National Center for
Technological Literacy®
Museum of Science, Boston

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Written Statement of
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Museum of Science, Boston
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National Center for Technological Literacy ®
submitted to the
Research and Science Education Subcommittee
Committee on Science and Technology
U.S House of Representatives
hearing regarding
K-12 Engineering Education

October 22, 2009

On behalf of the Museum of Science, Boston and our National Center for Technological Literacy (NCTL), I applaud Chairman Lipinski and the members of the Subcommittee for holding this hearing on the occurrence and effect of K-12 engineering education. This has been my passion and focus for the past 20 years.

The Museum of Science, Boston is one of the world's largest science centers and New England's most attended cultural institution. We work to bring science, technology, engineering, and mathematics alive for about 1.5 million visitors a year through our interactive exhibits and programs, serving 186,000 students and 100,000 more in traveling and overnight programs. The goal of the NCTL is to introduce engineering into K-12 classrooms nationwide.

Why K-12 Engineering?

With an economy in flux and a workforce at risk, educating the nation's future engineers and scientists and advancing technological literacy are more important than ever. We need a strong technical and engineering workforce to remain competitive and innovative. To maintain our country's vitality and security, we must expand students' understanding of technology and engineering and widen the pipeline to careers in these fields so that a diverse array of talented students can pursue them.

The key to educating students to thrive in this competitive global economy is introducing them to the engineering design skills and concepts that will engage them in applying their math and science knowledge to solve real problems. This is the way to harness the creativity of young minds. This is also the process that fuels innovation of new technologies.

Lately, K-12 math and science education has received a lot of attention, while K-12 technology and engineering education has been largely overlooked. The problem is that the school science curricula still focus more on the natural, not the human-made or technological, world, and have taught little or no engineering. The beauty of engineering is that it is the connector that uses science and math to create the technological innovations that facilitate daily experience.

Our curricula frameworks were established in the nineteenth century society, when the society was largely agrarian - no phones, automobiles, or computers. Obviously, our world has changed but most curricula have not, leaving a huge gap in students' learning. While most people spend 95 percent of their time interacting with technologies of the human-made world, few know these products are made through engineering. We need to add technology and engineering as standard subjects in U.S. schools.

There are many reasons to introduce engineering in K-12 schools:

First, engineering is rich in hands-on experiences. Children are born engineers, fascinated with building and taking things apart to see how they work. Describing these activities as engineering can help them develop positive associations with the field.

Second, engineering brings math and science to life, demonstrating that they are relevant subjects thereby motivating students to pursue them. Relevance is particularly significant for girls and other underrepresented groups. Engineering pulls together many other disciplines, including math, science, language arts, history, and art, engaging children of differing abilities in problem-based learning, where teamwork is important.

Third, to create a diverse, technologically literate workforce, we need to support engineering in K-12 schools. Most engineers will tell you they were inspired by an engineer in their family. Unfortunately, the engineering profession is not diverse – we are mostly white men. Therefore, many children are not exposed to such role models nor have access to enhancement experiences which will lead them to pursue engineering careers. To break this cycle, expand opportunities, and diversify the profession, we must offer engineering education in K-12 classrooms to make those careers more desirable and accessible to all children from all backgrounds.

The fourth and major reason to start engineering early is that technological literacy is basic literacy for the 21st century. We live in a technological world. We need to understand how human-made things like shoes and band-aids are created, how they work, and how to improve them.

However, according to, *Technically Speaking: Why All Americans Need to Know More About Technology* (National Academy of Engineering/National Research Council, 2002, page 1), "Although the United States is increasingly defined by and dependent on technology … its citizens are not equipped to make well-considered decisions or think critically about technology." The report also said, "Neither the educational system … nor the policy-making apparatus has recognized the importance of technological literacy." Far beyond a facility with computers, "technological literacy" involves understanding what technology is, how it is created, and how it influences our lives. To paraphrase from *Technically Speaking* (page 4), a technologically literate person should:

- recognize technology in its many forms;
- understand basic engineering concepts and terms such as systems, constraints, and trade-offs;
- have a range of hands-on skills in using a variety of technologies;
- know that people shape technology and technology shapes behavior;
- know there are risks and benefits in using or not using technology to solve problems; and,
- be able to use math concepts to make informed decisions about technological risks and benefits.

