


Doing: A National Education Imperative

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A National Imperative



“Education is not preparation for life;
education is life itself.”

Dr. John Dewey

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Overview of Presentation



- Purpose of Study
- Definition – Doing
- Importance of Study
- Select Findings
- A Call to Action
- Conclusion

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Purpose of Study



To determine the extent to which U.S. public school elementary and secondary education science, technology, engineering, and mathematics (STEM) students are *doing* activities in their classrooms.

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Definition of “Doing”



A tactile/hands-on process of technological problem solving starting with human needs and wants that leads to the principles of innovation such as designing, making/building, producing, and evaluating.

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Background



- Schools should prepare students to succeed in life (PDK – 49th Poll)
- Cost of education in U.S., among highest in the world (NCES, 2017)
- U.S. Students science and mathematics PISA_2015 – Science: 39 / 71; Mathematics: 24 / 71 (Pew Research)
- Cognitive Learning - VS - Hands-on Learning – Doing
- STEM Education – Requires Doing.

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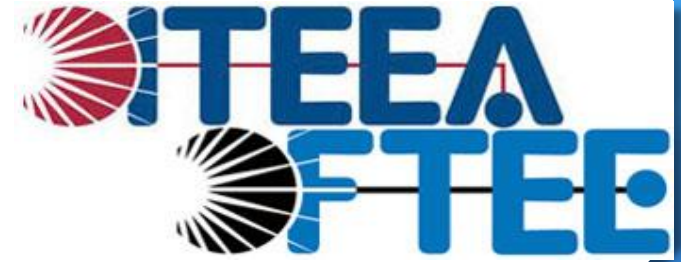
Importance of Study



- *Doing* prepares students for life.
- Determine where learning by doing is occurring.
- Iterate the importance of doing as a learning method.
- Relationship and repositioning of content within STEM subject areas.

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Doing Study Support

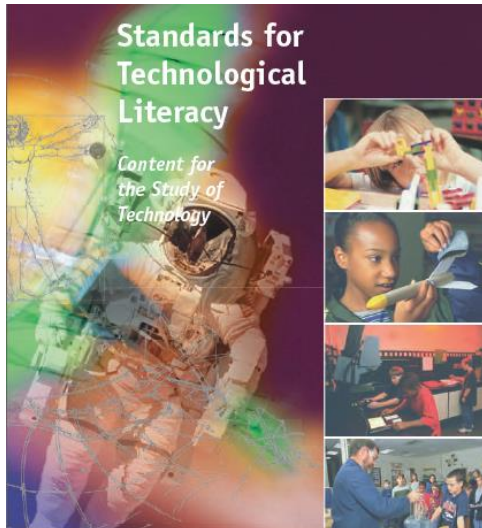


- Foundation for Technology and Engineering Education - Dugger/Gerrish Endowment
- International Technology and Engineering Educators Association (ITEEA)
- Researchers:
 - Johnny Moye
 - William Dugger
 - Kendall Starkweather

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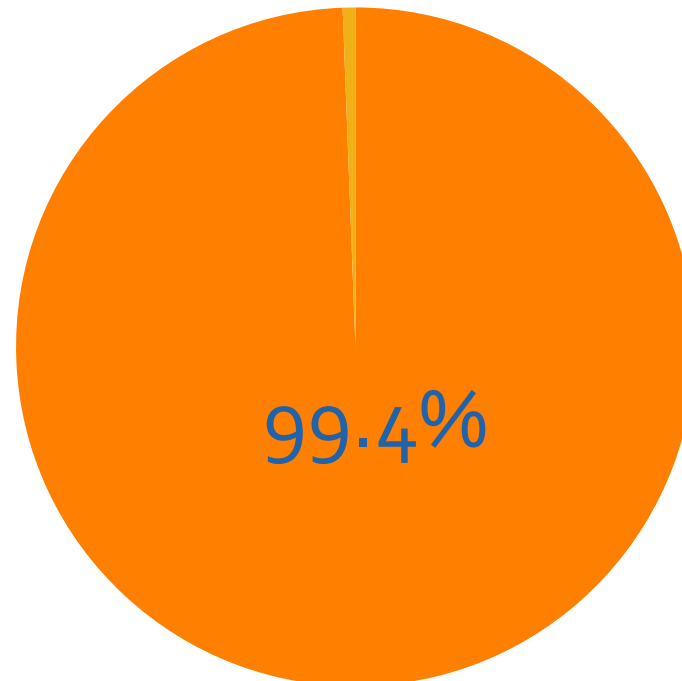
Three Survey Instruments



