Professional Development Final Report: Using STEM to Add Context to Content

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STEM Leadership Seminar

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I. Professional Development Title

Adding context to content through STEM and Rockets

II. Background Information

a. Curriculum Topics: STE(A)M engagement for secondary teachers

b. School Name: Garden City High School (Large rural School with around 2300 students)

c. Number of Educators at workshop: 12

III. Standards Addressed

Due to the diversity of educators that were at the workshop, I attempted to tie cross-curricular concepts into the PD by targeting standards from math, science, language arts, and social studies. Though the nature of this particular PD could have warranted a broad selection of standards; to help focus the learning, the following key standards were addressed:

a. Science –

- NGSS - 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.

b. Math –

- CCSS.Math.Content.HSS.ID.B.6.a
Fit a function to the data; use functions fitted to data to solve problems in the context of the data. Use given functions or choose a function suggested by the context. Emphasize linear, quadratic, and exponential models.

CCSS.Math.Content.HSF.IF.C.7.a
Graph linear and quadratic functions and show intercepts, maxima, and minima

c. Language Arts –

CCSS.ELA-Literacy.W.9-10.9
Draw evidence from literary or informational texts to support analysis, reflection, and research.

d. Social Studies –

HGSS.KSDE.5.3
The student will investigate and connect dynamic relationships to contemporary issues.

IV. Summary of Project

The driving question of this PD was, how can educators apply an engaging context to the content they teach using STEAM? The PD was broken up into two 35 minute sessions conducted during a PLC. During the first session educators were given an opportunity to build and launch their own paper rockets using a homemade launcher made from PVC and a bike pump. The second session was intended to be done the following week but due to the sudden closure of schools in the state due to the Corona virus, resources and a brief video were shared with the attendees instead. The second sessions was intended to be a discussion on the cross-curricular concepts that the rocket activity could have addresses as well as resources and lesson ideas being shared.

V. Pre-questions Survey List

The survey educators filled out before the session asked them to reflect on their experiences (or lack thereof) using STE(A)M in the classroom. The survey was conducted through Google Forms with the link emailed to the attendees. The six questions below were asked and the results of the survey can be seen in appendix A.

- How often do you use STE(A)M activities to support content you teach?
- What are the biggest obstacle to implementing STE(A)M activities in your content?
- Have you ever used rockets in a lesson or activity?
- Do you think there is an opportunity to connect rockets to something you teach?
- Are you familiar with NASA resources and lesson plans for educators?
- Have you heard of the 5e lesson structure before?

VI. Brief Description of training:

I began the PD by discussing the idea of content versus context. I discussed the need to add context to content heavy classes such as math and science as well as the need to add content to more traditionally hands-on classes which are often the career and tech education (CTE classes). By presenting a diagram, I intended to help visualize the two separate ends of the spectrum between content-heavy and context-heavy.

After discussing the dichotomy between content and context I told participants that natural students are more engaged in context heavy classes rather than content heavy classes so I would focus on that aspect. I then introduced and demonstrated the paper rocket activity. I informed participants that during the first session we would build and shoot rockets

(Appendix B has photos). To add a competitive aspect to the activity and encourage discussion about design, I told participants that the highest rocket would get a gift card to a coffee shop in town.

The second session was meant to discuss the context and applications of rockets across the curriculum of the teachers present as well as share NASA resources for educators. If the sessions would have taken place, educators would have started out with a sticky note activity that brainstormed ways that rockets could connect to a specific content area (see appendix C). I would have then shared a selection of essential questions that could have hit on possible content that teachers were using in their classes.

I would have then shared the 5e lesson structure as a way to encourage constructivist learning by students. This would have included a handout that lists the role of the teacher and the student during each of the 5e's. I would have concluded the workshop by presenting an authentic assessment idea by sharing a NASA website that went over how to create a Podcast.

VII. Brief outline of the activities in the professional development session:

- Intro to PD and NASA master's degree program the PD is part of
- Discussion of content versus context and the need to find the middle ground
- Building paper rockets and shoot them outside
- Collaboration activity on cross-curricular connections
- Discuss 5e lesson structure and the role of teacher/student for each 'e'
- Discuss creating essential questions around STEAM activities – go over examples for rocket activity
- Share authentic assessment activity through NASA podcasts

VIII. What NASA mission data or Endeavor resource did you include?

My goal in searching for NASA resources was to find the resources that could apply to a variety of subjects in the secondary classroom. I would share the resource and discuss ways it could be adjusted for different subjects. The following are a selection of resources that were bookmarked and would have been shared in the second part of the PD:

- Straw Rocket Activity: https://www.jpl.nasa.gov/edu/learn/project/make-a-straw-rocket/
- NASA rocketry page with lesson plans: https://www.nasa.gov/audience/foreducators/rocketry/home/index.html

- NASA Do-it-yourself podcasts: https://www.nasa.gov/audience/foreducators/diypodcast/index.html
- NASA 5e lesson structure: https://nasaeclips.arc.nasa.gov/teachertoolbox/the5e

IX. Follow-up activities

After having informal discussions with a couple teachers about the first part of the PD, they said they enjoyed the activity and are looking forward to the second part to see how they could implement this in their classroom. However, due to the school closures, I will share resources and a short video with the teachers instead. My initial plan was to offer teachers the materials they needed if they planned to use the activity in their classroom and look over their lesson plans as well as suggest ideas.

