

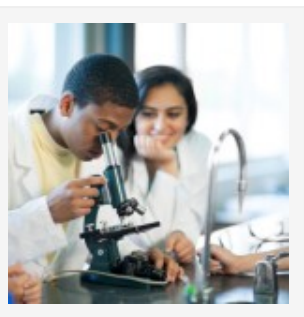
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21st-Century Leadership, Inspiring Others



Full STEAM ahead: Arts, STEM and 21st century learning

By [Doug Haller](#) on October 31st, 2012 | [Comments\(38\)](#)



It's autumn in the Rockies and a season for debate and confrontation. In nature, the bugle call of the male elk woos mates and incites challengers for control of the harem. In politics, President Barack Obama and challenger Mitt Romney return again and again to the West to assert their positions. Why fight it? This month, let's take a look at the argument for adding an "A" to STEM to create STEAM and acknowledge the role of the arts in 21st century learning.

The acronym STEM already suffers from lack of clarity, so why add to the confusion by including the arts? To some, STEM implies an integration of several disciplines into a coherent tapestry. Others use STEM to refer to a group of disciplines that require similar cognitive skills associated with research and innovation. Readers need to ask themselves: Will adding the "A" to STEM create more confusion, dilute student preparation for a technically advanced work environment or improve innovation by acknowledging the creative act and processes more commonly associated with the arts?

Many scientists I've met integrate art into their work intentionally or unconsciously.

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Communicating scientific concepts and data requires creating visual and even sonic representations. I've "heard" energy pulses from space because scientists thought to convert electromagnetic radiation into sound. As a geology student, one of my great joys was illustrating maps of the terrain we researched. In my science classroom, I encouraged my students to draw and communicate their ideas visually as well as in writing or speech. Looking at human history, it appears to me that flourishing societies demonstrate excellence in the arts as well as STEM. The transition from the Middle Ages to the Renaissance included revolutions in the arts as well as the sciences. Clearly, something about art brings out creativity and innovation in ways different from but complementary to the sciences.

In Boulder, Colo., associate professor in the College of Music and jazz saxophonist John Gunther recently received funding to explore ways to enhance the pedagogy of STEM through music and the arts. Specifically, Gunther will explore the "Science of Creativity" to better understand the creative process as it applies to the arts and the sciences. Working with students and faculty from an array of disciplines, Gunther hopes to learn where commonalities in creativity in the sciences and arts exist, develop ways to visually and sonically represent data and use technology to further the education of the arts and the sciences. His initiative will also take into account the growing body of research and applications in the neurosciences that allow us to map active areas of the brain during different physical and mental pursuits. Gunther is not alone in his interest in the relationship between STEM and music. Recently, Smithsonian magazine featured an article by author and Talking Heads musician David Byrne titled "**How Do Our Brains Process Music?**" Like Gunther, Byrne explores the application of neuroscience to understanding the brain and the importance of music in our lives and its role in human evolution.

Art Institute of Chicago professor of architecture and environmental design Linda Keane advocates for STEAM, emphasizing that the "A" for arts includes design, a process applied by professions in fields as diverse as urban planning and mechanical engineering. In addition to her professorial responsibilities, Keane co-directs **NEXT.cc**, a nonprofit organization dedicated to K-12 design and environmental education. According to Keane, the arts and design create meaningful relationships between the built and natural environments. Keane's arguments for including the arts in STEM echo throughout a report by the National Governors Association. In May, the NGA released "**New Engines for Growth: Five Roles for Arts, Culture and Design.**" The document argues that including the arts in urban (and rural) development plans increases economic prosperity because the creative juices of artists feed innovation in STEM professions. In a way, the report represents an expansion of the NGA's 2007 **STEM Communication Toolkit** by articulating the relationships between

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Who We Are



STEM and the arts and their combined effectiveness to drive economic development.