- Elementary, Middle & High School STEM
- 2 general statements
- 11 grade level specific statements
- 2014 - 2017
- 5,910 Participants (total)
 - 1,285 Elementary
 - 1,437 Sec. Science
 - 2,083 Sec. Tech.& Eng.
 - 1,105 Sec. Mathematics

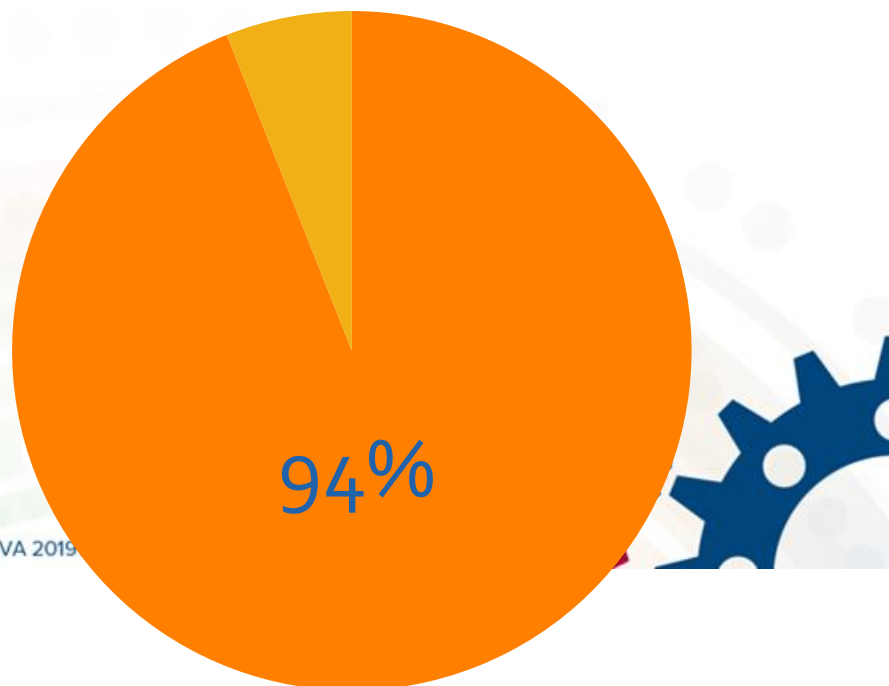
General Statement 1

I believe that students benefit from doing activities to support learning.
(Percent – Yes)



General Statement 2

If given the time and resources, I would assign my students more projects to do in class.
(Percent Yes)



