The Value of Interdisciplinary Learning to STEM Skills and Creativity

STEM/STEAM

The TA3 Conference, June 2014
What is Our Focus?

- One “charismatic adult”
- “I will never give up on you.”
ACT has long defined college and career readiness as the acquisition of the knowledge and skills a student needs to enroll and succeed in credit bearing first-year courses at a postsecondary institution (such as a two- or four year college, trade school, or technical school) without the need for remediation.*

(Also adopted by the Common Core)

*as determined by entrance exams
Why does an entrance exam (testing theoretical math and memorization of facts) determine college or career ready?
Do students “need more math” (or reading/writing)?
NAEP **Math Scores** - High School

Note: Long-Term Trends NAEP

**Source:** NAEP 2004 Trends in Academic Progress and NAEP 1999 Trends in Academic Progress.
Achievement Flat or Declining in Reading 17 Year Olds

12.9 Academic Credits

Only 35% of 12th graders are proficient in reading. (38% proficient in 2009)

79% at or above modal score

70% at or above modal score

Note: Long-Term Trends NAEP

NAEP *Science* Scores—High School

New Framework in 2009 No Trend available: 60% Basic; 21% proficient


150

1.5 Credits

3.2 Credits

147*

New Scale

305

295*

190

140
What Businesses Think the Goal of Education Should Be

To prepare students for careers in my industry/business.
What Educators Think the Job of Education Is

- To create educated young adults (who score well on tests and pursue a baccalaureate degree).
Where Education Functions

- Knowledge in one discipline (what is tested)
- Application within discipline
- Application across disciplines (sometimes)

Where Business Functions

- Application to real-world predictable situations
- Application to real-world unpredictable situations
The Importance of Business Partnerships

- Developing a common language
  - More math classes or more math that is used in a business environment?

- Creating compatible goals

- Realizing one another’s goals.
STEM Has Four Letters

...and it is most successful when all four work together.
What Works

- PLTW
  - “I hate math but I love POE.”
- Geometry in Construction/Algebra in Engineering
- NE3i
  - Nanotechnology Employment, Education and Economic Development Initiative
State Standardized Test Scores

Average of Geometry CSAP Scores from Spring 2010 (Excludes Honors and IB)
N = 588 Students

- **Berthoud** – Math & Science Academy, PLTW School
- **Loveland** – Traditionally taught Geometry
- **Mountain View** – PLTW School, School of the Arts
- **Thompson Valley** – District’s “AP” School
What Happens When You Add STEAM?
It is easy to dismiss design – to relegate it to mere ornament, the prettifying of places and objects to disguise their banality. But that is a serious misunderstanding of what design is and why it matters – especially now.

Daniel Pink, *A Whole New Mind*
Broad Institute – Harvard and MIT

- Committed to meeting the most critical challenges in Biology and Medicine.

- Even before the Broad Institute had a physical home, artists were invited into the Broad community. This was done because the interactions between artists and scientists - the sharing of views and the disparate approaches to solving problems – possess the potential to inspire both science and art.

- The Broad's *artist-in-residence* program lies at the intersection of science and art. The program is designed to stimulate collaborative problem-solving using an interdisciplinary approach.
One of design's most potent economic effects is the capacity to create new markets. The only way to survive is by constantly developing new innovations, inventing new categories – giving the world something it didn't know it was missing.

Daniel Pink – A Whole New Mind
We don’t just have fun with gear art, Winzeler surrounds everyone with Gear Art. It is just another way to foster a creative atmosphere that encourages people to find new ways to look at gears. And it is how we continually help our partners solve complex challenges for gears and gear assemblies.

February 2012 saw the project begin with an introduction to gears, gear design, and gear manufacturing by way of a class taught by me and gear engineer Mike Cassata at the school and here in our art gallery at the Winzeler Gear plant. Mike instructed the students on the complexity and beauty of the involute curve (shown here), a key element of gear design.
Design Thinking in STEM

New Trier Design Thinking
Crutch Project
Design Thinking In STEM - IDEO

**Inspiration** – the problem or opportunity that motivates the search for solutions

**Ideation** – the process of generating, developing and testing ideas.

**Implementation** – the path that leads from the project stage into people’s lives.
Discover Design

Discover Architecture

• Society
• Site
• Spaces
• Systems
• Structure
• Skin
• Stuff

Choose a Design Project – judged by architects from around the world

Student Gallery

My Discover Design

http://discoverdesign.org/

The Design Process
Architects and engineers use the design process to solve problems and figure out new solutions.

Math + Science Connections
Wondering what your math and science classes have to do with architecture?
**Program Design**  
(Maker Movement)
- Hanging Out
- Messing Around
- Geeking Out

**Local and online collaborative communities for STEAM education**
- 20+ challenges that can be done individually or in groups
- Engineers, scientists, graduate students as mentors.
- Designed to appeal to students who don’t think of themselves as “good at” math and science.
- **STEAM Challenges**
- Mobile apps, jewelry design, solar cars, 3D modeling, designing a dream home
Design Thinking & Communication

Segal Design Institute – Northwestern University

- Required freshman engineering course.
- Puts students to work on real design problems submitted by individuals, non-profits, entrepreneurs and industry.
  - Study a problem from multiple perspectives.
  - Frame the design challenge properly.
  - Ideate, Prototype and Iterate solutions.
  - Communicate to the customer in design reviews, reports and presentations.
  - Learn from the design process how to create value and prepare for careers.

Bedside Button Buddy

Enables case managers to determine when residents are awake or asleep without infringing on their privacy.
Students will learn and use “Design Thinking,” a process used by Engineering and Design schools across the country. They will work in interdisciplinary teams and use art, engineering, math, technology, and science to design innovative solutions to problems. Students will choose design challenges focusing on problems we face every day in our community or around the globe, and present their design solutions to multiple user groups.
Functional Focus Areas

- **Technology**
  - Computing
  - Robotics
  - Networking
  - Mobile tech
  - Biotech
  - Nanotech

- **Design**
  - Human-centered design
  - Problem solving:
    - Product
    - Service
    - Process

- **Lean Start-up* Methods**
  - Learn
  - Test
  - Ideate
  - Prototyping & MVPs (minimal viable product)
  - *The Lean Start-Up by Eric Ries

- **Entrepreneurship**
  - Business formation
  - Fundraising
  - Development

Dr. Eric James and Tim Lavengood
You really need to understand it, and you really need to understand *why* you need to know this, to be able to complete the project.
Keeping It Real

**NSERVE Career Exploration Courses**
- Engineering, Robotics & Nanotech
- Healthcare
- Business and Law

Career Speakers
Job Shadowing
Site visits
Internships
E-mentors
Glenbrook South High School’s Electric Car Partnership with high school Physics, Automotive, Oakton Community College, and Illinois Tool Works 
Three 1st place, One 2nd place 
(7 categories – Innovative Vehicle Design national competition)

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