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Standard Analysis Synthesis

Engineering Design and problem solving can be a "unifying" concept across the subjects of Science, Math and Technology in the following 3 sets of standards: The Common Core Math Standards, ITEEA Standards for Technological Literacy, and the Next Generation Science Standards. Since I am currently teaching 5th grade, I will focus on standards from the upper elementary grades (3rd-5th).

Standards for Technological Literacy (*STL*) numbers 8-13 all apply to the design process. STL's state the student's need to develop the attributes and application of technical design, troubleshooting problems, research and development, intervention which involves experimentation of problem-solving, and the ability to use technology then successfully assess the impact of technology on society today.

In the Common Core Math Standards (CCSS), each math domain has one or two math standards that relate to solving "real world" problems and "explaining the student's thinking." The CCSS are ways to demonstrate or describe and illustrate the design problem-solving process. In CCSS.MATH.CONTENT.5.OA.B.3 , the students are to identify patterns and relations, in CSS.MATH.CONTENT.5.OA.A.1 interpret numerical expressions, in CCSS.MATH.CONTENT.5.NF.B.6 solve real world problems with visual fraction models, in CCSS.MATH.CONTENT.5.NBT.B.6 interpret relationships and illustrate calculations with arrays, equations, or area models, in CCSS.MATH.CONTENT.5.MD.C.5.C find the volume of solid figures in real world problems, and in CCSS.MATH.CONTENT.5.G.A.2 represent real world and mathematical problems by graphing points.

In the Next Generation Science Standards (NGSS) 3-5-ETS1-3, students are asked to define a simple problem with specified criteria, generate and compare multiple solutions, and then plan and conduct test with controlled variables and failure points. These science standards demonstrate the need for all students to individually and in groups experience problem-solving and conduct engineering design projects.

These standards are similar to each other in that they are all student centered, interrelated with other discipline standards, and defined by grade bands. Each grade "adds on" new level of complexity. They were created to unify and define what students should be taught at each grade level, so that students could move from one district or state and be taught the same standards in each grade level. We need our students to be prepared to compete in the worldwide arena! These standards are different from each other because they are domain, specific subjects with different foundational

vocabulary, knowledge and skills. Each set of standards is discipline specific focusing on the information and outcomes individually needed in math, science, or technology.

From A Framework for K-12 Science Education Practices, Crosscutting Concepts, and Core Ideas (2012), the NGSS integrate traditionally taught science content with engineering content through a “Disciplinary Core Idea”. Science experiments can be reframed into design engineering projects and explained or proven through mathematical language and expressions, therefore being a “unifying” concept/skill. Engineering design encourages the students to make connections and correlations across the disciples of math and science. The foundational knowledge learned in science and math can be applied using the engineering design problem process. The design process forces/encourages students to use higher level thinking skills and apply these skills to “real world” situations. This process could motivate and help create curiosity in all students especially less focused, or very active students. In my 5th grade class, the group work inherently involved in the design process and the need for a written report/oral report needs careful scaffolding to create an experience that will be a “good use” of limited teaching time. There are many ELA skills embedded in this design process such as informational writing and communication of data through an oral report. There also are social skills such as group work and communication skills that my students lack, therefore adding a layer of complexity to an engineering design project during the first semester of school. The overarching idea of engineering design projects “unifying” the STEM subjects is freeing to me. This encourages me to persevere and give my students some hands-on design experiences this school year.