Learn Better by Doing

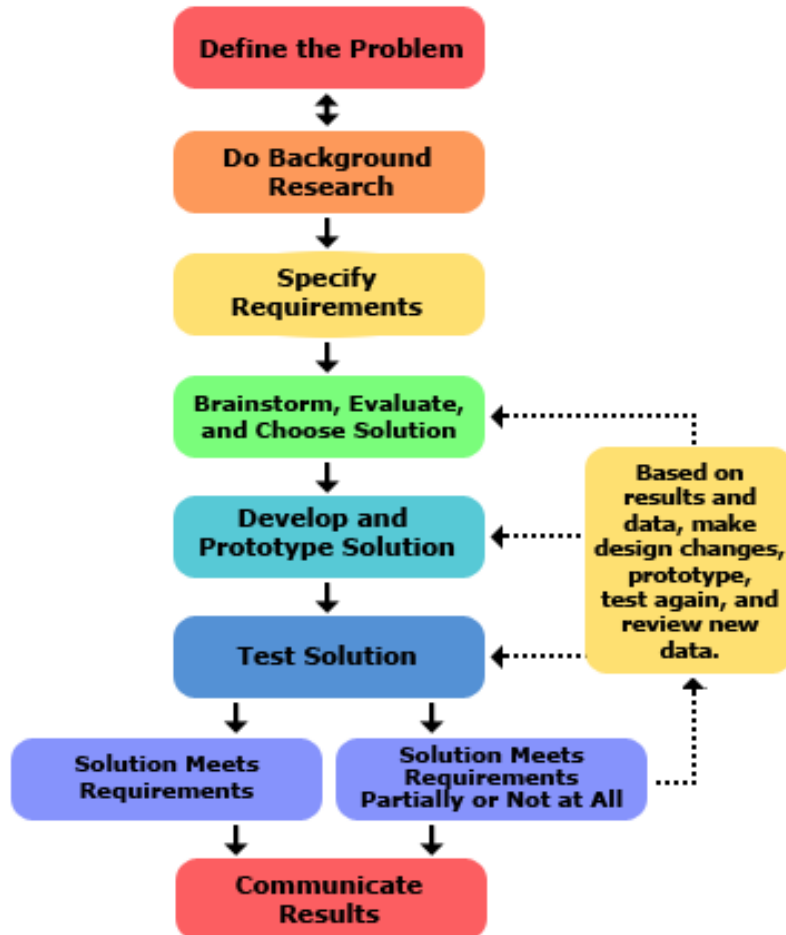


- Teachers feel students learn by doing activities, but do not have the time and/or resources to assign more *doing* experiences.
- With this point in mind, it seems appropriate that students should be doing more standards-based, hands-on, activities in their classrooms.

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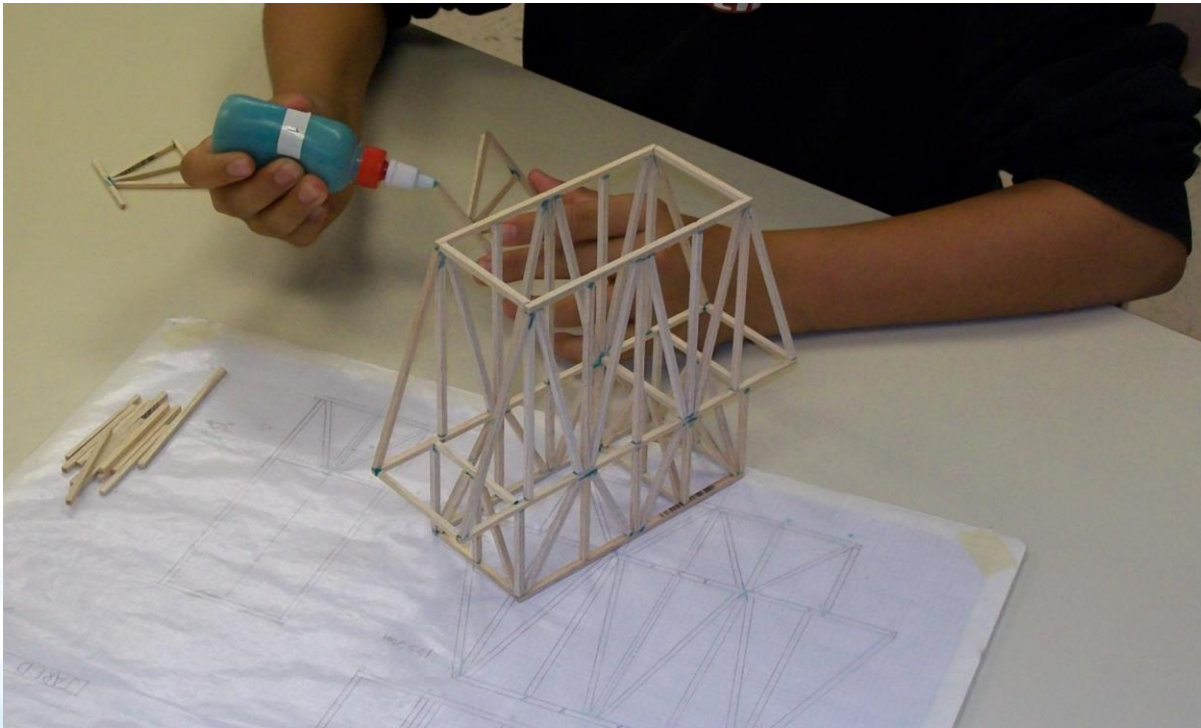
Elementary Statement