An important goal of engineering education is to introduce students to engineering as a profession which takes skill, creativity, and knowledge of science and mathematics, but which novices can begin to practice in an intellectually honest way, just as they can practice scientific inquiry at an amateur level in an intellectually honest way. We want students to feel that engineering design can be fun, can help people, and is worth learning to do better. In addition, we want them to be exposed to the enormous range of technologies in use today, as well the enormous inheritance they receive of accumulated design know-how. Engineering is ongoing, and can be used to solve human problems. These are goals worthy of students' time and effort.

Understanding the importance of technological literacy and the need for trained engineers, the Museum of Science launched the National Center for Technological Literacy in 2004 to enhance knowledge of engineering and technology for people of all ages and to inspire the next generation of engineers and scientists. A detailed description of our work follows the Challenges and Recommendations sections.

Challenges

While the NCTL has made tremendous progress in advancing K-12 engineering education in Massachusetts and in an increasing number of states, we have encountered a number of challenges that can be overcome.

Because K-12 engineering education is not terribly widespread, the one challenge lies in the sense of apprehension and misunderstanding by teachers and administrators. Engineering may frighten some teachers, especially those uncomfortable with science. However, once they have received our training, which ranges from a day and a half to three weeks, most are excited and willing to implement.

Through our professional development training, we explain that the engineering design process is similar to scientific inquiry that explores the natural world, except that engineering explores the human-made world (see comparison chart in appendices). This provides a frame of reference and comfort level. We do not expect our teachers to teach something as complex as tribology and finite element analysis. We do want them to expose students to open-ended problem-solving using limited resources or designing under constraint.

Lack of appropriate resources is another challenge. Schools and teachers need access to effective instructional materials and hands-on kits so students can actually apply their skills.

Some argue there is no time to add a new topic to an already packed school year. They express concern that adding another subject or topic will simply extend the content rather than allow deeper exploration. Our engineering curricula allow students to multi-task – applying science, math, language arts, and technology in engineering design challenges thereby covering multiple subjects at once. As one elementary teacher says, "it's an add-in, not an add-on."

Another concern we hear is that there are no separate engineering education standards for curricula development, teacher preparation, student achievement, etc. Some advocate for the creation and implementation of new separate K-12 engineering standards and assessments. Some advocate the revision of existing standards including math, science and technology standards to incorporate and integrate engineering education. The National Academies of Engineering is currently studying these options and that report is due to be published next year. We support the integration of engineering in all grades, particularly in science and math, and separate courses for both middle and high school students.

It is important to note, on the assessment front, that the National Assessment of Educational Progress - Science 2009 will include a number of items that will assess student technological design skills. Further, the National Assessment Governing Board is currently developing a Technological Literacy study that will likely assess design and systems thinking, as well as information and computer technology literacy, and technology and society.

Another challenge is the lack of recognition by some policy makers and education leaders that K-12 engineering education is taking place in classrooms across the nation and that positive results are occurring. This is further complicated by the fact that there are no existing federal programs to specifically support K-12 engineering education in core academic classrooms. Many agencies espouse support for STEM programs; however, most focus on science and math to the exclusion of technology and engineering. While the National Science Foundation, which has awarded several grants to the Museum and the NCTL, and other science and engineering agencies support STEM education, there are no specific programs designed to help all states pursue

K-12 engineering education nor has there been any large scale research programs to measure the efficacy of the various curricular programs.

Recommendations

To respond to these challenges, we encourage the Chairman, the Committee and the Congress to consider legislation that will further implementation and research of K-12 engineering education. We suggest a three part grant program that would allow states to plan and to implement K-12 engineering education more broadly in their schools and to participate in a large scale evaluation. We suspect this research will confirm the promising preliminary results uncovered by the National Academy of Engineering K-12 Engineering Education study group and provide tremendous guidance to future development and implementation of K-12 engineering education, student learning and STEM, career aspirations.

Furthermore, as Congress considers revising the Elementary and Secondary Education Act, we suggest the following:

- Allow informal STEM education centers and other non-profit educational organizations to receive funds for teacher professional development;
- Expand and rename the Math/Science Partnerships to STEM Partnerships to include technology and engineering educators in teacher professional development opportunities;
- Encourage states to adopt technology and engineering standards and assessments;
- Encourage states to include technology and engineering in the definition of "rigorous curricula" for high school graduation;
- Expand the definition and requirement for "technology literacy" to go beyond the use of computers to include the engineering design process;
- Include engineering/technology teachers alongside math/science teachers in all incentive programs to recruit, train, mentor, retain, and further educate teachers; and
- Support after-school programs that include technology and engineering activities.

