Computational Thinking Within Technology and Engineering Education

Introduction, Context, and Perspective/Thoughts Through Integrative STEM Education Approaches
Computational Thinking Overview

- **Clarifying Our Mission**: The development of technological literacy standards indicated that computers are but one tool in the use of technologies, rather than its sole definition or purpose.

- **Where is the fit?** Computer programming was once more closely associated with a career and technical education path than with the technological literacy of open-ended engineering design and problem solving.

- **The Tipping Point**: Greater capabilities and infusion of computational thinking in today’s work world, perhaps it is time for educational leaders to begin rethinking long-held ideas about computational thinking” (Buckler, Koperski, & Loveland, 2017).
Computational Thinking Overview

**Goal:** ITEEA providing fundamental resources to enable all technology and engineering educators to:

- Take the initiative and better understand how computational thinking is operationally defined within the context of teaching technology and engineering education through an Integrative STEM Education approach. We need to be confident in our knowledge base and delivery of the content, skills, assessments, and resources associated with computational thinking.
Computational Thinking Overview

- **Goal:** ITEEA providing fundamental resources to enable all technology and engineering educators to:

  - **Operationalize** the “T & E’ through “I-STEM Education” to provide examples that assist technology and engineering educators (and all others in the STEM field) to understand and implement computational thinking and understandings that are driven through engagement and dynamic instructional practices preK-12 and beyond to benefit ALL students!
In 2006, Wing argued that computational methods, concepts, and tools could be embedded in all K-12 classrooms to develop computational skills and literacy in all students. (Wing)

Recent writing by Wing and Stanzionne (2016) focused on the potential of computational thinking to be a third pillar of the scientific method, its use in simulation of complex systems, and use by academic and STEM educators as a fundamental tool of education.

QUESTION: To what end? Computational Thinking: What is it? How should it be taught? (Youtube Video by Wayne Lewis)

ITEEA Resources for Computational Thinking: https://www.iteea.org/Resources1507/ComputationalThinking.aspx
How We Define Computational Thinking

Questions We Must Address:

- How is computational thinking related to I-STEM Education?

- Should use of computers dominate our discussions and work in technology and engineering? Is computational thinking compatible with technological literacy?

- These questions continue to be raised by educators in our field as efforts are underway to promote computational thinking as our new focus and an equally determined group of educators wanting to keep computers as subservient to the greater goals of technological and engineering literacy.
It is clear that to include technological and engineering literacy in computer science coursework at the K-12 level would be more challenging to implement than including computational thinking in Technology and Engineering coursework . . . Like we have been doing in a significant way for well over the past twenty-five years.

ITEEA will provide best practice examples on how to include computational thinking in our programs, courses, and lesson plans in a way that promotes technological and engineering literacy, and the hands-on, mind-on practices we are known for.
Computational Thinking Practiced

- Many technology and engineering courses use computational thinking and practices now.
- These include courses using game design, computer numerical control coding, robotics, and cybersecurity.
- Included below are some best practice examples of computational thinking embedded within I-STEM Education.
The Bigger Picture:

How do you define and deliver Technology and engineering education and STEM to your students?

- STL
- Common Core State Standards
- NGSS
- National Academy of Engineering initiatives on building capacity for K-12 Engineering Education
- NAE Grand Challenges
- Maker Spaces/Maker Education
Computational Thinking Resources

- Is Computer Science Compatible with Technological Literacy? By Chris Buckler, Kevin Koperski, and Thomas Loveland, DTE.

- Integrating Computational Thinking into Technology and Engineering Education - By Michael Hacker

- Recommendations to support computational thinking in the elementary classroom: - Anne Estapa, Amy Hutchison, and Larysa Nadolny
Technology and Engineering Literacy Assessment Framework

Understand Technological Principles
Design and Systems
Information and Communication Technology
Technology and Society
Communicating & Collaborating
Developing Solutions & Achieving Goals

https://nces.ed.gov/nationsreportcard/videos/telanimation/
More Importantly, How Do You Define and Operationalize Technology and Engineering Literacy?

“Technology and engineering literacy” is the capacity to use, understand, and evaluate technology as well as to understand technological principles and strategies needed to develop solutions and achieve goals. (NAEP, 2014)
**Integrative STEM Education** is operationally defined as: "the application of technological/engineering design based pedagogical approaches to intentionally teach content and practices of science and mathematics education through the content and practices of technology/engineering education. Integrative STEM Education is equally applicable at the natural intersections of learning within the continuum of content areas, educational environments, and academic levels"  (Wells & Ernst, 2012/2015) (as adapted from Wells/Sanders program documents 2006-10).
The Takeaways

- We need to take action now and build a leadership model within our field
- Build resources with your input!
- Solicit colleagues to submit exemplars
- Take the lead role in I-STEM within your schools and institutions
Thank you!

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Reflection, Questions, & Feedback