My students have constructed an object using the design process.



Middle School Statement



My students have created a model by applying criteria and constraints.

High School Statement

My students have built a prototype and checked it for quality and efficiency.



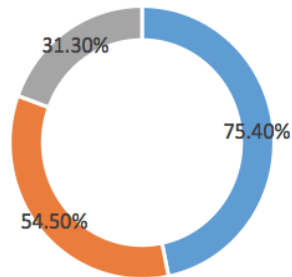
Secondary Percentage of Doing 2014-2017



STEM students do activities addressing same standards.

Secondary Percentage of Doing

Note: The Sum of Percentages Not 100%



■ Technology & Engineering ■ Science ■ Mathematics

Secondary technology and engineering students doing more.

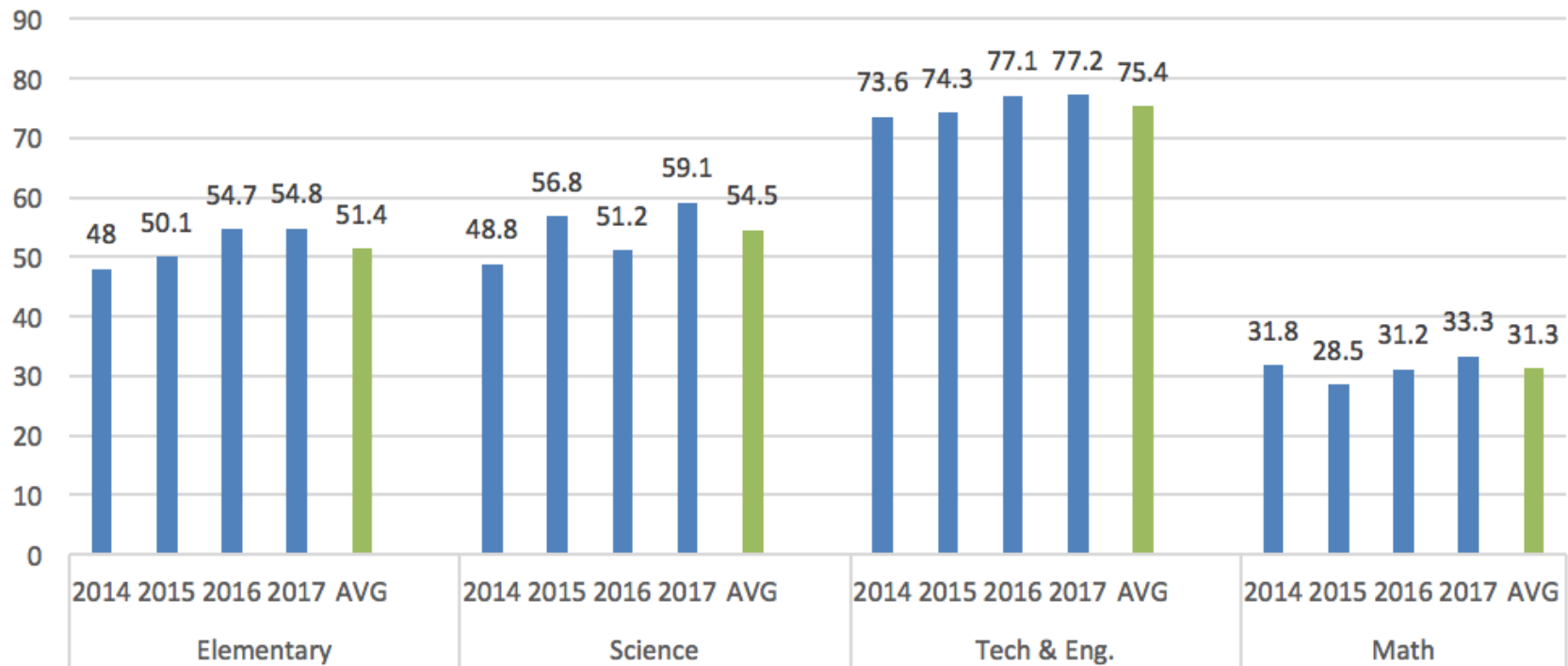
- T&E: 75.4%
- Science: 54.5%
- Math: 31.3%