National Center for Technological Literacy: Mission and Function

The NCTL is integrating engineering as a new discipline in schools via: 1) standards-based, teacher-tested K-12 curricula development; 2) pre-service and in-service teacher professional development and leadership training programs; and, 3) advocating for aligned standards, assessments, and policies promoting K-12 engineering education. The Museum of Science is the only science museum in the country with a comprehensive strategy and infrastructure to foster engineering education and technological literacy in both K-12 schools and science museums nationwide.

I. Curricula Development

Our curricula follow in large measure the three core principles for K-12 engineering education recommended in the recent report by the National Academy of Engineering (NAE) and the National Research Council (NRC), *Engineering in K 12 Education: Understanding the Status and Improving the Prospects.* Our materials: 1) emphasize the engineering design process; 2) incorporate important and developmentally appropriate mathematics, science, and technology knowledge and skills; and, 3) promote engineering habits of mind including systems thinking, creativity, collaboration, communication and attention to ethical considerations.

The curricula we create are not intended to replicate college level sources. We intend to impart habits of mind that include an engineering design process, optimization, efficiency and economy. It allows students to apply their math and science skills to solve community-based problems. It opens their minds to a variety of technology and engineering careers they may have never heard of before. It demonstrates that all students are capable of engineering.

An early project of the NCTL was to examine existing K-12 engineering curricula. Our online *Technology and Engineering Curriculum Review* includes instructional materials in a searchable database. The most promising have been peer reviewed and mapped to national standards. During this review process, we discovered that very little was available to address the elementary grades. www.mos.org/TEC

Our philosophy is that children construct a much deeper understanding of the world around them, including science, technology, and engineering, when they interact with meaningful, challenging activities. The NCTL curricula development team performs a detailed curriculum development process that is based heavily on, *Understanding by Design* (Wiggins & McTighe, 1998).

For example, each of our elementary units entails more than 3000 hours of development over the course of two years. In addition to this development time, units are pilot tested across Massachusetts and field tested across the United States. A typical unit development cycle begins with background research and ends with a unit release two years later.

A major focus of our work is to expand interest in engineering across all demographics. Our curricular resources emphasize diversity, including both genders, and people of races, ethnic backgrounds, physical abilities, and cultures. We also work to integrate with other topics including science, mathematics and language arts.

The *Engineering is Elementary* series is closely aligned with popular elementary science topics and is steeped in language arts. The middle school series, *Building Math*, integrates algebra with engineering design challenges and is typically taught by math teachers and also used in technology education classes. The new middle grades series, *Engineering Today*, is aligned with science subjects. *Engineering the Future* is a full year course that is taught by either technology/engineering educators or physics teachers.

A. Engineering is Elementary®

The Engineering is Elementary (EiE) project integrates engineering and technology with science, language arts, social studies, and mathematics via storybooks and hands-on design activities. Each unit begins with an illustrated storybook, in which a child from a different country uses the engineering design process to solve a community-based problem, and includes four lessons. Elementary school teachers nationwide can use these curricular materials to teach technology and engineering concepts to children in grades 1-5. The development of this series is funded in large measure by a National Science Foundation Instructional Materials Development grant as well several corporate sponsors.

The NAE report, *Engineering in K 12 Education,* cites EiE as one of the curricula offering the "most comprehensive" resources to support implementation. Materials "are clearly written to enrich and complement existing instruction…the emphasis on literacy is especially noteworthy." The EiE series "illustrates how a wide range of problems can be overcome through a systematic engineering design process that involves the application of math, science, and creativity…the idea that engineers combine creativity with their knowledge of math and science to solve problems is introduced and reinforced."

As of May 14, 2009, EiE had reached 15,660 teachers (750 in MA) and 1,021,725 students in 50 states and Washington, DC. Of those states, 34 have a significant presence with larger orders and professional development participants. Sales have also reached over one million dollars over the 5 years of sales. The receipts are reinvested into the enhancement and implementation of the curricula. These units can be obtained at www.mos.org.eie.

