Chapter 2
The Snowball Effect:
A Perspective on the Challenges to Computer Science Education in K–12

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ABSTRACT

Recognizing the persistent problem of the underrepresentation of women in computer science, this chapter examines the barriers existing in the kindergarten through Grade 12 educational environment. It explores the vicious cycle that exists in the education field, as the change agents are predominantly women. Much of the research from the past decade reiterates the issue but substantive changes to reduce the gender gap have not occurred at rates that keep pace with the evolving digital society. This chapter offers practical solutions to (1) distinguish between computer science, instructional technology, and digital literacy in the K-12 educational setting; (2) propose ways to promote opportunities in these environments, for all students, with a focus on the underrepresented female population; (3) formulate strategies for educational leaders to incorporate computer science knowledge including computational thinking skills into teacher preparation programs and professional development to support those never exposed.

INTRODUCTION

Technologies have been transformational in society and throughout most of the world. The use of digital technologies, in all facets of society, are ever changing and continually advancing. Education in the kindergarten through grade 12 (K-12) environment has not been spared by the profound impact of digital transformations. Transformations that have influenced and altered the professional practice of educators with phrases such as *integrating educational technology*, *integrating technology into the curriculum,* or *digital teaching and learning.* These words are often heard at faculty meetings, during post-observation

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conferences, professional development days, in professional course offerings and in collegial conversations. Technology has seeped into education as it has with everyday life resulting in easier access, and thereby reducing any previous gender gap in technology usage (Abbiss, 2008). However, a reduction of the gender gap in terms of women choosing to study computer science has failed to materialize and ultimately the problem of female underrepresentation in the computer science field endures.

Literature addressing the shortage of female participation in electing to pursue degrees and careers in computer science dates back over a decade, which is an eternity in the ever-advancing digital age. Substantive action needs to be taken in K-12 educational settings. It is in this environment where exposure to computer science education currently lacks and commonly where the decision to pursue a degree or a career in the field is made (Wang & Degol, 2017). Unfortunately, it is evident that the majority of educators do not view computer science as a top priority (Google Inc. & Gallup Inc., 2015a). Moreover, they appear to be unclear about the body of knowledge that constitutes computer science and how that knowledge differs from general use of digital and computing technologies (Google Inc. & Gallup Inc., 2016b).

Without addressing, analyzing and reshaping the dynamics of the state of computer science with the mission of confronting the seemingly perpetual deficiency of gender diversity in K-12 education, there will be a shortfall of women in the computer science field. The goal is to foster experiences that will support and encourage young women to consider a degree in computer science and grow a fresh crop of females ultimately choosing a career in the field. Considering the discussion has been ongoing for numerous years, there is a great urgency to train, inform and enlighten educational professionals, both in-service and pre-service, regarding computer science. Furthermore, many of the change agents are the exact demographic that are poorly represented, yet are grossly overlooked as part of the target audience that can contribute to the potential growth of the field.

This chapter offers practical suggestions for K-12 educators to reduce the gender gap and provide ways to (a) distinguish between computer science & digital literacy as a means to removing the barrier to computational thinking skills thereby promoting the study of computer science; (b) create and promote opportunities in a K-12 educational environments for all students with a focus on underrepresented populations; and (c) propose strategies for educational leaders to incorporate computer science knowledge and effective approaches to develop computational thinking skills into teacher preparation programs and in-service professional development. By instituting the recommendations suggested herein, it is hoped that real progress can be effectuated to cultivate the growth of female participation as well as other marginalized groups in the computer science field.

DEFINING TECHNOLOGY IN EDUCATION

Abstraction is an important term in the study of computer science, as well as a key descriptor in characterizing one of the barriers that exists for underrepresented groups in educational environments. Just as students struggle to understand abstraction as a generalization in computer terms, the administrators of many K-12 environments only know the study of computer science in terms of the abstract. At the core of the problem, there exists an ambiguity surrounding what computer science is and what form it should take in the K-12 educational system.

Frequently, computer science is erroneously confused with integrating digital tools and media into curriculum and teaching, such as word processing, creation of slide presentations or searching the internet,