

Professional Development Final Paper: Enhancing Engineering in STEM Challenges

NASA Endeavor

STEM Leadership Seminar

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Enhancing Engineering in STEM Challenges Professional Development

I work at a Pre-K through fifth grade elementary school. Our school has a student population of about 370. We have sixteen classroom teachers. Our classrooms have anywhere from 18 to 29 students each. All teachers in my building were present at my PD. We have the following number of teachers in each grade level: 5th (2), 4th (2), 3rd (2), 2nd (2), 1st (3), K (3), Pre-K (2). The physical education teacher, music teacher, art teacher, our counselor, our literacy teacher, and the principal also attended. There was a total of 22 educators in attendance the day that I presented my PD. All teachers in our building teach all subjects and are required to incorporate STEM into their curriculum. Our curriculum includes typical literacy, math, and social studies purchased programs. It is expected that our science lessons follow the state standards, yet be very hands-on, include design challenges, and allows students to use their creative mindset where they come up with solutions to problems and follow the design process.

The title of my STEM PD was **Enhancing Engineering in STEM Challenges**. I set out to share with the teachers in my building ways in which they could possibly dive deeper into their STEM projects and challenges. My goals included showing the teachers in my building ideas on ways to introduce STEM design challenges by using brain warm-ups or phenomena, how to use a design notebook throughout projects, and great resources to find engineering design challenges that are perfect for each grade level and/or class. I selected this topic because I already work at a STEM school. All teachers in my building are already incorporating STEM into their classrooms and every classroom attends Makerspace at least once a week, if not more. We have many resources already at our fingertips. Showing teachers how to do a design challenge, the design process, or how to begin coding would not be a great use of their PD time. However, I know a lot of teachers in our school are constantly searching for new ideas and ways to deepen

our student's experiences and understanding in Makerspace. I also wanted my PD to follow best practices as closely as possible. In Lustick's 2011 article, he stated that PDs should include:

- (1) Focus on subject-matter content and how students learn that content;
- (2) Be ongoing and sustained throughout the year;
- (3) Be consistent with other activities;
- (4) Provide opportunities for teachers to actively interact around issues of curriculum and instruction (pg. 224)

These are the reasons why I thought the best topic would be to show my fellow teachers the ways in which I have learned to enrich the STEM experience which they are already doing through the use of design notebooks and extra resources to use when deciding on and searching for new challenges. I wanted my PD to be relevant and also wanted to give teachers time to use the information to actively engage and plan.

Any direction teachers and grade level teams take this PD, they will be hitting NGSS engineering standards:

K-2- ETS1-1 Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.

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.

I also believe including the design notebook always hits a writing standard (or many) across all grade levels. This allows teachers to spend less time on writing in isolation, since it can now be included in STEM and science activities. While our state standards may look slightly different throughout the grade levels, here is an example from first grade:

Colorado State Reading Writing, and Communicating Standard 4: Research and Reasoning: Gather information from a variety of sources; analyze and evaluate the quality and relevance of the source; and use it to answer complex questions.

I held my PD in our school library. The library has tables and chairs set up for our staff, a projector, and plenty of room for movement. Teachers all brought their computers for planning

purposes and to complete activities. I shared my PowerPoint with teachers 10 minutes prior to the PD session so they could follow along and click on provided links throughout. This PD was really close to the one-hour mark.

I began my PD by reminding teachers what it means for students to be problem solvers. I used part of the Jamie Kirkley reading from Josh Brown's class, The E in STEM, as an introduction. I then compared NASA's design process to the one we use at our school using the following link: <https://www.nasa.gov/audience/foreducators/best/edp.html>.

I had teachers try a few of the online problem-solving problems from The E in STEM. Teachers discussed in teams the parts of the engineering process they had to use to complete those simple problems. I shared with them that even as adults; we unconsciously use the design process when solving problems.

At this point, I introduced the use of design notebooks. According to my pre-survey, teachers in my building do not use design notebooks at all with the exception of two teachers. I showed a few examples for various grade level design notebooks. Teachers were given time to consider how they would revamp the notebook to fit their grade. I then introduced the PBS Kids Design Squad Webpage for finding challenge ideas using the following link:

<https://pbskids.org/designsquad/parentseducators/workshop/welcome.html>.

Teachers were given planning time to browse and plan a challenge for their grade level that could include a design notebook for an upcoming standard they had. I concluded this PD with a gallery walk using the post PD survey questions.

Some survey questions were answered on a scale from one-four. One being never, and four being always. One question required a written response.

Pre-Survey Questions:

1. Have you ever seen or used a design process outside of the one used in St. Vrain?
2. How familiar/comfortable are you with design notebooks? (1-4 scale)
3. How often do you use a design notebook to enhance a STEM challenge? (1-4 scale)
4. How often do you introduce engineering design challenges using phenomena or brain warm ups? (1-4 scale)
5. What is your favorite step/most relied on piece of the design process when you are personally solving problems? (1-4 scale)
6. Where do you typically find your STEM challenge ideas?