Percentage of Doing 2014-2017



Four year total percentages and overall average:

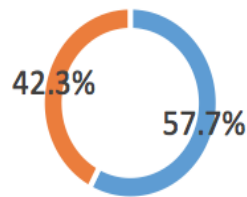
Percentage of Elementary and Secondary Doing: 2014, 15, 16, 17 &
Overall Average



Engineering Design – Elementary Schools



Percentage of Elementary Students Who Have and Have Not Used a Design Process in Class



■ Have Used Design Process ■ Have Not Used Design Process

- Engineering Design Process – important tool
 - Constraints: time, cost, Tool, process or system
- Elementary students
 - 57.7% Yes
 - 42.3% No

Design and Modeling



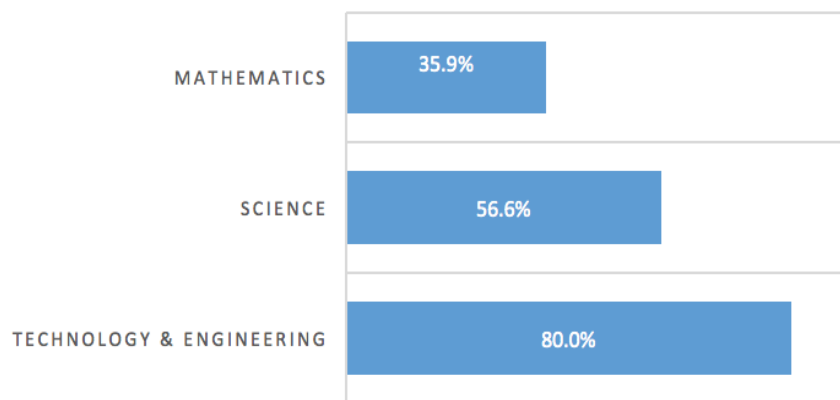
- Designing and modeling are key components in an engineering design process.
- Designing and modeling processes integrate various skills and types of thinking – analytical and synthetic.
- By learning how to design and model, students will master a set of abilities that will serve them well throughout their lives.

