How do you turn STEM into STEAM? Add the Arts!

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You may have noticed in the media the increased use of the acronym STEM, which stands for science, technology, engineering, and mathematics. There is a frenzy of activity at the national and state levels to increase student involvement and achievement in the STEM content areas. Educators, businessmen, economists, politicians, and pundits are driving these activities, because they believe that American students are not adequately prepared in science and mathematics to be competitive in the global economy. Accordingly, in order for the U.S. to maintain and expand its economy, America's schools must encourage more students to pursue careers in STEM, and better prepare all students in the STEM content areas. (Atkinson, 2007)

Ohio lawmakers are also concerned about STEM preparation and participation. Included in the FY08-09 state budget (Am. Sub. HB 119-Dolan) are funds for institutions of higher education and school districts to provide incentives for students to pursue STEM careers, develop STEM schools, and improve teacher preparation and instruction in STEM content.

The FY08-09 state budget also allows certain partnerships to create independent STEM public schools for any grades 6-12, and provides grants to support existing STEM programs in grades K-8. A subcommittee of the Partnership for Continued Learning, which is chaired by Governor Strickland, will select the schools and award the grants based on a request for proposals (RFP) process. Eligibility to participate in the STEM grant program is limited to partnerships of public and private entities that consist of at least a school district or Joint Vocational School, institutions of higher education, and business organizations. The criteria for creating a STEM school also requires the school to offer 'a rigorous, diverse, integrated, and project-based curriculum' that includes the arts and humanities. (For more details on the requirements for STEM schools please see Ohio Revised Code Section 3326.01, which is on page 646 of HB 119.)

So...what is the role of music and arts education in STEM initiatives?

Music and the arts are essential educational components for all students to learn, including students who are pursuing careers in the STEM areas. Educational opportunities in music and the arts first and foremost prepare students for competitive careers in the $316 billion communication, entertainment, and technology industries as musicians, artists, dancers, actors, directors,

choreographers, videographers, graphic designers, architects, photographers, designers, film makers, arts administrators, and other professions. The growth of the visual technologies alone, from computer graphics to digital video, has had a tremendous impact on our nation's economy and the global economy. According to The Creative Industries Report, published by Americans for the Arts, more than 548,000 businesses nationwide are related to the arts and employ 2.99 million people. In Ohio there are 16,000 arts-related industries that employ 89,000 people. Many of these arts-related jobs require employees to understand and apply higher order concepts in the STEM content areas in addition to having a preparation in the arts.

In addition, the knowledge, skills, attitudes, and behaviors students acquire from studying the arts have been identified by the Partnership for 21st Century Skills and other organizations as the skills needed to be successful in the global economy. These skills include creativity and innovation; critical thinking and problem solving; communication and collaboration; flexibility and adaptability; and social and cross-cultural skills.
(http://www.21stcenturyskills.org/index.php?option=com_content&task=view&id=254&Itemid=120)

According to a February 25, 2007 article published in the Pittsburgh Post-Gazette by Kate Pielemeier called "Human resource experts say workers could benefit more from art than from math and science", artists have unique ways of solving business problems, because they are not hindered by conventional business practices and rules. (Post Gazette) The article also refers to Daniel Pink's book, 'A Whole New Mind: Why Right-Brainers Will Rule the Future', in which the author argues that the master's in fine arts is the new MBA.

Researchers have also found a strong relationship between instruction in the arts and learning mathematical skills and improving student observational skills in science. According to one study, students who studied music showed improved spatial temporal-reasoning skills, which helped them later learn math concepts. (Graziano, Critical Links) In another study researchers found that students who studied art were able to apply the observational skills that they had learned to critically view a painting to observing a science experiment. (Tishman, Critical Links)

A meta-analysis of ten years of SAT scores has confirmed the relationship between the study of music and student performance on standardized mathematics tests. And, another study has shown that students involved in orchestra and band through grade 12 performed better in math than peers not involved in music. (Catteral, Critical Links)

Students who participate in the arts also consistently outperform non-arts peers on

the Scholastic Aptitude Test, according to the 2006 SAT results published by the College Board. (2006 CollegeBoard)

There currently exist a number of STEM schools in Ohio and other states that also include a focus on the arts.

