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Not Just Consumers: Finding Space for Student Creativity During Mathematics Instruction

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I am grateful for this opportunity to serve as the lead Guest Editor for this Special Issue of the *Journal of Mathematics Education*, which offers a collection of articles examining innovative approaches to mathematics pedagogy. Many of the articles focus on entertainment-education—sometimes abbreviated as E-E, or referred to as edutainment—as an avenue for exercising student creativity during mathematics instruction. The entertainment-education framework should not be thought of as a learning theory, but rather as a learning strategy (Singhal & Rogers, 2002). In concept, the approach utilizing entertainment-education is a simple formula: place educational content into an entertainment-based context and students can then learn while being entertained. Successful examples of entertainment-education range the gamut of prosocial themes and often incorporate transmedia approaches—topics have ranged from promoting sexual and reproductive health to reducing illiteracy and domestic violence (Singhal, 2007; Wang & Singhal, 2016). However, the obstacles to successful implementation of the entertainment-education learning strategy in the mathematics classroom are non-trivial, and require careful remediation if they are to be circumvented (Tillman, An, & Boren, 2013, 2015).

To obtain a better understanding of the teaching and learning opportunities, as well as obstacles, that arise from implementing an entertainment-education learning strategy, I spent over a decade working in educational multimedia development. I performed the various roles of director, animator, cinematographer, scriptwriter, and editor, depending upon the needs of each individual project. Some of the agencies that funded these productions included George Washington's Mount Vernon Estate, The Women's Memorial at Arlington National Cemetery, the Navajo Nation's Institute for Culture, and the Helen A. Kellar Institute for Human Disabilities at George Mason University. The time I spent working in non-fiction digital multimedia production enabled me to experience the pedagogical power that arises when instruction is both authentically engaging to students and properly supported via well-designed instructional materials.

After transitioning into a research career at my current university, these earlier experiences working in production helped me to understand the tremendous extent to which each student's learning is influenced by the social and physical environments where the learning takes place. The optimization

of learning environments has become a dominant theme in my research and my teaching philosophy, both of which integrate a variety of socio-cultural theories recognizing the importance of social context and interpersonal activity in the development of understanding. Situated cognition is a learning theory that has become central to my research, as this learning theory additionally emphasizes the influence of specific physical contexts and objects, recognizing that in the real world, each problem is inextricably immersed within a concrete setting and can only be resolved by employing reasoning and resources that are specific to the situation.

During the past several years of research, I have focused upon clarifying the situated cognition learning theory by examining interventions employing digital multimedia to support quality, scalability, and cost-effectiveness of entertainment-education in the mathematics classroom. The aim of this research has been to facilitate creating an optimized hybrid-learning environment that utilizes educational affordances of both the physical world and the virtual realm to engage and educate students. I chose this research focus because mathematics in the elementary and middle grades has emerged as a gauntlet that prevents many students from pursuing advanced science, technology, engineering, and mathematics (STEM) courses in high school and, therefore, limits their preparation for college and/or selection of STEM careers in the future.

I believe that the main leverage point for improving K-12 mathematics education is primary teacher preparation during their undergraduate instruction—before these future teachers have formally entered the classroom as a professional and experience all of the associated pressures involved. I focus most of my research and teaching on the challenge of producing future mathematics teachers that employ educational technology effectively. Unlike the decontextualized and rote classroom approaches presented in much of traditional mathematics instruction, my research and teaching philosophy emphasizes preparing future teachers to provide lessons in which students participate in STEM-themed design tasks that highlight mathematical concepts. Much of this research has employed 3D-printing and other digital fabrication technologies that can enable students as young as age five to participate in designing and manufacturing physical objects that aid tiered learning within a primary school mathematics classroom.

This line of research aims to contribute to the formation of future STEM professionals who will participate in the American workforce, and is exemplified by a statement from President Obama to the National Academy of Sciences: “I want you to encourage young people to be makers of things, not just consumers of things.” (Berry, Bull, Browning, Thomas, Starkweather, Aylor, 2010, p. 167) Within this context, the current Special Issue of the *Journal of Mathematics Education* examines innovative approaches to mathematics pedagogy, and presents articles providing a diverse set of perspectives on employing and encouraging student creativity. Many of the

articles examine the potential role for student-generated media productions within various facets of K-12 mathematics instruction, in-service teacher professional development, or pre-service teacher preparation. All of the papers share the common goal of illuminating potential opportunities for improving mathematics pedagogy.

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