*Doug Haller is the principal of **Haller STEM Education Consulting**. Haller is an education consultant specializing in strategic planning and market analysis to drive design, development and sales of niche education products for clients in the for-profit, nonprofit, and education and public outreach fields. His creative approach is based on years of practical experience as an educator, instructional designer and education consultant. Check out his blog, **STEM Education: Inspire, Engage, Educate**.*

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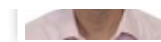
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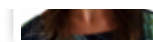
[harrykeller](#) 13p · 3 weeks ago

+1  

I have to agree that STEM suffers from a lack of clarity. The "technology" part is not truly a separate learning discipline but rather a hodgepodge of different things coming from our scientists and engineers. The remaining parts of the acronym each use a different skill set and different thinking strategies. Mathematics is about proving things absolutely. Science is about being unable ever to provide absolute proof of any scientific theory and is about either disproving or buttressing theories, often without knowing ahead of time which you are doing. Engineering is about building things, designing according to what you know about how things work and sometimes exploring where you don't know. Science is always about exploring where you don't know.



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Mathematicians provide the underpinnings of science and engineering, in a sense the materials you build metaphorical ships from. Engineers are the ones who build those ships, again metaphorically. Scientists sail them to explore the sea of knowledge.

So, where do the arts fit into all of this? More often than not, engineers must create things that people use. Appearance is very important. The Apple company that Steve Jobs remade proves that fact. Many famous scientists were musicians -- e.g. Einstein. However, the most important commonality of science and engineering with art is creativity. Unfortunately, creativity, the word, suffers from a lack of clarity too. People can differ strongly as to whether a given piece of art is truly creative or just derivative -- or not even art at all.

In think that the creative acts of the scientist, the engineer, and the artist are different. Mathematicians have to be very creative too if they're to advance beyond what's current, and that's yet another sort of creativity.

The consistent part about these different creative acts, IMO, is thinking "outside of the box." This is the part of creativity (the kind that comes up with something truly new and different) that separates the creative practitioner from the pedestrian one. It's hard to pin down because many practitioners will claim that they're creative while others disagree. This part requires opening up your mind to new thoughts, ignoring those barriers we all set up in our minds to make our daily life easier.

For me, you don't have to do art to make that happen. You can do science or engineering (or math for that matter) and practice thinking outside of normal boundaries. It's just more "fun" with art -- for most. Lots of people find it easier to express themselves with painting, drawing, sculpting, or stories than with experiments and machines. It's a nice way to exercise your creative brain cells that probably have atrophied somewhat from neglect in the usual curricula. I'm not one of those people, but I understand that most others aren't really interested in the heavy lifting intellectually required to be creative in more technical fields.

Reply ▶ **1 reply** · active 3 weeks ago

Report



Kerrie Levenduski · 3 weeks ago

+7  

I am an Elementary Music Teacher so perhaps I may be a bit biased but... as I understand it, STEM includes Science, Technology, Engineering, and Math. As a music teacher all of these disciplines are naturally involved or included in Music Education. Additionally we also incorporate, Language (not just English), Litteracy, Art, Physical Education, and Social Studies. The way I see it, "The Arts" would be the core that brings the other disciplines together. It's not just frill or fluff for fun, it's the way to bring them alive to show how they all work together. While each discipline has a unique skill set, they all share some of the same components. Bringing them together seems to be the challenge and the Arts seem to me to be the solution to this challenge. I don't just have a STEM in my classroom, I have the whole plant, and it's alive and growing well.

Reply ▶ **2 replies** · active 3 weeks ago

Report



James Gabbard · 3 weeks ago

+2  

I like this conversation. Hope you will read Daniel Pink's book, " A Whole New Mind ". STEM's orientation is towards the left brain and Pink points out many reasons to make more effective use of the right brain

as well. In my experience in STEM schools for the last 3 years, I noticed that most of our top students were also involved in the Fine Arts.

Reply

Report



Mr. Pearson · 3 weeks ago

+1  

Creativity is a muscle of the Mind. Science, Technology, Engineering and Mathematics are tools contrived by Mankind to further our understanding of ourselves and our environment. As with any muscle the more we exercise and develop our power to create and innovate, the more effectively we can employ those other "STEM" tools that we value so dearly. The Arts are an excellent venue to expand and strengthen that ability to create which in turn powers and provides purpose to our acquisition of knowledge and our pursuit of STEM. In my classroom I was given two words to post on the wall to provide focus to my students. The two words were; WHAT and WHY. I promptly changed them to; WHAT IF ; and WHY NOT. Yes, I am the Art teacher.