Secondary Education: Design



SECONDARY DESIGN

NOTE: THE SUM OF PERCENTAGES NOT 100%



Design Activities

T&E: 80%

Science: 56.6%

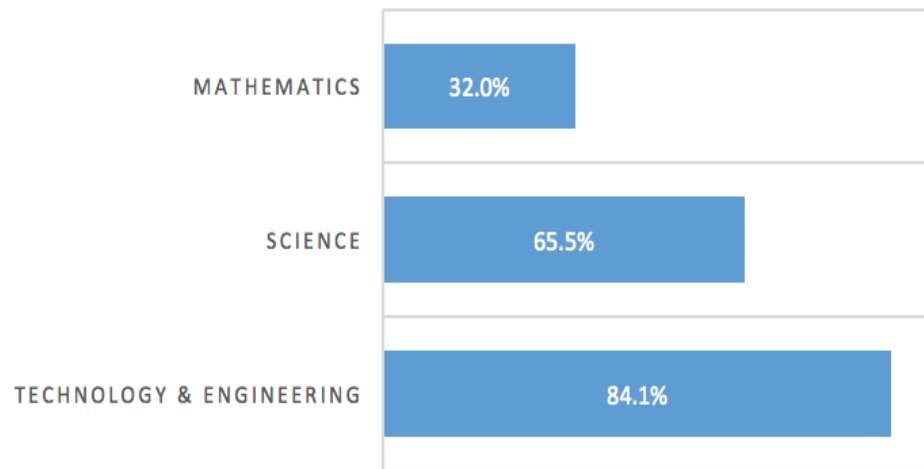
Math: 35.9%

Secondary Education: Modeling



SECONDARY MODELING

NOTE: THE SUM OF PERCENTAGES NOT 100%



Modeling Activities

T&E: 84.1%

Science: 65.5%

Math: 32%

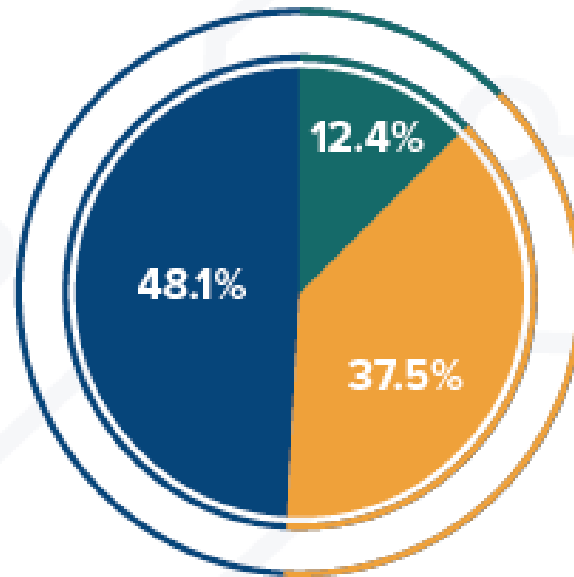
T&E Activities Promote Female STEM Participation



- Female students prefer studies and occupations that directly benefit society and/or individual needs and wants.
- Three middle and high school statements



T&E Activities Promote Female STEM Participation (Cont.)



Percentage of Secondary STEM Students assigned societal/individual needs or wants activities

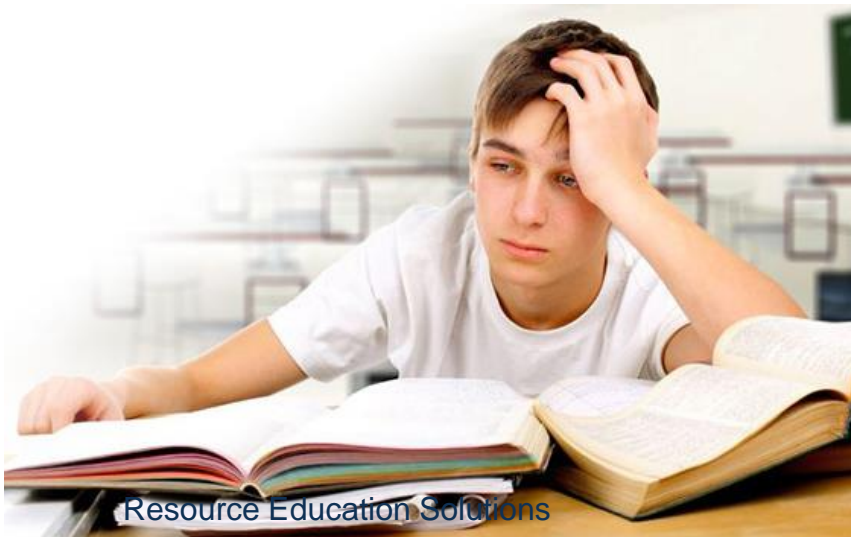
**Note: The sum of percentages not 100%*

