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Standards Analysis

Problem solving and engineering can be a unifying concept across the STEM disciplines. For this assignment, I chose to explore the following three standards:

- Next Generation Science Standards (NGSS)
- Common Core Mathematics
- Standards for Technical Literacy

The goal is to look into these standards to see where problem solving and engineering design is utilized. These standards will be examined to find similarities and differences and how engineering and design can act as a unifying concept or skill.

As I looked at all three standards, there were a few that best represented problem solving and design. I teach life science to high school students, thus, I researched the NGSS for my particular discipline. Within the standards, I found that standard HS-LS2-7 Ecosystems: Interactions, Energy, and Dynamics, is a great example of problem solving and design. The standards request that students “design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.” (NGSS, Lead States, 2013) The problem that students will have to identify is how humans are impacting the environment (urbanization or invasive species) and thus ultimately design a solution to mitigate ecological damage. There are several more examples within different disciplines of the NGSS. Within the common core mathematics standards, I found standard CCSS.MATH.PRACTICE.MP1 Make sense of problems and persevere in solving them to best represent the engineering design and problem solving.(National Governors Association Center for Best Practices, 2010) Students are asked to find solutions to a problem by completing mathematical expressions and computation. In the last standard set in technology education, I selected the technological standard that best represents problem solving and design Standard 5: Students will develop an understanding of engineering design. This standard states “design is regarded as the core problem-solving process of technological development.” (ITEA.2007)

Although three different standards were investigated, I found that these standards were often very similar to one another. Each standard proposed that students solve real world conflicts as their problem solving initiative. This is often a great way to increase student engagement and investment into the assignment. Each standard often applauded a creative approach to problem solving. Promoting student choice is another way to increase student buy-in. These standards required that students are able to initially identify the problem and research the issue. This is important if students don't have the context. Often, these problems often require that students activate prior knowledge and have a indepth context of the discipline in order to rationalize engineering and design. Also, these standards are engaged in modeling and/or computations to achieve a solution. It is not uncommon for teachers to have to budget for supplies that students can use to model. Lastly, and most importantly, all 3 standards require students to revise and self- evaluate their engineering designs to optimize their outcomes for a solution. If students' designs are flawed, they are expected to remove errors and re-test their design for a superior design.

Conversely, there were a few differences between the three sets of standards. Clearly, all of the standards could require different declarative and procedural knowledge. Science standards are going to require scientific knowledge whereas math may require particular mathematical formulas. This does not mean that they don't overlap, it is just more common to be content specific. For example, not all of the problem solving standards in science are going to require mathematical computation. Some of the standards come with defined criteria and constraints within the problem solving.(ITEA, 2007) This is not the case with a broad problem set like human impact on the environment. Solutions can vary within disciplines from a one answer solution to endless outcomes. Some standards require tangible modeling while some may require calculations or sketches. Lastly, as a science teacher that is switching to new standards in the upcoming years, I feel current standards are remiss of including problem solving and engineering design. There is a clear disproportionality in the use of these skills amongst different disciplines.

As I reflect on engineering design and problem solving I feel that they could be used as a unifying skill across disciplines very easily. When examining the standards, one could see that there were so many similarities in the way that problem solving is approached. I could also agree that having a good skill set could enhance student understanding in multiple areas of learning especially if they are evenly practiced across STEM disciplines. This would lead to a greater integration in our STEM classes. It is clear that engineering design problem solving promotes critical thinking, conceptualization, collaboration, and self evaluation. These are all skills that students need to be prepared for in their daily life and careers.

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