Chapter 9
The Transdisciplinary Nature of STEAM Education:
Integrating STEAM in Pre-Service Teacher Education

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ABSTRACT

The purpose of this chapter is to describe and explain multiple methods of integrating STEAM into the curriculum for pre-service teachers. The chapter includes both stand-alone modular methods of integration and continuous integration methods that attempt to merge STEAM concepts throughout the curriculum. The advantages and disadvantages of each method are discussed, along with the challenges teachers faces as they attempt to integrate STEAM. Recommendations are made along with suggestions for the future direction of STEAM integration as the field becomes more transdisciplinary.

INTRODUCTION

The movement to shift from STEM to STEAM is based on the idea that science, technology, engineering, mathematics and the arts are inter-disciplinary, and that teachers should integrate ideas from each of these fields in meaningful ways. There are many examples where one or two fields are integrated in a course. We see examples where technology or mathematics is added onto a science lesson, or technology is added onto science; however, the STEAM movement is attempting to go beyond add-on models of integration. The STEAM movement is attempting to push the field further and integrate all five areas in meaningful ways.

However, integrating science, technology, engineering, arts, and mathematics is a complex challenge for the field of education. One of the challenges is that the concepts in STEAM are constantly evolving. At times STEAM appears more multidisciplinary, meaning that various fields such as science, technology and engineering are overlapping. At other times the field is interdisciplinary in that STEAM concepts interrelate in new and ever increasing ways. Some would even take this idea further and describe STEAM as "transdisciplinary." Transdisciplinary can be defined as the merging of distinct and diverse fields into a unified whole to foster new paradigms or domains and converge on a target (NSF, 2017). The new field is larger than the sum of the parts. Thinking about STEAM as transdisciplinary is a new and potentially transformative way to use STEAM ideas. The concept of "unified whole" is important in transdisciplinary fields such as STEAM. The goal is to truly unify all areas of STEAM such that the sum of the parts creates a more meaningful experience for all students. The objective of this chapter is to describe various ways of integrating STEAM in the classroom.

BACKGROUND

According to a report by the American Academy of Arts and Science, "The lines among disciplines are blurring, leading to the emergence of new fields of study that span disciplinary boundaries and allow dramatic advances that no one field could have achieved in isolation" (AAAS, 2013). The evolving multidisciplinary, interdisciplinary and transdisciplinary nature of STEAM makes it difficult to understand how to integrate concepts into the curriculum. However, as the field evolves it is important to explore new ways of achieving the transformative potential of STEAM.

One of the challenges for the field of education is to understand how to integrate STEAM into the elementary, middle school or high school curriculum (Briener, Harkness, Johnson & Koehler, 2012; Margot & Kettler, 2019; National Research

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