

Professional Development Final Paper-Engineering for Young Minds

Danielle Bianco-Sheldon

Endeavor STEM Teaching Certificate Project

LEADERSHIP PROPOSAL

Curriculum Topics and Educators

The presentation, “Engineering for Young Minds” was presented to teachers in the Council Rock School District. Council Rock is a public school district located in Newtown, PA, which is a suburb of Philadelphia. It has 10,989 students in grades K-12 with a student-teacher ratio of 15 to 1. The teachers who participated in the professional development are all elementary teachers and teach all academic subjects. They have an average of 25 students in their classes. The following are four of the elementary teachers:

- 1) Mary Grace Della Polla- mdellapolla@crsd.org
- 2) Tara Wrigley-twrigley@crsd.org
- 3) Jennifer West-jwest@crsd.org
- 4) Tammy Marshall-tmarshall@crsd.org

The curriculum topic is engineering. The focus was implementing engineering activities at the elementary level. Components of the professional development included engineering standards, problem solving activities, engineering design models, and engineering challenges for students from kindergarten to sixth grade.

There were some limitations to my professional development since schools are currently closed. When school is back in session next year, I will be presenting this live to the teachers at my own school in the Wissahickon School District in Ambler, PA. I will cover the same topics, but also include hands-on engineering activities that the teachers will do during my professional development. I will also have teachers work with their grade partners to brainstorm ways that they can use the activities provided.

Standards

The following Next Generation Science Standards: Engineering Design were implemented:

3-5-ETS1-1.

Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.

3-5-ETS1-2.

Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.

3-5-ETS1-3.

Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

Project Summary

I feel that most elementary teachers do a wonderful job implementing math, science, and technology lessons and activities. Engineering is the STEAM area that is often left behind.

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Engineering provides an opportunity for students to apply what they know about math and science, while building critical thinking and problem-solving skills. Engineering activities are based on real-world technologies and problems, which helps students to understand how STEAM areas like math and science are relevant to their lives. I recently took the course, “The E in STEM: Meaningful Content for Engineering.” My goal was to share some of the information that I learned in this course and to provide resources and activities for teachers to teach engineering in the elementary classroom.

I shared the following engineering topics with the teachers as part of my professional development.

- Introduction to engineering
- Next Generation Science Standards: Engineering Design
- Problem solving activities
- Engineering design models for elementary students
- Engineering design challenges including those from NASA/Design Squad
- Engineering resources

Pre-questions Survey List

The following questions were included in the survey prior to the professional development.

- 1) How much time do you spend teaching math each week?
- 2) How much time do you spend teaching science each week?
- 3) How much time are student using technology each week in your class?
- 4) How much time is devoted to engineering each week in your class?
- 5) Have you ever implemented engineering challenges with your students?
- 6) Have your students ever used an engineering notebook?
- 7) Do you know what the engineering design process is?
- 8) What resources have you used for engineering activities?
- 9) What questions about engineering activities do you have?
- 10) What do you believe are some obstacles for incorporating more engineering in your class?

Description and Outline of Professional Development Training

This professional development training was shared virtually. Teachers learned about the engineering topics and received information, videos, samples, and resources and materials that they can use with their students. When we return to school next year, I will implement this professional development in person with the teachers at my school. This will include hands-on activities involving the teachers trying engineering challenges together with their colleagues. It will end with grade-level partners working together to plan engineering activities for their students.

The following is an outline of my presentation:

1. Introduction to STEAM
2. Discussion about engineering and its benefits for elementary students
3. Overview of the Next Generation Science Standards: Engineering Design
4. Engineering video-What is an engineer?

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5. Problem solving activities and resources-Teachers tried this interactive component and discussed their problem solving
6. Engineering design models for elementary students-compared and contrasted the various elementary models
7. NASA's BEST videos explaining the engineering design process
8. NASA'S BEST: An Educator Guide to the Engineering Design Process-Review of different grade level activities and lesson plans
9. Engineering design challenges including those from NASA/Design Squad-time to explore
10. Engineering resources-Shared resources and planned activities for students

NASA Mission Data and Endeavor Resources

Throughout this professional development, NASA Mission Data and Endeavor resources were incorporated. The Next Generation Science Standards: Engineering design standards were reviewed. These were discussed in my Endeavor engineering course, "The E in STEM: Meaningful Content for Engineering." Problem solving challenges from this course were also shared. NASA's BEST videos were shown in the presentation to help explain the steps in the engineering design process. Many other NASA resources were shared including the NASA's BEST STUDENTS: An Educator Guide to the Engineering Design Process and engineering design challenges including those from NASA/Design Squad.