B. Building Math®

Building Math, created with Tufts University, provides innovative practices for integrating engineering with math to help middle school students develop algebraic thinking. Building Math consists of three middle school instructional units that uniquely integrate inquiry-based mathematics investigations and engineering design challenges. The engineering design challenges provide meaningful and engaging contexts to learn and use mathematics, and to develop students' teamwork, communication, and manual skills. The mathematics investigations yield useful results to help students make informed design decisions.

Building Math was pilot tested in Massachusetts and has sold almost 1,900 units and is estimated to reach almost 95,000 students. Six states have ordered more than 100 units and the curriculum is placed in 42 states at some level.

According to *Engineering in K-12 Education*, the units are "very deliberative in their use of contextual learning to make the study of math more interesting, practical, and engaging." The math activities have a "direct bearing on the solution to the problem." The materials are also "very consistent" in using the engineering design process to "orchestrate learning." The "richest" portion of the design process involves doing research and testing the final design and the "richest" analysis in the materials involves interpreting data and discovering "quantitative patterns and relationships."

Awarded the 2008 Distinguished Curriculum Award by the Association of Educational Publishers, the Building Math series for grades 6-8 are available from Walch Publishing www.walch.com.

C. Engineering Today: New Middle School Series

The NCTL is developing a new series of middle-school supplemental units that meet engineering and science standards by integrating the two subjects. Introduced by *WGBH Design Squad* reality TV shows, the hands-on units engage students in engineering design challenges that are informed by the relevant science topics. Students work in teams to tackle the challenges and learn about engineers and scientists who work on similar projects in the US Department of Defense laboratories. It will focus on 10 areas including communications, energy, aerospace, bioengineering, construction, and transportation. Pilot testing will begin in Fall 2010.

D. Engineering the Future®: Science, Technology, and the Design Process:

This standards-based, full year course engages high school students in hands-on design and building challenges reflecting real engineering problems. The textbook, narrated by practicing engineers from various ethnic and cultural backgrounds, encourages students to explore what engineering and technology are and how they influence our society. According *Engineering in K 12 Education*, one of the most prominent features of this curriculum is the "emphasis placed on people and story telling." All the laboratory activities "are broken down into very small pieces that build upon one another in a very incremental manner." The "culminating design problems provide students a lot of latitude to be creative and to operationalize the problem in a way that capitalizes on their interests."

Engineering the Future is currently taught in over 25 states. Over the past three years, on site and online professional development has been delivered to more than 500 teachers. Preliminary studies show that students increase their understanding of engineering in all four *Engineering the Future* units. The *Engineering the Future* textbook and related materials are available from Key Curriculum Press www.keypress.com.etf.

E. Efficacy

Our curricula development process incorporates research, evaluation, and assessment into all aspects of its design and testing. During the development, pilot and field testing, students complete pre- and post-assessments that measure pupils' understandings of engineering, technology, and science or math concepts. Most of our post-implementation research has focused on EiE and to a lesser extent, Building Math.

National, controlled studies indicate that children who engage with engineering and science through EiE learn engineering, technology, and related science concepts significantly better than students who study just the science (without engineering). This was true for both sexes and all racial/ethnic groups. They were also more positive about the prospect of being an engineer after participating in EiE.

Teachers also report that EiE curricular materials work well, whether students are low- or high-achieving, including those with cognitive, linguistic, and behavioral challenges, who are girls, children of color, or at risk in other ways.

Promising preliminary research indicates that EiE may be narrowing the achievement gap. In a national controlled study, thousands of students who participated in an EiE unit and related science instruction were compared to a control group that studied only the related science instruction. In two of the three units studied, the performance gap between low and high socioeconomic students was significantly smaller after participation in an EiE unit.

In summary, EiE students:

- are much more likely to correctly answer science content questions relating to the unit after completing an EiE unit;
- are much more likely to correctly identify the work of the field of engineers related to the unit on the post-assessment after completing an EiE unit;
- are much more likely to correctly identify relevant aspects and types of technologies featured in the unit after completing an EiE unit;
- demonstrate a much clearer understanding of relevant criteria for a design, as well as how to judge a design against those criteria, after completing the *Designing Plant Packages* or the *Evaluating a Landscape* unit;
- are significantly more likely to choose a more scientific method for answering a hypothetical question after completing the *Designing Plant Packages* unit;
- show that they understand what a model is after completing the *Evaluating a Landscape* unit;
- demonstrate a clearer understanding of materials, their properties, and their uses in different engineering design scenarios after completing the EiE unit *Designing Maglev Systems*; and
- show evidence of increased data analysis skills after completing the *Designing Maglev Systems* unit.

