Chapter 43
Integrating Computing Across the Curriculum:
Incorporating Technology into STEM Education

Alia Carter
University of Alabama – Birmingham, USA

LaToya J. O'Neal
University of Alabama – Birmingham, USA

Shelia R Cotten
Michigan State University, USA

Zachary Simoni
University of Alabama – Birmingham, USA

Philip Gibson
University of Alabama – Birmingham, USA

Kristi Stringer
University of Alabama – Birmingham, USA

Leticia S. Watkins
University of Alabama – Birmingham, USA

ABSTRACT

The need for technology-enriched learning environments is driven by advancements in 21st century technology and an increase in STEM-related careers. Although women and racial/ethnic minorities make up a significant portion of the American workforce, they remain underrepresented in STEM-related careers. Integrating Computing Across the Curriculum (ICAC) is a five-year research intervention project whose aim is to reduce STEM career-related inequality by providing teachers with the resources they need to integrate computing across the curriculum. The ICAC integration model involves administrators, teachers, students, and their parents. This chapter provides support for the ICAC model as a means of promoting student interest in STEM and as a means of developing technology-enriched curricula designed to improve 21st century teaching and learning.

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INTRODUCTION

Advancements in 21st century technology are changing the occupational landscape. Careers requiring only general proficiencies are being replaced by those requiring more specialized competencies (Wagner, 2010). More specifically, careers in the fields of science, technology, engineering, and mathematics, abbreviated as STEM, are growing at a rapid pace (Milfort, 2012). From the year 2000 to the year 2010, STEM careers experienced a growth of 7.9% and these numbers are expected to more than double in the coming years with STEM careers projected to grow by 17% between 2008 and 2018 (Langdon, Mckittrick, Beede, Kahn, & Doms, 2011). In order to build a workforce that is prepared for 21st century careers, we must begin including STEM education as early as elementary school as the fourth and fifth grades are when students begin to lose interest in STEM (Chall & Jacobs, 2003). Moreover, we must address the issue of STEM career inequality. Despite the proportion of women and racial/ethnic minorities who make up the U.S. workforce, both groups remain underrepresented in the STEM areas (U.S. Department of Labor Statistics, 2013; U.S. Department of Labor Statistics, 2012). Thus, integrating computing across the K-12 curriculum is necessary not only for advancing 21st century teaching and learning but for decreasing STEM career inequality as well.

Despite the potential of technology use to improve teaching and learning, many teachers fail to adopt technology as a means of engaging students in their classrooms. Several factors influence teacher use of technology and student interest in STEM careers. Teacher adoption of classroom technology is influenced by factors such as their own knowledge and skill levels, their comfort using technology, technology use among colleagues, school resources and adoption of technology, technology related professional development and support of technology integration issues (Afshari, Bakar, Luan, Samah, & Fooi, 2009; Carvin, 1999; Dexter, Anderson, & Becker, 1999; Eteokleous, 2008; Inan & Lowther, 2010). Student engagement is impacted by teacher use of technology, teacher attitudes towards technology, and teachers' teaching philosophy (Baylor & Ritchie, 2002; Becker & Ravitz, 2001; Becker & Riel, 2000; Cardelle-Elawar & Wetzel, 1995; Carvin, 1999; Dexter et al., 1999; Eteokleous, 2008; Keengwe, Schnellert, & Mills, 2012; Mouza, 2008). Parental involvement also impacts teaching and learning of technology in the K-12 classroom (Ortiz, Green, & Lim, 2011; Selwyn, 2011).

Computer access has opened an exciting new dimension for STEM education; however, if computers in the classroom are to realize their full potential as a tool for advancing STEM education, methods must be developed to allow them to serve as a bridge across the STEM disciplines. Integrating Computing Across the Curriculum (ICAC) is a multi-method, multi-disciplinary project with the primary goal of increasing the number of minority students in the STEM pipeline. ICAC provides teachers and students with the resources needed to enhance STEM education in the elementary school classroom.

ICAC seeks to transform fourth and fifth grade classrooms into technology-enriched learning environments by integrating computing across the elementary school disciplines. This is accomplished through a novel integration model involving school administrators, teachers, students, and parents. This intervention, which began with 2 schools in the first year, has been implemented in increments and incorporates more schools each successive year of the project (e.g., 6 in Year 2, 10 in Year 3, and 12 in Year 4). The integration model includes assessment and planning meetings for principals, professional development and in-class support for fourth and fifth grade teachers, summer computing camps and after-school computer clubs for fourth and fifth grade students, and weekend learning sessions for students and their parents. This chapter reviews literature related to the need for K-12 educators to integrate comput-