Reply

Report



Gerry M · 3 weeks ago

-2  

No doubt Art requires innovation and creativity. So does any original work whether it is in STEM, art, or the social sciences. So maybe we should make it STEAMSS. We can add a few more areas to make a well rounded professional and citizen. But that is not the issue: what groups the STEM fields together is evidence-based reasoning. The arts want to be included so they too can share the limelight and have funding priority. But the wider we cast the net the less priority means. STEM began as SMET, an awful acronym whose only merit was that it reflected an orderly priority moving from basics to applications. If you expanded that to the arts and social sciences, it would become STEMASS. Enough humor. Leave STEM alone but recognize that creativity and innovation draws on other areas as well.

Reply

Report



Virginia M · 3 weeks ago

+1  

As I see it, you're missing the point of creating elegant and truly beautiful solutions to any problem unless visual artists are involved. Visual artists have the understanding of design principals and an understanding of aesthetics that are crucial to take solutions to the next level (think: Apple and Steve Jobs' philosophy). It's not a question of "adding on", it's a question of raising the bar. Visual artists will push the engineers to create that one-piece aluminum case (Mac) that's incredibly thin, even though the engineers say it's not possible!

Reply

Report



Anne Hayden Stevens · 3 weeks ago

0  

As a previous commenter mentioned, "It's a nice way to exercise your creative brain cells that probably have atrophied somewhat from neglect in the usual curricula." To my mind, one role of the Arts in STEM is to make sure all our engineers, scientists and mathematicians have put in enough hours drawing,

performing, playing music, and building things to really excel in their field. By evolving to STEAM, we try to ensure that these neglected domains regain their well-documented significance in the education of innovators.

Reply

Report



Harold Pratt · 3 weeks ago

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Why not call it creativity and get a little closer to the intellectual bent and need of students in the rest of the acronym? We could many other disciplines in an effort to provide a well rounded education but is that the intent of trying to bring the three (or is it four?) disciplines together is a coherent integration? Why not add another E for expression, the ability to write and speak, probably a greater need or deficiency of STEM graduates. The list of "why not add" goes on ..and on.

Reply

▶ 1 reply · active 3 weeks ago

Report



Beth VM · 3 weeks ago

0



In researching what STEM looks like in early childhood, I find that children integrate STEM beautifully as they explore how the social, physical, and biological world works. For example, as children build with blocks to create their own technology, they grapple with the constraints of physics and learn how to engineer using a growing awareness of physical properties of objects. Simultaneously, they engage in spatial thinking as they negotiate the placement of each piece of their system. Children allowed the luxury of time and afforded the respect for the thinking that goes into the engineering of their structures are capable of designing beautiful works of architecture. Knowledgeable teachers who know when and how to question and comment as children build facilitate the development of engineering and scientific habits of mind as they persevere in problem-solving. Most teachers understand this and desire to teach in this way.

The problem? It isn't tested. Public school teachers are no longer able to engineer their own curriculum to meet the individual needs of their students. Instead our state and federal legislators, who are lobbied by corporations who profit from tests and packaged curriculum, tell teachers what to teach, what curriculum to use, and how to test it. Pacing guides that serve as mandates rather than guides often demand each teacher write the day's objectives on the board throughout the school system. This ignores the fact that many of the children are not ready to move on, or desire to explore a concept in more depth. This is a bipartisan effort.

Look for the future leaders in STEM to come from private schools (usually affluent populations) whose teachers are not dealing with the constraints of legislated tests.

Reply

▶ 1 reply · active 3 weeks ago

Report



doug haller · 3 weeks ago

0



Hi All,

Thanks for your comments. The only other blog that has received this much attention was one I wrote on funding STEM. Interesting...

Keep the comments coming...

Reply

Report



Russ Kohnken · 3 weeks ago

0



As a scientist and science teacher, I have to agree that there is a tremendous amount of art in science, and likewise science in art. I think that HarryKeller wrote a good summary of how the parts fit together. Rather than 'outside the box', I sometimes say that a creative scientist, or artist, manages to look at things in a different way. In science, we may find a discovery, in art, an enduring masterpiece.

However, I also agree with Gerry M. although I would argue that STEM is tied together through quantitative reasoning; most fields are at least partially evidence-based. In order to avoid diluting that unifying piece, I would rather not see us bring the arts into it. Indeed, we don't need to; it's already there, but not as an explicit field of study. STEM may already be too broad a field to make much sense educationally.

