Chapter 4
Science Cartoons (SciToons):
A Model for Integrating Arts With STEM

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ABSTRACT

The 21st century offers many technological advancements resulting from cutting-edge research being conducted by scientists and engineers at higher education institutions, industries, and national labs. As exciting scientific research is being conducted, the need to address the challenges of inspiring and engaging new learners in science, technology, engineering, and mathematics (STEM) fields continues to grow. The authors present the Science Cartoons (SciToons) program as a model for making science more accessible through the integration of the arts with STEM (STEAM). The SciToons model is based on a Multimedia Learning Theoretical Framework (MLTF), which facilitates co-creation of knowledge and takes into account the contributions of STEM and non-STEM experts. The SciToons model combines this knowledge and expertise with art, animation, high-quality multimedia, and storytelling in the development of science videos that are engaging to a broad audience.

INTRODUCTION

One of the challenges of the 21st century for the science, technology, engineering and mathematics (STEM) communities in the private and public sectors, particularly in the United States, is persistence, retention and sustainability of *human capital*

engaged in STEM fields. This challenge is not new, but the critical economic and innovation roles provided by the STEM workforce, coupled with an increase in global engagement over the last two decades, have increased the need for more human capital to address these current and future issues facing STEM communities (National Science Board [NSB], 2010).

The most recent demographic data available from the United States show that women and students from Historically Underrepresented Groups (HUG) are poorly represented within the current pools of graduates with a bachelor's, master's or doctoral degree in the physical sciences (National Center for Science and Engineering Statistics [NCSES], 2017). The recognition of STEM's human capital problem by major education and research institutions in the United States has resulted in the creation of initiatives or programs, offices or centers of excellence charged with finding ways to engage and sustain women and students from Historically Underrepresented Groups (HUG) in STEM fields. For example, it is now common to find programs and centers focused on the mentoring and supporting first-generation college students or high-need students, who are disproportionately underrepresented in STEM fields, through degree completion. The approaches that have been developed to address this challenge are mainly centered on STEM-focused curricula or domain-specific interventions, such as the Meyerhoff program (Stolle-McAllister, Domingo, & Carrillo, 2010).

Arts and STEM are two powerful domains for understanding natural and social phenomena. STEM represents a focus on scientific concepts and applied research; STEAM represents STEM plus the arts (Maeda, 2013), yet more broadly can include music and dance, visual arts and design, language and literature, narrative and story-telling, and digital media, among other humanistic disciplines. STEAM uses the creative process as a vehicle to critically explore, challenge, contextualize, interpret, and communicate scientific concepts and research applications. Therefore, through the lens of STEAM, groups of STEM experts and new learners work collaboratively to produce new knowledge, in some cases resulting in improved ways to communicate scientific concepts and research.

The purpose of this chapter is to describe an innovative and inclusive approach for integrating the Arts with STEM through the development and dissemination of science animation videos called SciToons. The animations are designed to be engaging and accessible to audiences with diverse academic backgrounds.

The chapter begins with a brief description of the models (Cognitive Load Theory, the Cognitive Theory of Mulitmedia Learning (Mayer, 2014), and the Multimedia Learning Theoretical Framework (Adetunji and Levine, 2016)) upon which the production of SciToons are based. This is followed by a brief review of video animation research, including studies examining specific components of effective videos. As SciToons are produced by diverse, interdisciplinary groups,

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