic skills and critical. Because of our particular context, we are interested in the play of gender and socioeconomic status in the development of technological and computational abilities. We share ideas we experimented with in Science and English language arts pre-service methods courses, as well as faculty and pre-service teacher perspectives on the developing experience.

INTRODUCTION

No Child Left Behind (NCLB) ushered in an era of standardization and accountability. Schools were lauded with blue ribbons for high achievement and penalized for failing scores. While some still tout the law as a means of pushing schools into complacency, others argue that NCLB in conjunction with other policy reforms (i.e. Every Student Succeeds Act, Race to the Top) have created a generation or more of students trained to find an a, b, c, or d answer. In such cases, students may see black and white with few shades of grey and attain mastery at the expense of exploration. As university professors, how do we encourage imaginative and creative thinking while simultaneously appropriately scaffolding our pre-service teachers' knowledge of skills necessary for the future? Research has demonstrated that most often we "do school" in a similar manner to the way we were schooled (Bloome & Theodorou, 1989). Therefore, the question remains: how do we encourage pre-service teachers and in-service teachers to move away from an ingrained manner of teaching and learning, towards a lens of critical thinking that emphasize inquiry and problem solving?

We would like to argue that we are at a critical precipice, a fork in the road, if you will, that could be ripe for a change in the role of critical thinking related to computational thinking in the K-12 and post-secondary fields. For example, Common Core State Standards (CCSS) have called for students to possess robust analytical skills and consistency across the disciplines. Meanwhile, statistics demonstrate a changing global society, which will produce more Science Technology Engineering and Math (STEM) related jobs than there will be qualified graduates to fill them (Yadav, Stephenson, & Hai, 2017). Additionally, daily our world becomes more technologically savvy, and we often struggle as educators to remain current and appropriately skilled in a changing global society.

In this chapter, we suggest computational thinking as a means of building confidence in not only the areas of technology and integration, but also as a foundation for a shift in the application of critical thinking and its place in the K-12 and university classroom and beyond. As university educators, the term computational thinking, was not a familiar one to us. We immersed ourselves in literature about computational thinking, its role across content areas, and its place in a globalized and technologically rich society. Therefore, we begin this chapter by addressing the definition of computational thinking, the what of computational thinking, and how computational thinking fits with an education framework. We follow with the why of computational thinking as we consider how computational thinking might be a productive means of increasing problem solving and critical thinking skills at both the K-12 and post-secondary levels. Lastly, we share our concerns about disparities and connections to power related to access and share practical strategies that we have tested in our pre-service classrooms.

COMPUTATIONAL THINKING

We have seen increased interest in computational thinking in recent years as a means of developing students' analytic thinking skills and interest in inquiry-based literacy learning tasks (Yadav, Stephenson, & Hong, 2017; The Royal Society, 2012). Yadav, Mayflied, Zhou, Hambrusch, and Korb (2014) defined computational thinking as, "the mental activity for abstracting problems and formulating solutions that can be automated" (p. 1). Likewise, Barr & Stephenson (2011) posit that computational thinking manifests through the process of critical thinking and problem solving. For example, they describe computational thinking as a problem-solving process in which they imagine students "engaged in using tools to solve

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