Chapter 14
Opportunity to Start Strong: Integration of Technology in Science Lessons in the Early Elementary Grades

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ABSTRACT

This chapter investigates challenges faced by educators in the early elementary grades as well as opportunities to transform science education in these critical, early years of schooling. We studied kindergarten teacher's first attempt to integrate one-to-one technology in an inquiry-based science lesson, drawing on works of Randi Engle to analyze the framing of the students and the activity, as well as on the works of Peggy Ertmer and colleagues to investigate barriers encountered in the implementation process. We employed Mishra and Koehler's (2006) Technological Pedagogical Content Knowledge (TPACK) framework to understand the dynamic triad of teacher's pedagogy, content, and technology knowledge, need for successful technology implementation endeavors. While implementations of technology enhanced inquiry-based science lessons in early elementary grades present educators with some unique dilemmas, they also carry a potential for sparking the scientific curiosity of the youngest elementary school learners' and illuminating the years to come.

INTRODUCTION

When Presky (2001) and Palfrey and Gasser (2008) defined the term "digital natives", bright-eyed children who are now occupying kindergarten, first- and second-grade classrooms were not yet born. These students, who learned to type on glass on a handheld device such as a smartphone or a tablet, are living in a world markedly different from the one their parents and teachers, the digital immigrants, grew up in. Researchers, curriculum designers, and educational policymakers all agree that prosper-

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ous living in this rapidly changing new world requires increasing scientific and technological literacy (NGSS Lead States, 2013; National Research Council [NRC], 2012). The unique opportunity to build the strong foundation of such literacy belongs to the teachers in the early elementary classrooms. Teachers in kindergarten through second grade (K-2) can rely on two natural allies in fostering the science learning of the young digital natives. First, young children are natural explorers (NRC, 2012). Second, they "only know the world that is digital" (Palfrey & Gasser, 2008, p. 4). Combined, these two traits of the youngest elementary school learners provide an organic base for effective integration of technology in inquiry-based science lessons.

A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas (NRC, 2012) and *Next Generation Science Standards: For States, by States* (NGSS Lead States, 2013) outlined the importance of students' engagement in scientific inquiry and engineering design. More recently, the *Guide to Implementing the Next Generation Science Standards* (NRC, 2015) reminded educators that engagement in scientific inquiry and engineering practices is of critical importance for facilitating conceptual changes in students' understanding of the world they live in, as well as helping students learn about ways in which scientific knowledge evolves. Furthermore, all of these documents support a purposeful use of technologies which best advance specific learning goals, such as students' engagement with real data, investigation of phenomena, modeling, and/or testing of engineering designs (NGSS Lead States 2013; NRC, 2015; NRC, 2012). Hence, thoughtfully structured, inquiry-based and technology enriched science instruction enables K-2 teachers to deal with some of the students' existing preconceptions early on in their education. This purposeful engagement in science learning promotes conceptual change and prepares students for older grades.

When it comes to learning how to design and implement such science lessons, teachers should not have to go it alone. They need to be supported in the holistic development of their technology skills, which, we believe, will expand their horizons with respect to future integration of technology in their pedagogical practice. In fall of 2015, our research team partnered with teachers at an urban elementary school in the United States Southeast on co-construction of technology enhanced science lessons. We chose this school because of its science, technology, engineering and mathematics (STEM) focus and its 1:1 iPad initiative. Caldwell Elementary[1], a Title I school, has a diverse population of around 570 students. The student body is 67% African-American, 29% Latino, 2% Caucasian, and 1% Asian.

Our chapter first explores the unique challenges faced by educators in the early elementary grades through the study of Georgia[2], an experienced kindergarten teacher at Caldwell Elementary, and her first attempt to integrate one-to-one technology in her kindergarten classroom. Through technology enhanced inquiry lessons which build upon children's ingenuous curiosity and desire to explore the world that surrounds them, we examine ways in which this vision of science education is implemented in early elementary classrooms. We discuss themes that emerged during our study and the barriers to teaching science in the early elementary grades, and more specifically, to the implementation of technology enhanced science inquiry experiences. Finally, we will address the implications of our findings for teacher professional development and pre-service teacher education.

BACKGROUND

In recent years, schools across the nation have focused their resources on meeting national and state grade level performance standards in literacy and mathematics, under the watchful eyes of parents,