I was also planning to follow up with participants to see if they would be interested in working individually with me to see how they could develop STEAM lessons for their particular subject area.
Finally, a survey would have been distributed to participants asking the following questions:

1) Did the PD give you any ideas for lessons?
2) Do you plan to use anything you learned in the PD in your class?
3) What is the most valuable or meaningful thing you learned from the PD?
4) What is one thing the PD could have done differently?
5) Would you be interested in doing future PD’s in this manner?

X. Outcomes

a. Content of the project (How does the PD help teachers understand the content?)

As mentioned previously the second session was intended to encourage teachers to think about how they can apply rockets to the content area they teach. I was going to show a slide with essential questions from different content areas that involve using rockets. I was also going to model how the activity can tie into modeling quadratic equations in math by gathering data on the height and time of the rocket by recording an ipad video.

b. Pedagogy of the project (How does the PD help teachers with instruction?)

The intent of the PD was to model how hands-on activities can help engage students across different content areas. In the survey conducted before the first session, one of the questions asked teachers what the biggest obstacle to implementing STEM activities in their classrooms was. The most popular response was there is not enough time to fit it into the curriculum. By modeling how the activity could be done, showing NASA resources with pre-made plans, and offering ideas for how to adapt the activity for their content, the hope is that it could help teachers engage students at a deeper level.

c. Was it a successful PD?

I think the hands-on part of the PD was successful. I did the rocket activity with students before I did it with teachers and the students had fun with it. I was worried that teachers, especially teachers across different content areas, would not be as enthusiastic. However, it seemed teachers had just as much fun as the students. While teachers were building the rockets I heard good discussion about design strategies as well as similar STEM activities they either tried or wanted to try in their class. Getting those types of discussions going, I feel, I was an important accomplishment for teachers, who often don't collaborate on STEM projects at that level.

Concluding the first part of the PD, I felt confident that the second part would tie the activity together well. Even though I did not get a chance to do the second part, I feel the activities I had planned during the second session, (appendix C), would have effectively encouraged teachers to think about the potential of STEM based activities in their classes and across the curriculum.

d. How did this project relate to the readings?

This PD was a chance for some teachers to get out of their comfort zone and try something different. Since it was conducted during a PLC, the teachers who attended had to be there as part of their responsibilities. However, as the 'school reform' article read earlier in the course mentions, "habitual routines tend to distance the practitioner from consciously developing and learning, and subsequently changing and improving professional practice (Kaniuka, 2012). Our school's PLC's are academy based, and often focus more on things that need to get done rather than best practices for student learning. This PD was a break from that routine and a chance to challenge teachers to think about things they could add into their practice that would engage students.

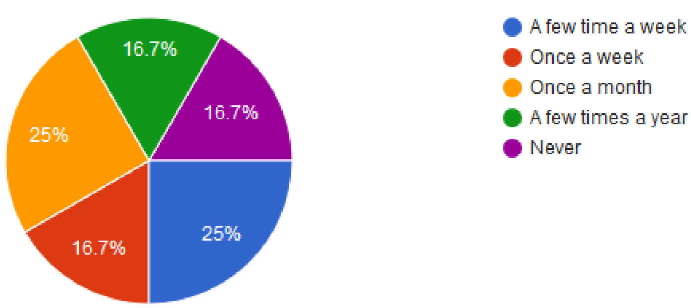
Furthermore, in the ‘Effective Professional Development’ article, the author lays out five keys to effective professional development which include; content focus, active learning, coherence, duration, and collective participation, (Desimone, 2011). In reflecting on my PD, both the first session, and the planned second session, I think I was able to tie the practices described together. In the future I would like to present this PD to middle school and high school math and science teachers exclusively. This would allow me to use my experience in those subject areas to focus the PD and give it more relevance.

e. Will the teacher do these activities again?

