

Engineering Design and Problem Solving are two areas that are getting incorporated more and more into classroom instruction. I believe there are a few reasons for that. One of the main reasons that it has been utilized so much is that it is a fun and engaging way to teach and learn. In the last decade, teachers have moved away from paper assignments and moved on to hands-on engineering and problem solving strategies. Of course, pencil/paper assignments are still being used and needed but engineering and problem solving have been incorporated much more than before. Another reason that I think this has become more common in the classroom is because it's a great way to incorporate other subjects. Often, engineering design and problem solving allow teachers to teach standards from three different subjects at one time. Probably the biggest benefit in my opinion is that it incorporates higher order thinking and application for students. Students are more prepared to think through real world problems and come up with solutions that help them apply the content they've learned in class.

I teach special education in science classrooms at the high school level. Because I work in the high school, those are the standards that I focused on. There were so many standards in each of these subject areas that related to problem solving or engineering design. In my opinion, when looking at the math common core standards, I felt that any standard relating to functions really utilized engineering design and problem solving. This is because when students are trying to find a relationship between two data points in order to solve a problem or design a solution, they would most likely use functions. In my opinion, data is the most common way to use engineering design in a math class and interpreting functions would be necessary.

When looking at technology design, several standards relate to engineering design and problem solving. The standards in this section focus on looking at the ways that you can change your design in order to have the optimal design, looking at how the world around them guides development and design and then to find the similarities and differences among scientific, mathematics, engineering and technological knowledge and skills. In my opinion, it really focuses on preparing students for a future career in engineering because these are real world benchmarks.

When looking at science, a lot of the focus is to look at huge issues that are affecting us or the world around us and to analyze the data and design a solution. Since science is the area that I teach, I can think of so many different ways that we teach using problem solving and engineering design. I feel like science is the subject that incorporates all three subjects the best. Anytime, we have a EDC (Engineering Design Challenge), students need to be able to look at the data about the global issue, physics problem, etc. and analyze that data. When students are analyzing the data, we are incorporating the math standards and finding the connections. After students analyze their data, they are then asked to use problem solving skills and design a solution for this problem. Technology is addressed when students look at ways to change their design in order to have an optimal design and look at how the world around them guides their design.

These standards have similarities in the way that each of them (math, technology and science) want students to be able to take a minimal amount of information and use it to solve problems. Each of these require a lot of high order thinking, application skills and inferencing on the student's part along with making visual representations of what they are learning. The main differences that I see between all of them is that the math standard is very exact. When you look at it, you understand exactly what the student will be working on. The science standards are little more vague. It just has to be a global issue and can be left to your discretion. I feel that the technology standards are even more vague. Document trade offs in order to have an optimal design. Optimal design could mean something different for each of us. I believe the differences in how these standards are written are what allows them to work together. If the technology standard was more specific, it may not work as well with the math and science standards.

Standards that I found at the High School Level are listed below.

Common Core Math:

CCSS.MATH.CONTENT.HSA.CED.A.1

Create equations and inequalities in one variable and use them to solve problems. *Include equations arising from linear and quadratic functions, and simple rational and exponential functions.*

CCSS.MATH.CONTENT.HSF.IF.A.1

Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If f is a function and x is an element of its domain, then $f(x)$ denotes the output of f corresponding to the input x . The graph of f is the graph of the equation $y = f(x)$.

CCSS.MATH.CONTENT.HSF.IF.A.2

Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context.

CCSS.MATH.CONTENT.HSF.IF.A.3

Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers. *For example, the Fibonacci sequence is defined recursively by $f(0) = f(1) = 1$, $f(n+1) = f(n) + f(n-1)$ for $n \geq 1$.*

CCSS.MATH.CONTENT.HSF.IF.B.4

For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. *Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.**

CCSS.MATH.CONTENT.HSF.IF.B.5

Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. *For example, if the function $h(n)$ gives the number of person-hours it takes to assemble n engines in a factory, then the positive integers would be an appropriate domain for the function.**

CCSS.MATH.CONTENT.HSF.IF.B.6

Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.

CCSS.MATH.CONTENT.HSF.BF.A.1

Write a function that describes a relationship between two quantities.*

CCSS.MATH.CONTENT.HSF.BF.A.1.A

Determine an explicit expression, a recursive process, or steps for calculation from a context.

CCSS.MATH.CONTENT.HSF.BF.A.1.B

Combine standard function types using arithmetic operations. *For example, build a function that models the temperature of a cooling body by adding a constant function to a decaying exponential, and relate these functions to the model.*

CCSS.MATH.CONTENT.HSF.BF.A.1.C

(+) Compose functions. *For example, if $T(y)$ is the temperature in the atmosphere as a function of height, and $h(t)$ is the height of a weather balloon as a function of time, then $T(h(t))$ is the temperature at the location of the weather balloon as a function of time.*

Technology Education

High School 9-12

Benchmark: STEL-7X - Document trade-offs in the technology and engineering design process to produce the optimal design

Benchmark: STEL-1N - Explain how the world around them guides technological development and engineering design

Benchmark: STEL-1O - Assess how similarities and differences among scientific, mathematics, engineering, and technological knowledge and skills contributed to the design of a product or system

Middle School 6-8

Benchmark: STEL-7Q - Apply the technology and engineering design process

Benchmark: STEL-3G - Explain how knowledge gained from other content areas affects the development of technological objects and systems

Benchmark: STEL-2S - Defend decisions related to a design problem

Benchmark: STEL-1L - Explain how technology and engineering are closely linked to creativity, which can result in both intended and unintended innovations

Benchmark: STEL-1K - Compare and contrast the contributions of science, engineering, and technologists in the development of technological systems

Science

HS-ETS 1-1. Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account

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Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.

HS-ETS1-2.

Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

HS-ETS1-3.

Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts.

HS-ETS1-4.

Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.

HS-PS3-3. Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.*

HS-ESS 1-4. Use mathematical or computational representations to predict the motion of orbiting objects in the solar system.

HS-ESS 3-4. Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.*

HS-ESS 2-3. Develop a model based on evidence of Earth's interior to describe the cycling of matter by thermal convection.