Follow-up Activities and Post- survey Questions

The following post-survey questions were asked to the teachers following the presentation.

- 1) The most useful part of this professional development was: _____
- 2) As a result of this professional development experience, I will use my new knowledge and skills in the following ways:_____
- 3) To continue learning about this topic I need the following: _____
- 4) Questions I still have:_____

I will continue to reach out to the teachers to follow-up and provide additional resources and materials. After teachers have time to try some of the engineering challenges with their students, I would ask the following question: "What activities have you tried?", "What worked well?", "What were some of the challenges?", "How did your students figure out a mathematical concept while working on their engineering projects?"

I have also decided that I will provide activities that the teachers can include in their virtual learning now. This can include activities that their students can do at home that involve the engineering design process. I will continue to look for resources that I can share for this purpose.

Outcomes

This professional development was successful. The teachers were excited to get ideas and resources to implement engineering activities in their classroom. School has closed in Pennsylvania, but the teachers are trying to incorporate engineering activities in their virtual learning and will also use them in their classrooms next year. The teachers seemed to appreciate the detailed lessons and activities. They also liked learning about the engineering standards, which they had not previously used. The teachers also enjoyed the problem-solving activities and plan to share these with their students to try at home.

This project related to the readings in several ways. According to Sato et al., 2002, when teachers build their confidence in some areas, this can lead them to pursue roles and responsibilities that they had not previously pursued. My goal was to help teachers feel confident in the area of teaching engineering and implementing engineering activities. Most teachers felt comfortable teaching math and science, but not consider themselves confident in the area of engineering. “Increasing the individual confidence of the teacher, along with increasing his or her sense of credibility, as discussed earlier, can lead to new choices about what kinds of leadership roles and responsibilities he or she takes on” (Sato, Hyler, & Monte-Sano, 2002). It is my hope that my professional development will help the teachers gain confidence in the area of engineering and then share their knowledge with other teachers.

The article “A Primer on Effective Professional Development” (DeSimone, 2011) suggested that there should be a focus on the features of professional development activities that lead to teacher learning, not just the type or structural aspects of activities for teachers. As I prepared my activities, I followed the suggested steps that lead to successful professional development:

1. Teachers experience professional development.
2. The professional development increases teachers’ knowledge and skills, changes their attitudes and beliefs, or both.
3. Teachers use their new knowledge, skills, attitudes, and beliefs to improve the content of their instruction, their approach to pedagogy, or both.
4. The instructional changes that the teachers introduce to the classroom boost their students’ learning.

(DeSimone, 2011)

At this point, teachers have experienced the first two steps. Now, I am hoping that teachers can continue with the next two steps either virtually or when they return to the classroom by implementing engineering activities and increasing students’ learning in the area of engineering.

I shared several engineering challenges and activities that the teachers can use in their own classrooms. These include the following:

- Launch It- Design an air-powered rocket that can hit a distant target.
- Touchdown-Create a platform that can safely cushion “astronauts” when they land on a table near you.

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- Roving on the Moon-Build a rubber band powered rover that can scramble across the room.
- Downhill Skier-Design a skier out of everyday items that can race to the bottom of a classroom ski ramp the fastest.
- Heavy Lifting-Build a cardboard crane and see how heavy a load it can lift.
- On Target-Modify a paper cup so it can zip down a line and drop a marble onto a target.
- Feel the Heat-Heat things up by building a solar hot water heater.
- Dance Pad Mania-Build a dance pad that sounds buzzers and flashes lights.
- Hidden Alarm-Build a circuit to power an alarm so small that you can hide it.
- Rocket Power- Make and test simple balloon rockets.
- Design a Lunar Rover-Design and build a model of a Lunar Rover.
- Cooking with the Sun-Build and compare the performance of four solar cooker designs.
- Desert Island Survival- design a prototype of a hut able to withstand strong winds on a deserted island

I believe this professional development was useful for teachers. Many of the teachers shared that the most difficult part of implementing activities is finding the resources. The detailed lesson plans and activities that I shared will be very helpful and make incorporating engineering more manageable for teachers. The teachers seemed excited to have engineering standards because they were not familiar with them. The teachers now have a collection of engineering activities that they can easily access and implement in their classrooms.

I also believe that the professional development will impact teacher pedagogy. The engineering design process was discussed in detail and various models were shared. This approach to implementing engineering challenges will help students to solve problems, try new ideas, think critically, and show creativity. Teachers learned how to incorporate engineering STEAM activities in their classes and ways to support their students to be like “engineers.”

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