EiE professional development is also influencing teachers, who report large gains in their knowledge and understanding of the range of engineering disciplines, what engineers do, and the pervasiveness of engineering. They also report changes in their pedagogy after learning about EiE and teaching. All EiE research can be found here: www.mos.org/eie/research_assessment.php#formalfindings

At the Science and Technology Committee field hearing in Texarkana, then Assistant Director of the NSF, Education & Human Resources Directorate, Dr. Cora Marrett noted, "Studies show that children using the Engineering is Elementary materials gain in their understanding of engineering and science topics, compared to children not using the materials. In addition, children in the experimental group come to know what engineers do and what technology entails… Initial research suggests that this approach has been successful in helping young children envision themselves as engineers."

With the Building Math units, students engage in algebraic reasoning by modeling physical phenomena, analyzing change in both linear and non-linear relationships, extrapolate and interpolate data based on trends, describe the shapes of graphs within meaningful contexts, represent data in tables and graphs, and generalize patterns.

Our research shows that when engaged in Building Math design challenges, middle school students at different grade levels use algebraic reasoning when analyzing changing rates of an exponential function, interpret slope in a meaningful context, and use a mathematical model to make reasonable predictions. They then use this understanding to inform their engineering designs to meet the criteria and constraints of the challenge. (ASEE, 2008)

Integrating algebra and engineering can be done effectively by having math be essential to informed engineering decisions. A contextual approach for the units provides engagement in the activity, especially when students can learn together in small groups. Through the Building Math activities, students can find meeting the engineering design challenges satisfying without being overly competitive. The findings from this analysis indicate that it is possible to make non-linear, exponential functions accessible to students of different grade levels using different approaches.

II. Professional Development

While science centers and museums are known to spark life-long interest in and understanding of science, engineering, mathematics, and technology, few appreciate the extent to which these informal science education organizations impact the formal education setting. Science centers and museums have resources that many schools do not and offer interactive, professional development activities that support school curriculum.

The Museum of Science and the NCTL routinely work with school districts to bring the excitement of the science, technology and engineering to the classroom, while providing support and resources for teachers through field trip workshops, pre- and post-visit activities, teacher professional development, outreach, and linking resources to state and national learning standards.

We understand that professional development necessitates partnership. We work closely with local or state agencies to provide professional development for teachers about engineering and technology. We employ a train-the-trainer model, working jointly with teacher educators to help them better understand core engineering and technology concepts, how to most effectively communicate these to other teachers, and how to structure and run workshops about engineering and technology.

We also work with other educational institutions to offer professional development opportunities. Two such partnerships are noted below:

- The NCTL is working with three Massachusetts community colleges to help educate pre-service elementary teachers with a three-year NSF Advanced Technology Education grant. The Advancing Technological Literacy and Skills (ATLAS) Project builds their understanding of technology and engineering content and teaching tools in community college coursework. Faculty engage in engineering design challenges, connect technology and engineering concepts with science, mathematics, literacy, and other subjects, learn about technical career options, and modify courses to include technology and engineering. The project includes outreach to four-year colleges and high schools working with the community colleges to ensure continuity and create a cadre of faculty to introduce this technology and engineering pedagogy to colleagues across the state. More details can be found here: www.mos.org/eie/atlas/index.php

- To address the national shortage of technology educators, "Closing the Technology & Engineering Teaching Gap," a new K-12 initiative, is integrating NCTL materials into the fully accredited online technology education programs of Valley City State University (VCSU), North Dakota. The goal is to improve the technological literacy of K-12 teachers and prepare qualified teachers. The NCTL is making its curriculum materials and training available to VCSU via this innovative online teacher certification program.

The NCTL's train-the-trainer approach to professional development helps teacher educators understand engineering and technology concepts, communicate them to other teachers, and run workshops. The NCTL has worked with teacher educators from over 25 states and Washington, DC, through institutes and online courses to familiarize them with engineering and lead professional development workshops in their region. A list of our educational partners appears in the Appendices.

We also conduct education leadership training for school and district administrators. The Gateway to Engineering and Technology Education project builds a community of school and district leaders in sharing best practices, experiencing hands-on engineering activities, and helping each other solve problems in order to implement technology and engineering standards. An Institute of Museum and Library Services grant allowed us to support 50 school district leadership teams over the first three years. Participant district leadership teams collaborated during summer institutes, call-back days and online forums with other Gateway teams.