Reply

Report



Nancy Gosen · 3 weeks ago

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Thank you Mr. Haller for the blog post that has prompted such a thoughtful discussion! I have two strands to add to the discussion.

First, I have been thinking for a number of years on the resistance that exists to include the arts in basic education (NCLB) and workforce education (such as STEM) in U.S. education policies and practice. Indeed, this is not the case in the top-performance countries such as South Korea, Finland, Japan, Australia, and Canada, all of which have consistent and comprehensive music and arts education in elementary and secondary schools.

Second, artistic expression has been around since caveman. I do believe that artistic expression is a way of reflection, i.e. information processing of and through the senses. I believe that artistic expressions are stem cells of great thought, including mathematical or scientific.

Reply

▶ 1 reply · active 3 weeks ago

Report



Beth VM · 3 weeks ago

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"do you think that the next generation science standards with their emphasis on practice will resolve some of the challenges teachers face?"

Unfortunately, no, but it's not that teachers don't agree with the recommendations. They do. While the Framework for K-12 Science Education calls for integration and focus on depth rather than breadth, the resulting conceptual development and development of scientific thinking and practices cannot be tested authentically. It is next to impossible to quantify. Low-level thinking is easy to quantify. Legislators like numbers to report to the public and make decisions. It doesn't seem to matter that the numbers don't measure what matters. The testing industry has such a strong foothold on K-12 and now in universities, it won't matter what the Science Community recommends. Look at the profits Pearson is making in the state of Florida based on the development of their testing products, and their curriculum that ensures student performance improvement in their testing products. Iowa is close behind as the governor holds up Florida as a good example.

My hope - that corporations that rely on employees strong in STEM root out the testing industry before it's too late.

Reply

Report



STEAM Education · 3 weeks ago

+1



I'm very excited by this discussion. I have a new download about 'Why STEAM,' written for educators, administrators, business leaders and community members to explain why STEAM Education has developed, is implemented and the reasoning for its use and the successes for programs adding this framework. free: www.steamedu.com

Reply

▶ **1 reply** · active 3 weeks ago

Report



pgraypiano1 2p · 3 weeks ago

+1



Integrating the 'Arts' into STEM often focuses on how to preserve and maintain the traditional practices of the 'Arts' and their transmission to students through rigid pedagogic practices that have resisted change. Far more valid and promising for STEM integration are the underlying reasons that make the Arts possible and probably inevitable. Today there are significant lines of research about the underlying principles and requirements of animal communication systems (including human) from neuroscience, life sciences, developmental and cognitive sciences, and physics that can provide that organic STEM to STEAM integration.

Recently, the National Science Foundation funded this new approach for an elementary school curriculum that supports both the national science and music standards. And it allows the science class and music class to play complementary roles without one being in the service of the other. If you wish to explore this curriculum , see <http://ubeats.uncg.edu>

Reply

▶ **3 replies** · active 2 weeks ago

Report



Bob Barboza · 3 weeks ago

0



The Kids Talk Radio Sound Effects Orchestra: STEM to STEAM (K-12). I am collaborating with teachers and students at the Museum of Latin American Art and we are running very important experiments of how the visual and performing arts can support STEAM. We have a wide collection of musical instruments and have received support from the music industry and are collaborating with USC's Mission Science Engineering Program. I feel that we are running some very important experiments and would like to collaborate with other teachers and students. This project is for teachers that love to teach STEAM.

I am a teacher on special assignment and I thank all of you for these great comments. It is very important that we keep these kinds of conversations going.

Reply

Report



Nancy Gosen · 3 weeks ago

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While I am all for having arts experiences in daily lives, I am still resisting the STEAM acronym. To me,

STEM is workforce education and is a reiteration of the likes of MTAG (Manufacturing Technology) guidelines that Boeing and others in WA State put forth in the late 1990s as a part of the school to work movement which developed K-14 systems. Music, art, and dance are as basic to education as Reading. It's a way to read the world. A teacher friend who was trained as a teacher in Brazil told me a child must learn to read the living world through their senses and emotions before they read and understand the written word.