■ Technology and Engineering

■ Science

■ Mathematics

Decrease in Doing Middle to High School

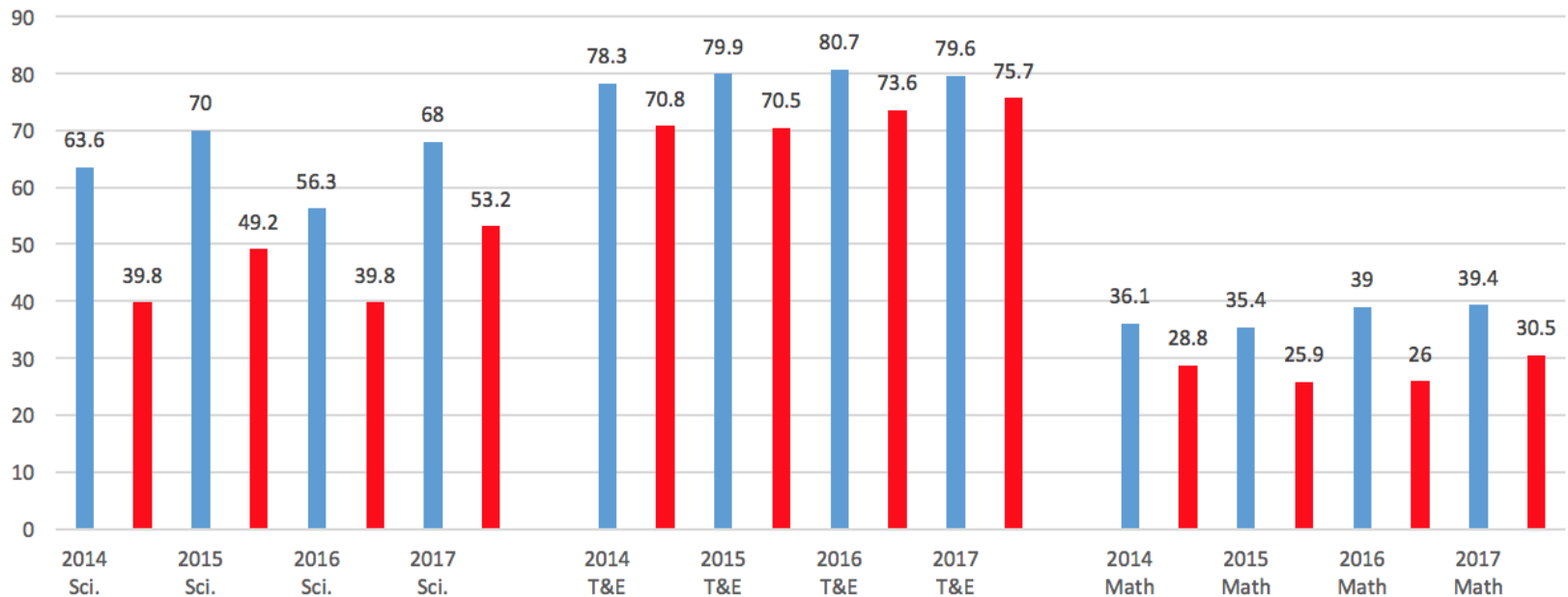


- Students lose interest between middle and high school
- Percentage of *doing* decreased from middle to high school in each content area each year of this study

Decrease in Doing Middle to High School (Cont.)