In Massachusetts, the Gateway program has reached nearly 300 teachers and administrators and 319,028 students (34.1% of MA public school enrollment). This Gateway model is being used in a partnership with Maine Math and Maine Mathematics and Science Alliance and Transformation 2013 in Austin and San Antonio, TX.

The Museum and the NCTL enhance the capacity of teachers to engage their students in STEM learning. Early evaluation findings suggest that, in addition to increased knowledge, teachers participating in the programs report feeling “renewed enthusiasm” and “rejuvenation” for teaching and learning about science. Future research could explore the longitudinal impacts of such programs for teacher interest and motivation for teaching and learning about science, as well as the impact on increased teacher retention.

III. Advocacy

Another function of the NCTL is advocacy. We work to develop policy and programs to support the advancement of K-12 technology and engineering education. We work at all levels of government to inform policy makers of the benefits of engineering education and how they can help promote and sustain it. We also work with like-minded organizations to further K-12 technology and engineering education across the nation.

We have been involved in the following advocacy efforts: 1) incorporating questions on technological design alongside those on scientific inquiry in the National Assessment of Educational Progress (NAEP) Science Framework for 2009; 2) the National Governors Association STEM agenda which calls for the adoption of technology and engineering standards and assessments, among other things; 3) the America COMPETES Act, which creates opportunities for technology teachers and engineering instruction at several federal agencies; and 4) the Higher Education Act expands the definition of “technology literacy” to include the engineering design process.

In 2001, I had the privilege of working with the state Massachusetts to develop the first statewide K-12 curriculum framework and assessments for technology and engineering in the nation. While forty states address technology education in their standards (often found I career and technical education standards), several states are also moving to include engineering in their core academic state standards. The NCTL has been in contact with people interested in K-12 education in all 50 states and Washington, DC, in various ways. We have worked specifically with New Hampshire, Minnesota, North Carolina, Ohio, Florida, Oregon, and Washington in revising state standards to include engineering in some form.

Conclusion

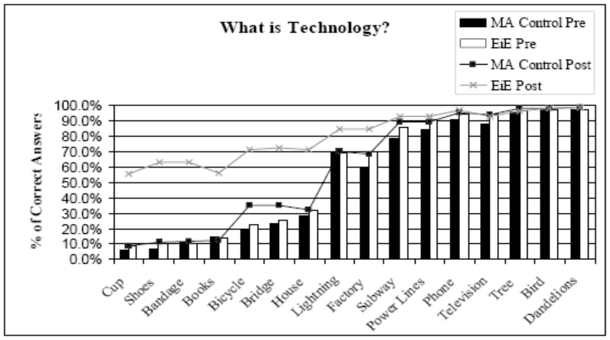
Thank you for the opportunity to present our efforts to promote, develop and implement K-12 engineering education across the nation. The National Center for Technological Literacy stands ready to assist in re-engineering today's schools, inside and out. Please visit our website, www.nctl.org. If we can provide any additional information, please let me know.

Appendices

1. Inquiry and Design

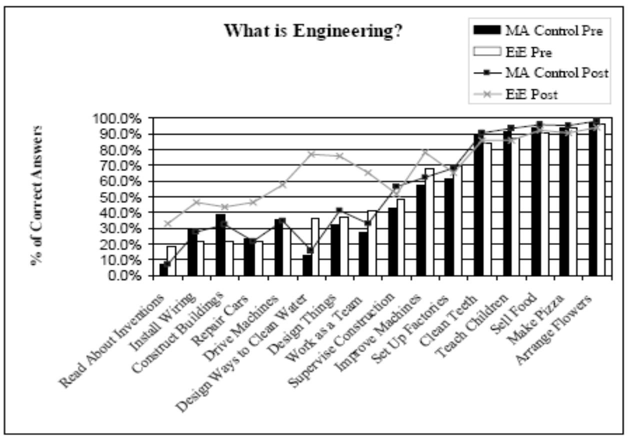
Scientific Inquiry	**Engineering Design**
Formulate a question.	Define a problem.
Research how others have answered it.	Research how others have solved it.
Brainstorm hypotheses and choose one.	Brainstorm solutions and select one.
Conduct an experiment.	Create and test a prototype.
Modify hypothesis based on results.	Redesign solution based on tests.
Draw conclusion, write paper.	Finalize design, make drawings.
Submit paper for peer review.	Present optimal solution to client.
Ask new question	Define new problem.

