Chapter 28
Girls and 3D Printing:
Considering the Content, Context, and Child

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ABSTRACT

Using Guernsey's framework for technology use with young children, this case study examines two middle elementary grade female students as they experience 3D printing in a Makerspace environment. In this case study, the girls spent a day working with a Makerspace staff member to learn how to 3D print a design of their choice from Thingiverse. The case study provides a chance to analyze the reactions, discourse, and activities of two girls introduced to 3D printing in a makerspace. The authors sorted the verbalizations, behaviors, and actions of the two girls into a reflection on the concepts of content, context, and child put forth by Guernsey.

INTRODUCTION

Around the globe, educators are scrambling to keep pace with the development and deployment of technological devices. Within the United States, early childhood and elementary school students are routinely using tablets, laptops, and programmable robots. Technology classes are introduced as young as kindergarten and skills that were once considered advanced in the curriculum, such as coding and typing, are now considered basic skills that should be in place in the elementary years. Sophisticated

devices such as three dimensional (3D) printers, conceived of mainly for science or manufacturing purposes, are now sought after in well-funded elementary schools.

Even experts in the field such as the National Association for the Education of Young Children (NAEYC) and the Fred Rogers Center for Early Learning and Children's Media in their 2012 joint position statement refer to 3D printing as "represent[ing] the next frontier in digital learning for our youngest citizens, leaving it to talented educators and caring adults to determine how best to leverage each new technology as an opportunity for children's learning in ways that are developmentally appropriate" (p. 3). One of the most troubling issues with the rapid adoption of these devices in public schools is the prevailing view that they should be purchased first, with integrating into the school curriculum and childhood activities as a necessary second step. This approach runs contrary to the detailed work outlining objectives and growth slopes in most areas of the United States public education system and it risks facilitating uneven or unequal experiences with technology by leaving unexamined the biases or differing expertise of the teachers or caring adults referred to in the statement. The onus for responsible decisions is on individual educators, leaving it in their hands to "...make informed decisions about how, when, and why to support early learning and healthy development through technology and digital media" (Donohue & Schomberg, 2015, p. 36). And reports show that while educators look favorably on technology as a whole, seeing it as a way to motivate students, respond to differing learning styles, and to reinforce content lessons (PBS Learning Media, 2013); they also delay adopting new technologies or limit their use because they do not feel prepared to meet the needs of all students with unfamiliar technology (Hew & Bush, 2007).

One of the many factors for which teachers need to account in technology education is the inequality of technology experiences across genders. Viewing technology adoption and use through Guernsey's (2007) lens, the efficacy will be greatly increased if educators consider the factors of child, context, and content. Looking at the current state of females in STEM fields in the United States, it is obvious and necessary that early experiences with technology such as 3D printing take gender into account. For example, research continues to indicate that women account for a small percentage of professionals in the technology and engineering workforce (National Girls Collaborative Project, 2017; National Science Board, 2016; Turner, Burnt & Pecora 2002; Beede, Julian, Langdon, McKittrick, Khan & Doms, 2011). In order to address this challenge educators and parents need to examine and address biases, opportunities, and curriculum for girls during the elementary and middle school years. Previous research indicates several themes, which create barriers to girls' interest in engaging with science, technology, engineering, and mathematics (STEM) activities and entering the workforce in technology and engineering fields. Main themes include cultural and environmental challenges, lack of relevance, and insufficient support structures.

Stereotypes and biases reveal the impact that our culture and environment have on perceptions on the success that girls have in STEM fields. Stereotypically, technology and careers associated with technology tend to be gendered towards males and perceptions that males are more successful than females in math and science education are prevalent (Andersson, 2012; Dell, Christman & Garrick, 2011). In addition, relevancy of content and activities have been shown to deter girls from pursuing course work or careers in the areas of technology and engineering (Chatoney & Andreucci, 2009; Amador & Soule, 2015). Traditionally, curriculum and activities in technology education have been created in closer alignment with typical male interests and hobbies, which does not provide girls with content that is engaging or relevant to their learning. Finally, there are insufficient support structures, including role models and peer groups, that are needed to provide a foundation for girls who are interested in pursuing technology

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