Career-Technical schools in Ohio connect technology with the arts through the career field of "Arts and Communication", which includes programs for students to pursue careers in journalism, broadcasting, graphics, performing arts and visual arts technologies.

Approximately one hundred math and science high schools have been established across the nation enrolling approximately 47,000 students. These schools provide motivated students with intense college level instruction in the STEM areas usually in grades eleven and twelve. In addition to a focus on math and science, several of these schools also include a focus on the arts. Highly recognized STEAM schools include the Louisiana School for Mathematics, Science, and the Arts; the Arkansas School for Mathematics, Sciences and the Arts; Indiana Academy for Science, Mathematics, and Humanities; the Macomb Academy of Arts and Science (Michigan); and the Appomattox Regional Governor's School for the Arts and Technology (Virginia). (National Association of Schools of Math and Science: http://www.ncsssmst.org/)

There are also a number of studies and resources available that provide examples of how the arts and STEM can be integrated throughout the curriculum of any school. Teachers in Ohio have developed lesson plans that integrate the arts with technology, math, science, social studies, and language arts. Samples of these integrated lessons, based on Ohio's academic content standards, are available through Ohio's Instructional Management System. Integrated lessons are also available through ArtsEdge, the National Arts and Education Network. ArtsEdge is a program of the John F. Kennedy Center for the Performing Arts, and a partner of MarcoPolo, a consortium of national arts education organizations, state education agencies, and the MarcoPolo Education Foundation. (ArtsEdge: http://artsedge.kennedy-center.org/teach/les.cfm)

The Arts Education Partnership has recently made available a publication called "Arts Integration Frameworks, Research & Practice: A Literature Review." This review provides information about research, theories, methods and practices pertaining to arts integration between 1995 and 2007. (Arts Education Partnership: http://www.aep-arts.org/resources/integration.htm)

AND....there are hundreds of examples of community based initiatives and partnerships that provide schools with ways to integrate music and the arts with

STEM. For example, the Art Institute in Chicago has worked with the Chicago Public Schools for several years on a project called Science, Art, and Technology, which provides science teachers and students with information about ways to use the resources of the museum to augment and enrich sciences classes. (The Art Institute: http://www.artic.edu/aic/education/sciarttech/index/html)

There are also examples of individual and organized initiatives that have increased communication and collaborations among those working in the arts and sciences. The Bridges Corporation is a nonprofit organization that hosts an annual conference called Bridges: Mathematical Connections in Art, Music, and Science. The objective of the conference is to exhibit innovative and integrative techniques that promote interdisciplinary work in the fields of mathematics and the arts. According to a Bridges publication, "The field of mathematics and art is healthy and growing, as evidenced by a series of major conferences in the past few years..." An offshoot of the Bridges Conference is the continuing work of artists, educators, scientists, and mathematicians to develop innovative artistic or educational tools and software to disseminate information about the connections between the arts and mathematics and sciences. (Bridges: http://www.bridgesmathart.org)

Institutions of higher education are also looking at the arts to stimulate creative thinking and innovative ideas. A major initiative to integrate arts education into all areas of learning was recently begun at Stanford University. In January 2006 a new cross-disciplinary institute was created called the Stanford Institute for Creativity and the Arts (SICA). Another initiative, Arts, Sciences and Technologies, links the arts with fields such as engineering and natural sciences using design thinking to help students use multiple perspectives to solve problems. According to Stanford President John L. Hennessy in a speech made on April 26, 2006, "In the last several years, we have asked how Stanford's research and educational programs can contribute to addressing the great challenges of this century. In that same way, the university is beginning to look to the arts, not only as a key part of our cultural lives, but also as an integral component in the university's educational mission." (Hennessy: 2006) …

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