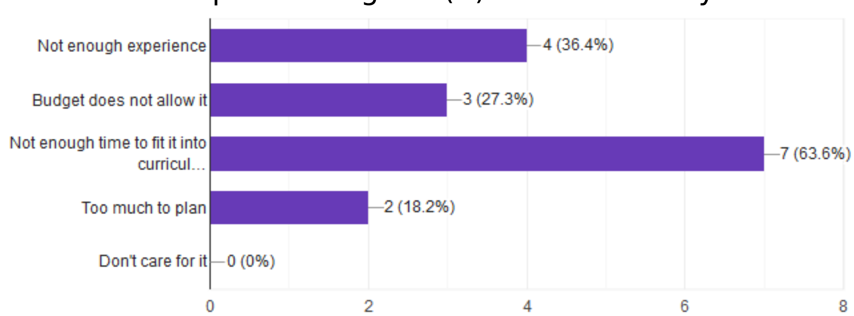
After the first session I offered teachers the launcher and supplies to run an activity like in the PD if they choose to. A few teachers said they might look at doing something like this in their class. I even mentioned that it could be done as an icebreaker or a STEAM day challenge if they found it difficult to incorporate directly into a lesson. I intend to share resources for the second session in a video with teachers. I am also looking to present this type of PD at a regional math and science conference next fall.

Appendix A: Pre-session survey results

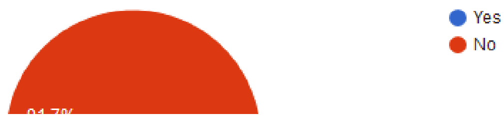
1) How often do you use STE(A)M activities to support content you teach?

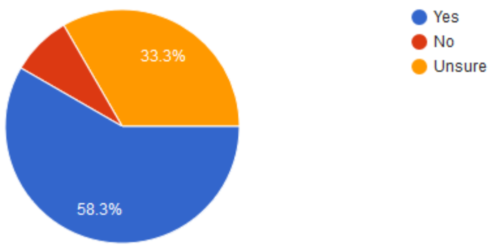


2) What are the biggest obstacle to implementing STE(A)M activities in your content?

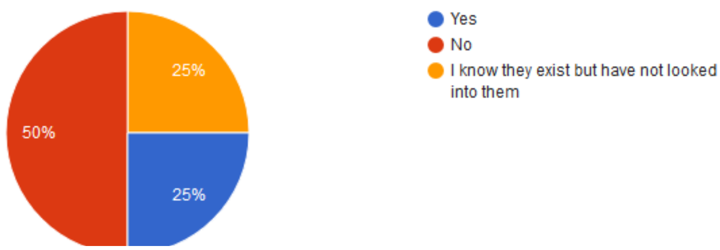


3) Have you ever used rockets in a lesson or activity?

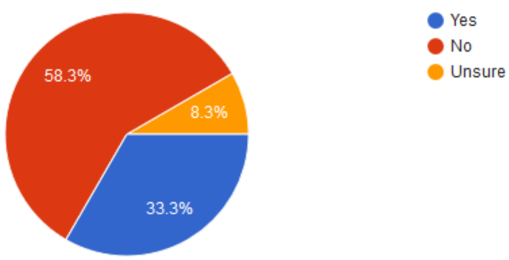




4) Do you think there is an opportunity to connect rockets to something you teach?

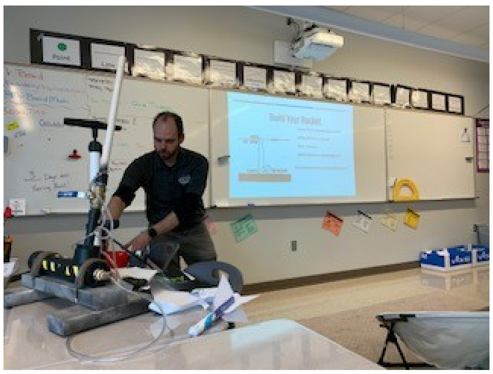


5) Are you familiar with NASA resources and lesson plans for educators?



6) Have you heard of the 5e lesson structure before?

Appendix B: Photos from Professional Development



Demonstrating how to create the paper rocket

Participants build their rockets

Participants test their rockets

Appendix C: Supplemental material and resources

a. Brainstorming activity to kick off the second session

BRAINSTORMING – WORLD CAFÉ ACTIVITY

- Break up into groups of 3
- Go to a big sticky note with a subject on it (I.e. Math, Social Studies, CTE, etc…)
- In 2 minutes come up and write as many ways as you can think of that rockets could be incorporated into the content of that subject.
- One person from each group moves to new sticky note.
- When new member arrives other to briefly summarize what was already said.
- Repeat the process of ideation.

b. Rocket PD cross-curricular essential question possibilities

Content Area	Essential Question
Algebra	1) What is the relationship between the height of a paper rocket and its time of flight? 2) How is a quadratic function used to model and predict the flight of a paper rocket?
Science	1) How do design aspects of a paper rocket such as number and placement of tail fins effect its flight? 2) How can an experiment be set up and data collected that would help develop an optimal design for a paper rocket?
Social Studies/U.S. History	How can the competitive aspect of building the highest flying paper rocket help us understand the space race between the United States and the Soviet Union?
English/Writing	What information must be included in order to write a detailed and thorough instruction manual for someone else to be able to understand and use?

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