

Standards Analysis

As a middle-school STEM educator in the west-metro Denver area, the most applicable standards for my teaching assignment are the Colorado CTE (Career and Technical Education) standards, Common Core Math Standards, and soon to be adopted - Next Generation Science Standards. Upon examination of these standards I discovered that many of them connect directly to problem solving and or engineering design in some way.

The Colorado CTE standards are broken down into a STEM Cluster that includes a Design, Development and Application Pathway, an Engineering and Technology Pathway, a Research, Exploration and Innovation Pathway, and a Science, Technology, Engineering and Math Pathway. Within the STEM cluster the following standards connect directly to problem solving and or engineering design:

- STCO.05 - Develop and demonstrate an understanding of the role of troubleshooting, research and development, invention and innovation and experimentation in problem solving.
- STCO.06 - Understand and demonstrate the attributes of design by applying the design process and assessing the impact of bringing a product to market.
- STCO.07 - Understand and demonstrate engineering design by applying the design process and assessing the impact of systems. (“Colorado Career and Technical Education,” n.d.)

The Common Core Math Standards include 8 mathematical practice standards that apply to everyday life and thus directly to problem solving. The 8 mathematical practice standards are as follows:

- Make sense of problems and persevere in solving them.

- Reason abstractly and quantitatively.
- Construct viable arguments and critique the reasoning of others.
- Model with mathematics.
- Use appropriate tools strategically.
- Attend to precision.
- Look for and make use of structure.
- Look for and express regularity in repeated reasoning. (“Common Core State Standards Initiative,” 2019).

The Next Generation Science Standards for middle school are broken down into physical science, life science, earth and space sciences, and engineering, technology, and applications of science. This last category, also known as Engineering Design, has the following four performance expectation standards:

- MS-ETS1-1 - Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.
- MS-ETS1-2 - Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.
- MS-ETS1-3 - Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.

- MS-ETS1-4 - Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved. (“Next Generation Science Standards,” 2019).

The similarities among the Colorado CTE, Common Core Math, and Next Generation Science Standards is that they all include methods or processes for solving real-world problems. The differences lie in their approaches or strategies for solving those problems. The Colorado CTE standards develop problem solving strategies through troubleshooting, research, experimentation, and by applying the engineering design process. The Common Core Math standards emphasize that there are multiple ways to break apart a problem in order to arrive at a solution. The math skills used to solve these problems can range from organizing different types of data to using math to make life connections. Additionally, when problem-solving with math, exactness and attention to detail also translates to greater problem solving in the real world. Lastly, the Next Generation Science Standards solves problems by using the engineering design process with sufficient attention to precision, along with a consideration of the relevant scientific principles and potential impacts on people and the natural environment in their solutions. The design process also allows students to identify elements of different problem-solving solutions and combine them to create new solutions followed by the testing and revision of their solutions to reach an optimal design.

As a unifying concept, the inclusion of the engineering design problem solving process does more than just focus on skill instruction; it provides students with an approach that brings together their knowledge from different core areas and allows them opportunities for real-world problem-solving that builds their critical-thinking skills. I feel that the logical flow of knowledge

and progress provided by the engineering design problem solving process will guide students to solve problems more systematically.

References

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