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
Overview of Presentation

- Purpose of Study
- Definition – Doing
- Importance of Study
- Select Findings
- A Call to Action
- Conclusion
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.
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.
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)
- STEM Education – Requires Doing
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.
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
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)

99.4%
If given the time and resources, I would assign my students more projects to do in class.

(Percent Yes)

94%
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.
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 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

<table>
<thead>
<tr>
<th>Year</th>
<th>Elementary</th>
<th>Science</th>
<th>Tech &amp; Eng.</th>
<th>Math</th>
<th>AVG</th>
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</thead>
<tbody>
<tr>
<td>2014</td>
<td>48</td>
<td>48.8</td>
<td>73.6</td>
<td>31.8</td>
<td>50.1</td>
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<tr>
<td>2015</td>
<td>50.1</td>
<td>51.2</td>
<td>74.3</td>
<td>28.5</td>
<td>54.7</td>
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<td>2016</td>
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<td>59.1</td>
<td>77.1</td>
<td>31.2</td>
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<tr>
<td>2017</td>
<td>54.8</td>
<td>54.5</td>
<td>77.2</td>
<td>33.3</td>
<td>51.4</td>
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<tr>
<td>AVG</td>
<td></td>
<td></td>
<td>75.4</td>
<td>31.3</td>
<td></td>
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</tbody>
</table>
Engineering Design – Elementary Schools

- 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

Design Activities

T&E: 80%
Science: 56.6%
Math: 35.9%
Secondary Education: Modeling

Modeling Activities

T&E: 84.1%
Science: 65.5%
Math: 32%

SECONDARY MODELING
NOTE: THE SUM OF PERCENTAGES NOT 100%

<table>
<thead>
<tr>
<th>Subject</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Mathematics</td>
<td>32.0%</td>
</tr>
<tr>
<td>Science</td>
<td>65.5%</td>
</tr>
<tr>
<td>Technology &amp; Engineering</td>
<td>84.1%</td>
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</table>
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: 48.1%
- Science: 37.5%
- Mathematics: 12.4%
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.)
Middle to High School Decrease in Doing (Cont.)

Percentage Decrease of Doing From Middle to High School
NOTE: The sum of Percentages Not 100%

- 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.
Technology and engineering courses bring STEM to life

- STEM is incomplete without the T and E.
- Technology and engineering education is an underutilized resource.
• If we teach today’s students as we taught yesterday’s, we rob them of tomorrow.”

Dr. John Dewey
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.
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Thank You