“Give the pupils something to do, not something to learn; and the doing is of such a nature as to demand thinking; learning naturally results.”

John Dewey
Overview of Presentation

• Purpose of Study
• Definition – Doing
• Importance of Study
• Findings
• A Call to Action
• Conclusion
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.
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.”
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
Doing Study Timeline

Oct 2013: Beta Test

2014: Survey Round 1

Sept/Nov 2014: Articles 1 & 2

2015: Survey Round 2

Sep 2015: Round 2 Article

2016: Round 3

Sep 2016: Round 3 Article

2017: Round 4

2018: Final report
Three Survey Instruments

- Elementary, Middle & High School STEM
- 2 general statements
- 11 grade level specific statements
- $N > 6,000$ & 30,000 +
- $n > 2014$: 1,670
- $n > 2015$: 1,350
- $n > 2016$: 1,050
General Statement 1

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

Overwhelmingly, teachers feel that students benefit from doing activities to support learning.
General Statement 2

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

- 2014: 95%
- 2015: 93.4%
- 2016: 97%

Vast majority of teachers also state that if given the time and resources they would assign students more projects in class.
Learn Better by Doing

Based on the fact that almost 100% of teachers said, “YES” to the previous two statements, one could infer that:

Students Learn Better by Doing.
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.
*The highest percentage of “doing” in Science (2015) is lower than the lowest percentage of “doing” in Tech & Eng (2014)*
Doing in Courses – Interesting Findings

• Teachers responded to same standards-based statements.

• Technology and engineering students do the same types of standards-based projects and activities (more frequently) than do science and mathematics students.
Elementary Findings

• Over 50% of elementary students:
  • Use design process, develop object, tool, process or system
  • Use constraints, e.g., materials, time, and cost
  • Construct objects to solve problems

• Students are exposed to the Engineering Design Process in their classrooms and they should be ready to use this process at the Secondary Level
Middle to High School Decrease in Doing

Percentage Doing Decreased Between Middle and High School: 2014, 2015, and 2016

<table>
<thead>
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<th>Year</th>
<th>Category</th>
<th>Middle School</th>
<th>High School</th>
</tr>
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<td>Sci</td>
<td>63.6</td>
<td>39.8</td>
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<tr>
<td>2015</td>
<td>Sci</td>
<td>70</td>
<td>49.2</td>
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<tr>
<td>2016</td>
<td>Sci</td>
<td>56.3</td>
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<tr>
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<td>T&amp;E</td>
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<tr>
<td>2016</td>
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</table>
Doing in Courses – Interesting Findings

- Research shows that female students prefer studies and occupations that directly benefit society or individuals.
- There are three statements (two middle and one high school) that focus on benefits to society and/or individuals.
- Overall, technology and engineering teachers reported a higher percentage of “Yes” responses to these three statements than did science and math teachers.
Summary

- K-12 STEM teachers feel that students learn better by doing.
- Technology and engineering students are doing more hands-on activities in class than are science and mathematics students.
Summary

• Elementary teachers teach engineering design process.

• Female students prefer activities related to individual and social needs and wants.
Conclusion

• Technology and engineering professionals understand the benefits of our programs.

• Many decision makers do not realize how technology and engineering programs benefit students’ science, technology, engineering, and mathematics literacy.

• The information resulting from this study should be used to inform others of the benefits of technology and engineering programs.
Call to Action

• Continue to promote the benefits of technology and engineering courses.

• Ensure that our programs integrate appropriate grade level mathematics and science content.

• Ensure that education leaders realize that students Learn Better by Doing and that this is happening more in technology and engineering courses than in science and mathematics courses.
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Thank You