Standards Analysis

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- ***Which technology education, mathematics, and science standards relate to problem solving or engineering design?***
- ***How are these standards similar to each other?***
- ***How are they different from each other?***
- ***What are your thoughts on engineering design problem solving as a "unifying" concept/skill?***

As a middle school 6th grade science teacher, I chose to look at 6th grade Common Core Mathematic Standards, 6th-8th ITEEA Standards for Technological Literacy, and the new Tennessee 6th Grade State Science Standards (which are being released this fall 2018).

The science standards that are most obviously related directly to engineering design and/or problem-solving are Engineering Design Standards 6.ETS1.1 & 1.2 (Evaluate design constraints on solutions for maintaining ecosystems and biodiversity and design and test different solutions that impact energy transfer). The associated core content standards relating to those standards are 6.PS3.4 (Conduct an investigation to demonstrate the way that heat – thermal energy – moves among objects through radiation, conduction, or convection) and 6.LS4.2 (Design a possible solution for maintaining biodiversity of ecosystems while still providing necessary human resources without disrupting environmental equilibrium). Upon further examination of the other content standards a few others lend themselves to both problem-solving and engineering design as follows, 6.LS2.5 (Analyze existing evidence about the effect of a specific invasive species on native populations in Tennessee and design a solution to mitigate its impact), and 6.ESS2.4 (Apply scientific principles to design a method to analyze and interpret the impact of humans and other organisms on the hydrologic cycle).

So much of the mathematic process involves problem-solving that my first instinct is that most of them will relate in some form or fashion in that respect, however upon closer investigation some of the standards that stood out to me as having the closest relation are as follows: CCSS.6.RP.A.3 (Use ratio and rate reasoning to solve real-world and mathematical problems. . .), CCSS. 6.NS.A.1 (Interpret and compute quotients of fractions, and solve word

problems involving division of fractions . . .), CCSS.6.EE.A.2.C (Evaluation expressions at specific values of their variables. Include expressions that arise from formulas used in real-world problems. . .), CCSS.6.EE.B.8 (Write an inequality of the form x>c or x<c to represent a constraint or condition in a real-world or mathematical problem. . .), CCSS. 6.EE.C.9 (Use variables to represent two quantities in a real-world problem that change in relationship to one another. . .), CCSS.6.G.A.1, 2, 3, 4 Geometry (. . . Apply these techniques in the context of solving real-world and mathematical problems).

The set of standards that I am least familiar with are the STL Standards, and I found the document a little difficult to decipher. To the best of my understanding the standards that appear to be most closely related to problem-solving and engineering are as follows: 1 (Scope of technology – requires an understanding that products and systems are developed to solve problems), 4, 5, 6 (understanding of cultural, social, economic, political, and environment effects of technology and the role of society in the development and use – problem solve to determine desirable and non-desirable consequences and how to use effectively), 8,9,10 (Understanding of the attributes of design, of engineering design, role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving), 11-20, in my opinion, all have to do with problem-solving in that the students have to be able to either use and apply, or select and use technologies. These are skills that require the ability to problem-solve in order to first select the correct technology, use the technology properly, and apply it to each individual situation.

The science and technology standards seem to be the most closely related, especially concerning the Engineering Design Process (EDP) (see science standards 6ETS1.1 & 2 and STL 8-10). The math standards seem more related to the STL and science standards concerning the application to real-world problem solving (although constraints were mentioned in CCSS.6.EE.B.8). Science standards focused on solving real-world problems as well, such as designing a solution to mitigate the effect of invasive species in Tennessee. The math standards relied heavily on real-world application of the mathematic skills such as geometry, variables, fractions, etc. as did the STL standards in selecting and using various technologies in the designed world.

Using engineering design problem solving to unify and make cross-curricular connections, in my opinion, is an engaging and exciting way to involve students in authentic,

meaningful educational experiences. These opportunities allow students to not only build the necessary academic skills to be successful in school, but also social/relational/cultural skills to be successful in the workforce beyond the classroom. As an educator who often works with college professors in clinical supervisory roles, one of the concerns that is often expressed to me is that many students come to college with the necessary academic knowledge, but very little real-world experience and skills. I use the engineering design problem solving process in my own classroom, and have for many years, and I find that my students grow the most through this process. It isn't easy growth, but it is earned growth that most of my student find very satisfactory in the end.