2. Engineering is Elementary Results



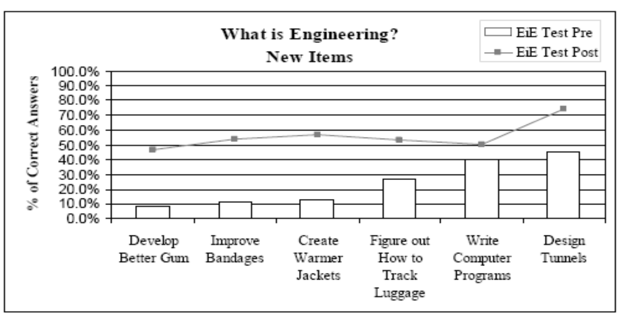
What is Technology?

Students were asked to identify 12 of 16 items that were forms of technology. Of the 9 items that were more difficult to classify – cup, shoes, bandage, bicycle, house, lightening, & factory – EiE students improved significantly.



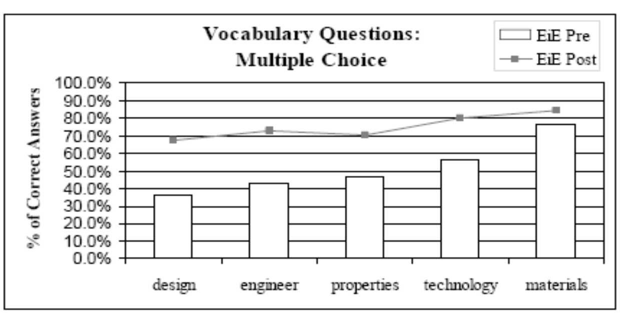
What is Engineering?

Students were asked to identify things that engineers might do on the job. EiE students showed significant improvement on 10 of the 16 items. The others were too easy. Where comparison to a control sample is available, EiE students have, for the most part, performed significantly better than the control students.



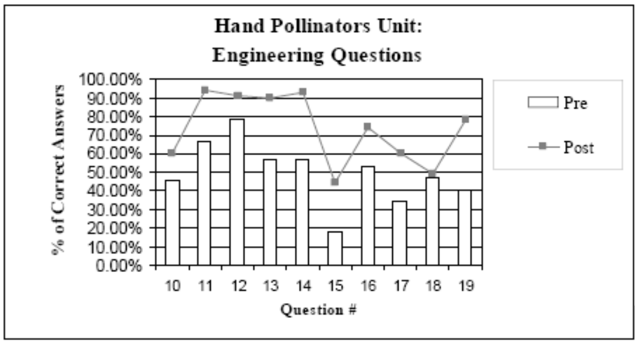
Myth Busters

More EiE students think that engineers might read about inventions, work and design as a team, and fewer think engineers drive machines, repair cars, install wiring or construct buildings.



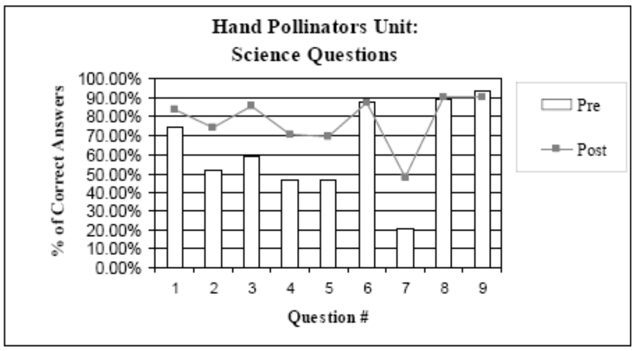
Getting it Right!

EiE students were significantly more likely to choose the correct vocabulary word on the post-assessment than on the pre-assessment. Control students did not receive these questions so there is no comparison available.



Elementary Students Learn Engineering!

Engineering is Elementary students consistently showed improvement—frequently dramatic improvement—on post-assessments designed to assess student understanding of science and engineering concepts.



Science Achievement Enhanced

Students were asked a series of questions about the roles of insects, plants, and parts of plants in the pollination process and whether sunlight, insects, people, and water are needed by plants to survive. On the more difficult science questions, EiE students improved significantly. Questions 6, 8 & 9 were too easy and not useful.