MS - HS Percentage Doing Decrease by Year

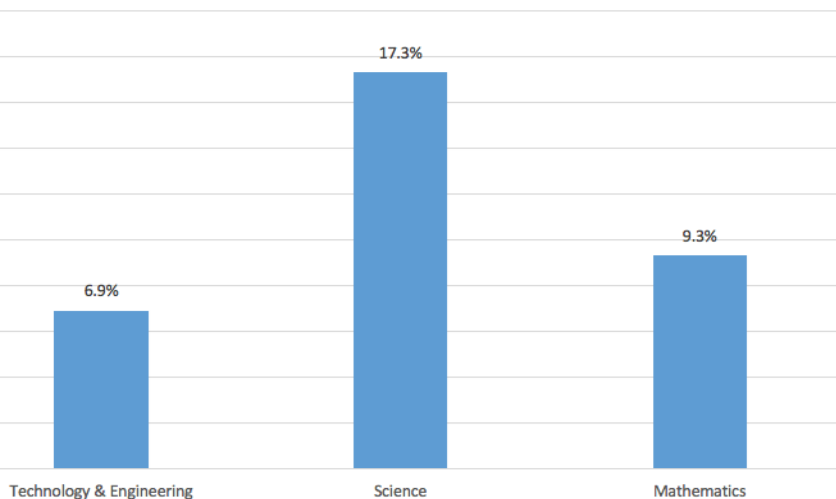


Middle to High School Decrease in Doing (Cont.)



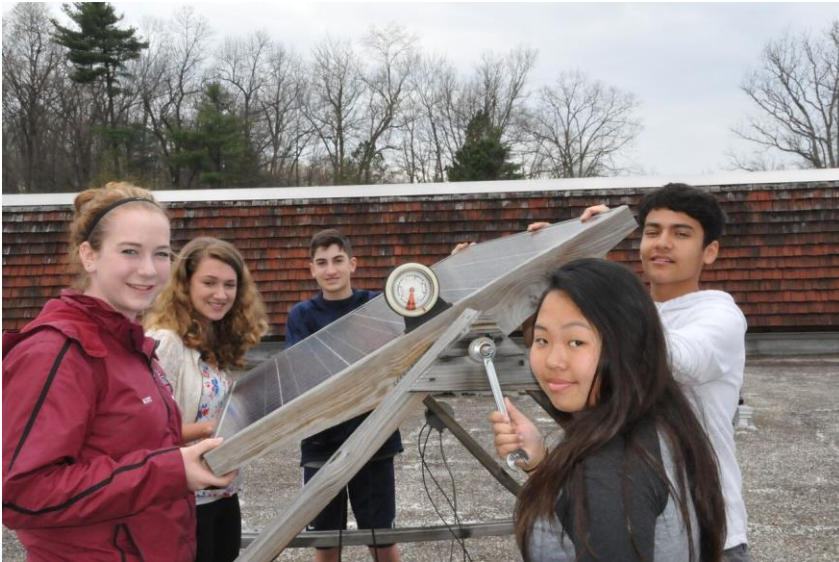
Percentage Decrease of Doing From Middle to High School

NOTE: The Sum of Percentages Not 100%



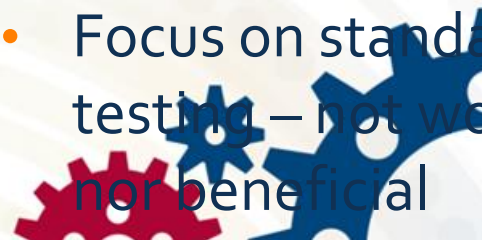
Decrease:
Science: 17.3%
Math: 9.3%
T&E: 6.9%

Engineering the Way Forward



- Break down old barriers and stereotypes.
- The U.S. has not fully utilized all of its resources to improve K-12 STEM literacy
- Focus on standardized testing – not working nor beneficial

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Engineering the Way Forward (Cont.)



Technology and engineering courses *bring STEM to life*



- STEM is incomplete without the T and E.
- Technology and engineering education is an underutilized resource.



Engineering the Way Forward (Cont.)



- If we teach today's students as we taught yesterday's, we rob them of tomorrow."

Dr. John Dewey

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Call to Action



- Promote the benefits of technology and engineering education courses.
- Illustrate how technology and engineering programs integrate standards based mathematics and science content using hands-on activities.
- Ensure that education leaders realize that students *Learn Better by Doing* and that *Doing* is happening more frequently in technology and engineering courses.



Contact Information



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Thank You

