

The Nature of Engineering

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METHODS OF STEM EDUCATION - ELEMENTARY

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For this assignment I have chosen the Nature of Engineering:

https://www.nsf.gov/attachments/117803/public/1b--Eng_in_K-12_Ed.pdf

As we have learned STEM is more than just a grouping of subject areas. It is a movement to develop deep understanding between these content areas, so students are more competitive in the 21st-century workforce. I choose NOE because 1) of my background and 2) it overlaps all the other “Nature of’s.”

A basic definition of engineering is the “application of science and math to solve problems. Engineers figure out how things work and find practical uses for scientific discoveries” (Lucas, 2014). Scientists and inventors often get the credit for innovations that advance the human condition, but it is engineers who are instrumental in making those innovations available to the world. A STEM classroom where engineering concepts are taught supports the goals of the NGSS and STEM education - to develop a scientifically literate citizenry, capable of asking good questions, thinking critically about information provided, and collaborating with others to problem solve. As the novelist James A. Michener (1982) aptly put it in his novel *Space* “Scientists dream about doing great things. Engineers do them” (p. 378).

When I introduce the E from STEM to my students, I emphasize that it reinforces math and science skills, promotes critical thinking and creativity, and teaches their students not to be afraid of taking intellectual risks. An important concept that I want them to learn is that as teachers just giving their students an engineering problem to solve doesn’t mean it will lead to learning. The examples I use and usually get head nods have been projects like building Lego robots or designing a cushion for an egg drop. The breakthrough moment is when they realizing engineering calls for them to apply what they know about science and math and their learning is enhanced as a result. I don’t want them to have their students just go through the motions and end up with a robot that does a particular thing, because the next problem they face will require a new set of skills. When my students learn that knowledge goes beyond the problem and they can help their students see how subjects like math and science are relevant to their lives because the activities were based on real-world technologies and problems.

There are several ways that I try to enhance my teaching and that of my students. In addressing the tenets of the Nature of Science through the E of STEM I want to make sure that when teaching a specific topic in the subject, the facts are be taught through context. The idea of science having a meaning is supported by creativity when learning because research has shown that for students to be creative, science has to involve fulfilling and purposeful activities leading to originality thus we will be able to make connections from previous experiences (BaniLower, Cohen, Pasley & Weiss, 2010). From my experience, practical lessons that are fun and exciting enabled students to understand science in full independent perspective and explore new ideas. My students need to be able to evaluate, critique and respond to data presented as scientific evidence in media reports and in advertising in order to make informed personal decisions and make judgements about scientific and pseudo-scientific claims. They need to become critical consumers of science.

My lessons consistently include *Classroom Equity*, *21st Century Skills*, *Engaged Citizenship* and *Building Science and Math Skills*. Teaching engineering activities help build *Classroom Equity*. Students from non-dominant communities often face opportunity gaps in their educational experience. **Inclusive approaches to science instruction** can reposition students as meaningful participants in science learning and recognize their science-related assets and those of their communities. Engaging students in understanding how engineering practices and knowledge are always developing as a part of human cultural activity, and how their own community histories, values, and practices have and continue to contribute to engineering and science. Additionally, the engineering design process removes the stigma from failure; instead, failure is an important part of the problem-solving process and a positive way to learn. It is equally important that there’s no single “right” answer in engineering; one problem can have many solutions. When classroom instruction includes engineering, all students can see themselves as successful.

To ensure that students are versed in *21st Century Skills* hands-on, project-based learning is the essence of my lessons. As groups of students work together to answer questions like, “How large should I make the canopy of this parachute?” or, “What material should I use for the blades of my windmill?” they collaborate, think critically and creatively, and communicate with one another. The focus of my classroom is on students experiencing the environment they will enter as 21st Century workers. The collaborative project-based curriculum used in this classroom develops the higher order thinking skills, effective communication skills, and knowledge of technology that students will need in the 21st Century workplace. The important message I want to pass on to my students is that the interdisciplinary nature of the 21st Century classroom sets it apart from the 20th Century classroom. Lectures on a single subject at a time were the norm in the past and today collaboration is the thread for all student learning.

As the world becomes more inter-connected and globally competitive, new economic opportunities become hand in hand with complex societal challenges *Engaged Citizenship* becomes a must. We must engage all of society in research and innovation processes. It is imperative that my lessons inform citizens (students) in a trustworthy and accessible way. We need to make decisions together – rather than from polarized positions and to take responsibility for those decisions, based on sound scientific evidence. In addition to informed decision making it is equally important for my students to be engaged in community service. Over the past three years my Science in the 21st Century and Mathematics in the 21st Century courses have partnered with Anaheim Ducks Hockey Club’s First Flight program. My students volunteered as instructors and presenters in a program sponsored by the Anaheim Ducks that introduced more than 16,000 elementary and middle school students to Science, Technology, Engineering, Arts, and Mathematics (STEAM) education. Last year’s theme was “Build a Better Puck,” exposed young people (the elementary and middle school students) to engineering by taking a closer look at an ice hockey puck. Students applied math and science to engineer an improved puck for hockey players using cutting-edge technology. The students who participate in the program applied their classroom knowledge, such as *Mathematics*, *Science*, and teaching strategies to a diverse student population – while making the learning experience relevant to the students they teach. <https://laverne.edu/news/2019/03/11/lafetra-college-education-students-volunteer-first-flight-field-trip/>

Engineering calls for children to apply what they know about science and math—and their learning is enhanced as a result. At the same time, because engineering activities are based on real-world technologies and problems, they help children see how disciplines like math and science are relevant to their lives.

Today, the role of the engineer is ever expanding in order to find innovative solutions for contemporary problems, and to address problems yet to be identified. It was engineering that brought us out of the caves; it was engineering that took us to the moon; and if we ever make it to the stars, it will be engineering that takes us there. As our knowledge continues to advance, engineers will have new opportunities to find practical uses for scientific discoveries.

References

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