3. States that have purchased NCTL Curricula

Engineering is Elementary is in all 50 states and DC.

Building Math is in: AK, AL, AR, AZ, CA, CO, CT, DC, DE, FL, GA, IL, IN, KY, LA, MA, MD, MI, MN, MO, MS, NC, ND, NE, NH, NJ, NM, NV, NY, OH, OK, OR, PA, RI, SC, TN, TX, VA, VT, WA, WI.

Engineering the Future is in: AL, CA, CT, FL, GA, MA, MD, MI, NC, ND, NH, NJ, NY, OH, PA, RI, SC, TX, VA, VT.

4. National Center for Technological Literacy Funders

Total: $57.4 million as of August 24, 2009 for formal and informal education efforts.

Federal Funding
Institute of Museum and Library Services
National Aeronautics & Space Administration
National Institute of Standards and Technology
National Science Foundation
U.S. Small Business Administration

State Partners
Massachusetts Board of Higher Education
Massachusetts Department of Elementary and Secondary Education
Massachusetts Technology Collaborative

Foundations
Boston Foundation
The Cargill Foundation
GE Foundation
Gordon Foundation
The Highland Street Foundation
Harvard Pilgrim Health Care Foundation
The Charles Hayden Foundation
S.D. Bechtel, Jr. Foundation
Stephen Bechtel Fund
Massachusetts Biotechnology Education Foundation

Corporations
AeroVironment, Inc.
Cisco Systems, Inc.
E.I. du Pont de Nemours & Co.
GreenFuel Technologies Corporation
Hewlett-Packard Company
Intel Corporation
Liberty Mutual
Lockheed Martin Corporation
Mercury Computer Systems, Inc.
Millipore Corporation
Novartis Institutes for BioMedical Research, Inc.
Philips Medical Systems
Teradyne, Inc.

Individuals
Sarah and Jeffrey Beir
Mr. and Mrs. Richard Burnes, Jr.
Mr. and Mrs. Paul Egerman
Paul Howley
Dr. and Mrs. Donald Kaplan
Segundo and Laura Mateo
Mr. and Mrs. Raymond C. McAfoose
Carolyn W. Miller
Dr. Leo Liu and Dr. Pendred Noyce
Mr. and Mrs. Ira Stepanian
Mr. and Mrs. Henri A. Termeer
Alice and A. Zaff
Mr. Michael J. Zak and Mrs. Roxanne Zak

5. Formal Educational Partnerships

Building Engineering and Science Talent/NDEP
Maine Mathematics and Science Alliance
Minnesota Department of Education
New Hampshire Department of Education
Stevens Institute of Technology, NJ
Transformation 2013: Education Service Center (ESC) Region 13 – Austin, TX and ESC Region 20 - San Antonio,TX
Valley State City University, ND
Villanova University College of Engineering, PA

Educational Collaborations

Aldine Independent School District, TX
Charles Dana Center, Austin, TX
ESC Region 1 – Edinburg, TX
ESC Region 3 – Victoria, TX
ESC Region 4 – Houston, TX
ESC Region 9 - Wichita Falls, TX
ESC Region 11 - Fort Worth, TX
ESC Region 12 – Waco, TX
ESC Region 16 – Amarillo, TX
ESC Region 18 – Midland, TX
Falcon School District #49, CCO
Georgia Department of Education
Hofstra University, NY
Long Beach Unified School District, CA
Massachusetts Department of Elementary and Secondary Education
Minorities in Mathematics, Science, and Engineering, OH
Mobile Area Education Foundation, AL
Montgomery County ESC – Dayton, OH
North Carolina State University
National Governors Association, Center for Best Practices
North Central Texas College
Ohio Department of Education
Oregon Museum of Science and Industry
Oregon State University
PA Department of Education
Purdue University, IN
Putnam County Education Service Center, OH
Sally Ride Academy, WI
Science and Math on the Move Center, OH
Science Museum of Minnesota
Stark County Education Service Center, OH
Texarkana ISD, TX
Towson University, MD
Tufts University, MA
University of Louisville, KY
University of Maryland Baltimore County
University of Alabama, Huntsville
University of Cincinnati, OH
University of Texas - Austin
Vermont Department of Education
Wichita Falls ISD, TX
Worcester Polytechnic Institute, MA