The results from my pre-survey actually surprised me in a way. Since we are a STEM school, I thought more teachers would say that they already use design notebooks, phenomena, and brain warm-ups. However, I received fifteen pre-surveys back and 93% of those surveys answered that they were not comfortable using design notebooks (1 or 2 on the scale). Only 14% of teachers said they use phenomena or brain warm-ups when introducing design challenges. And when asked where teachers get challenge ideas, most said things like, “from the kids’ curiosity” or “Pinterest”. Not one teacher mentioned a reliable online source. Moving forward, this survey made me feel confident that the topic and content of my PD was relevant for my staff.

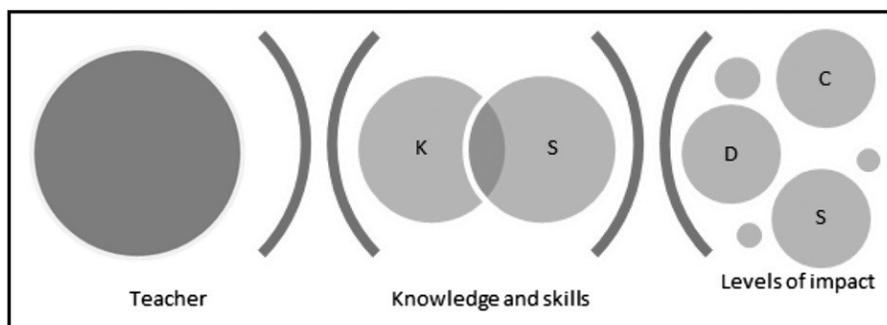
Post Survey Questions:

1. Did seeing different design processes help you understand our design process? (1-4 scale)
2. Can you see yourself incorporating design notebooks in the future? (1-4 scale).
3. How often do you see yourself using a design notebook to enhance a STEM challenge? (1-4 scale)
4. Will you try to use phenomena or brain warm-ups for future design challenges? (1-4 scale) How often? (1-4 scale)
5. Did you get any new challenge ideas from the PD today? (1-4 scale)
6. Will you use any of the resources I showed you today in for future planning? (1-4 scale)

I felt like most teachers left my PD with more STEM plans in place, excited about the resources shared, and ready to try using design notebooks. Teachers seemed to be excited about the PBS website and were actively planning STEM challenges for the remainder of the year. I

saw teachers searching more notebook ideas while walking around the room. According to the post survey, 93% of teachers said they saw themselves using a design notebook in future lessons. 100% said they got new challenge ideas from the PD. Even our music teacher said she appreciated that PBS kids had ideas for music class. 100% of teachers said they would use the resources I shared with them and I got several comments on how helpful they were. So even though this was a one-time PD which most research says is ineffective, I feel like this PD was successful in many ways. Teachers were engaged, the PD focused on enhancing content we already use, and the PD was consistent with content that we focus on as a school.

Holding this PD makes me feel like I am becoming more of a teacher leader, or at least beginning my journey in that direction. I still have not forgotten the image from the National Science Education Leadership Association that looked like this:



The following was a description from the Science Education article on how the chart is meant to be understood: “The circle to the left represents the teacher and all of his/her knowledge and skills. The middle circles represent the development of different skills (S) and knowledge bases (K). The different sized circles indicate the potential intensity, duration, or influence of a teacher leader on the different targeted areas. These targeted areas could be classrooms (C), schools (S), districts (D), policy makers, etc” (Science Education, 2016, pg. 2). I also believe this chart depicts the three different stages of teaching or the three different types of teachers we have. I

think on the left; it shows a teacher who teaches but doesn't go beyond. In the middle it shows teachers who really want to advance their knowledge, attends many PDs, and learns all that they can. The circles on the right show teachers who are leaders and who are expanding their knowledge base to others including peers, co-workers, the community, etc. They are not only expanding their knowledge, but leaving an imprint. There have been very few times in my career where I have felt like I am on that right side, but this PD was one of them. I can see myself striving to do more to feel like I am reaching the circles on that right side.

Finally, my follow-up plan when leaving my PD was to have teachers share at our future PDs design challenges they had done using design notebooks, ideas they used from the PBS Kids website, or any or the ideas I shared. When I created the plan for following up, I was unaware that in-person school would be canceled for the remainder of the school year. Unfortunately, this is something I may have to follow up with next year. However, I do believe the information I shared encompasses school wide improvement based on our current goals and ideas and is something we can use long term. This isn't a PD that is over and done. I think these are ideas we can foster and use for many years to come and is something I will still see benefits from the next few years. I am now hoping to follow up with teachers this fall and see what kind of new challenges and notebooks teachers are using for the new set of students awaiting us.

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