Reply

Report



Emil Barnabas · 3 weeks ago

+1  

I am a big proponent of the arts, but I do think that too many folks are trying to get their letter added to the STEM initiative. Nobody said that STEM included everything that was necessary! Leave the STEM guys alone.

I've seen English and Entrepreneurship trying to create STEEM, both Arts and Agriculture trying to create STEAM, as well as many others.

Instead of being an add on to someone else's program, why not create something called ARTS and then let the STEM folks try to add their letters to that?

Reply

Report



Lorna · 3 weeks ago

0  

The Odyssey of the Mind creative problem solving competition program challenges teams of students to solve complex problems using science, technology, engineering, and math by posing their solutions in the form of an 8 minute play they wrote, created backdrops, costumes and backdrops out of materials they have recycled. Students are immersed in STEM and perform using the Arts. It is the best combination of all the disciplines. This program should be in every school and be part of the school culture and curriculum. Check it out: <http://www.odysseyofthemind.com>

Reply

Report



Nancy Gosen · 3 weeks ago

0  

Yes, the Odyssey of the Mind is a wonderful program. I am familiar with it as my son and his friends were educated in public schools where PTAs and school levies helped to mitigate cuts in education funding. Here in Washington State over two dozen school districts brought suit against the state for their failure to fully fund basic education. The 102-page report --Why We're Behind: What Top Nations Teach Their Students but We Don't-- notes American students are spending "endless hours preparing to take tests of their basic reading and math skills" and the US is "the only leading industrialized nation that considers the mastery of basic skills to be the goal of K-12 education." Here's the website < <http://www.commoncore.org/ourreports.php>>

Many have made the case for consist and comprehensive arts education from progressive educators to brain scientists, yet instructional allocation of time and funding suffers. I would like to shift the conversation from how to justify arts within constrictive reforms and put together a vision to attain a broader reach. That is, after all, exactly what the arts provide: vision. The arts teach us to aspire to be

more than the sum of individual endeavors and it's this kind of thinking we need to take us to the top and beyond.

Reply

Report



Nancy Gosen · 3 weeks ago

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Here's the website < ;<http://www.commoncore.org/ourreports.php>>

Reply

Report



Nancy Gosen · 3 weeks ago

0

Not sure why the semi-colon comes up. <http://www.commoncore.org/ourreports.php>

Reply

Report



Madeleine F. Holzer · 3 weeks ago

0

I agree with those who say that the argument is really not about adding another letter to the STEM categories. All academic disciplines, when used to find creative solutions to problems in the real world, are integrated. Actually, all of them start with the same basic skills that foster perception and imagination, and then differentiate how those skills are used depending on the context of the specific problem. I've been working on a typology that clarifies this in a way that can be used in classrooms. Stay tuned...

Reply

Report



Guest · 3 weeks ago

0

STEM is already being used and the STEAM Operation should close its' steam down. STEAM is only jumping on the boat of something that is already remarkable. STEAM is not appreciated because they insist that students MUST go to the zoo for classes as well as force teachers to use the Steam Curriculum. Once the school system purchase this program and force the Teachers to use it, It will be an additional test the students will have to emark upon. Also, STEM already is across the curriculum incorporating the Arts. Science, Technology, Engineering, and Math all includes the Arts (STEM). Leave it alone!!!

Reply

▶ 1 reply · active 3 weeks ago

Report



Rosalind Flynn · 2 weeks ago

0

It's great to read all the thoughtful, thorough, and respectful conversations that this blog post has promoted. For me as an arts educator, adding an "A" for Arts to STEM is simply a way of declaring that the Arts deserve a place at the educational table. I can see why people would argue that the arts are already present within STEM. But would a similar argument work for not including Math, say, in the acronym because there's a tremendous amount of Math in Science? Math would be present—just not as an explicit field of study?

All of the arts have sets of disciplined skills, methodologies, and criteria for excellence. As a drama teacher, I think it's great when students create plays within their studies of other content areas, but overwhelmingly, when I get to observe these plays, they are not strong examples of the use of drama within learning. Yes, an art form (drama) was incorporated and present—as was creativity—but does insubstantial incorporation of artistic elements into STEM count as “It's already there?”

I don't think that adding the Arts to make STEAM is any kind of panacea for our educational problems—but it would be giving the discipline a place of recognition at the table.

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