

From **STEM**
to **STEAM**

**USING BRAIN-COMPATIBLE
STRATEGIES TO INTEGRATE THE ARTS**

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Chapter 1

Why STEM Should Become STEAM

It is by intuition that we discover and by logic we prove.

—Jules Henri Poincaré, French mathematician (1854–1912)

We have never discovered a culture on this planet, past or present, that doesn't have art in some form. Yet there have been a number of cultures—even some existing today—that do not have reading and writing. Why is that? One likely explanation is that the cognitive, physical, and emotional activities represented by the arts—dance, music, drama, and visual arts—are basic to the human experience and necessary for survival. If they weren't, why would they have been part of every civilization from the Cro-Magnon cave dwellers of 35,000 years ago to the urban citizens of the twenty-first century? (Please see Table 1.1.)

Table 1.1 Public often sees STEM and the arts as having opposite characteristics.

STEM	Arts
Objective	Subjective
Logical	Intuitive
Analytical	Sensual
Reproducible	Unique
Useful	Frivolous

Science, the scientific method, and mathematics, on the other hand, are more recent developments. Around 4,000 years ago, the Babylonians recorded the motions of the moon, planets, and stars on clay tablets. The ancient Egyptians and Chinese made significant advances in astronomy and mathematics. Variations of the scientific method—as we currently describe it—evolved during the Middle Ages in several cultures. Arts and sciences do not compete; they are complementary. The arts create a very subjective view of the world, while science creates an objective view of the world. A person's brain needs both views in order to make suitable decisions.

Few people will argue against studying the natural sciences and mathematics in the elementary and middle schools, and support remains strong for these subjects—including Advanced Placement courses—in high schools. We wish to make clear that we support initiatives that enhance K–12 STEM courses. Recent data show that although there are 3.6 unemployed workers for every job in the United States, there is only one unemployed STEM worker for two *unfilled* STEM jobs (Change the Equation, 2012). There are many STEM-area jobs going unfilled because we do not have the skilled workers for them. Clearly, we need to improve our teaching in the STEM areas.

However, our concern is that when budgets get tight, some people view music and other arts courses as a drain on the funds needed to preserve STEM—especially science and mathematics courses. They often see STEM and the arts as polar opposites. The STEM areas are thought of as objective, logical, analytical, reproducible, and useful. The arts, on the other hand, are supposed to be subjective, intuitive, sensual, unique, and frivolous. In the budgetary competition between the arts and STEM in U.S. schools, the arts have frequently lost.

Figure 1.1 summarizes a recent report by the U.S. Department of Education noting that fewer public elementary schools are offering visual arts, dance, and drama classes during the decade of 2000 to 2010, a decline many attribute to budget cuts and an increased focus on reading and mathematics (Parsad & Spiegelman, 2012). During the decade, the percentage of elementary schools with a visual arts class declined from 87 percent to 83 percent. Although the decline in the *percentage* of schools offering music is not that great, the *amount of time* devoted to music instruction dropped dramatically, typically from three to five periods a week to just one or two.

The drop in drama was larger, from 20 percent to only 4 percent in the 2009–2010 school year. Dance slid from 20 percent to just 3 percent in that same time period. Although dance and drama/theater dropped dramatically during the decade as stand-alone subjects in elementary schools, they

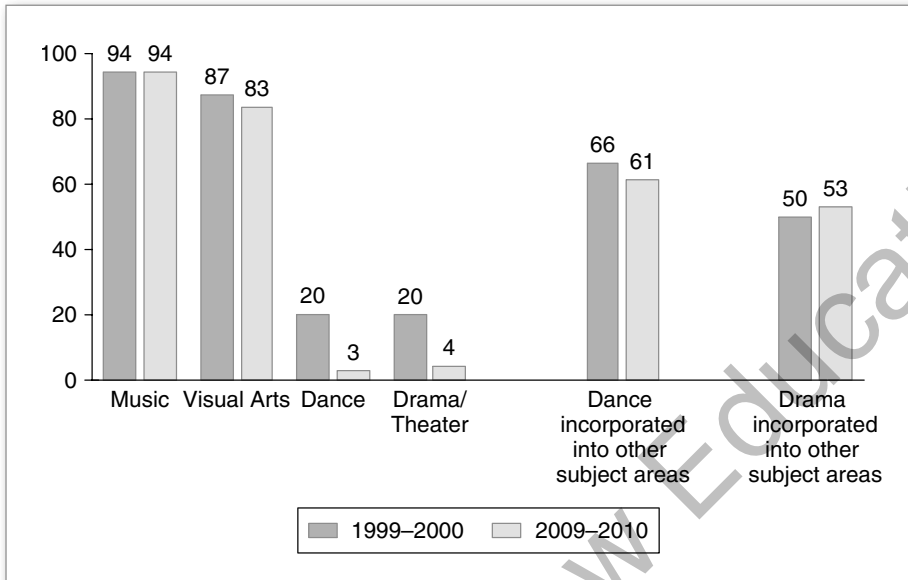


Figure 1.1 Percentage of public elementary schools with arts classes 1999–2000 and 2009–2010.

continued to be incorporated into other subject and curriculum areas. Music classes at the elementary and secondary schools remained steady, but there were noticeable declines in the nation's poorest schools. Just a decade ago, 100 percent of the poorest high schools had music classes, while today that number is down to 81 percent.

THE POWER OF THE ARTS

Many scientists, mathematicians, and engineers know that the arts are vital to their success, and they use skills borrowed from the arts as scientific tools. These include the ability to do the following:

- Draw on curiosity.
- Observe accurately.
- Perceive an object in a different form.
- Construct meaning and express one's observations accurately.
- Work effectively with others.
- Think spatially (How does an object appear when I rotate it in my head?).
- Perceive kinesthetically (How does it move?).