SPARK STEM

Sparking a Sense of Wonder in Mathematics and Science

SPARK STEM FORMATIVE EVALUATION – AUGUST 2017

Program Description:

The project goal for SPARK STEM is to develop and deliver an integrated professional development for upper elementary/middle grade *(4-6)* teachers. The project focuses on "Ambitious teaching" - which prepares teachers to build STEM lessons that integrate content and authentic tasks and problems. The program includes a strong emphasis on engaging underserved students in STEM through modeling and PBL strategies.

The SPARK STEM summer workshop was held from July 31-August 4 and provided 19 teachers with "pictures of practice" of ambitious teaching as they participated in STEM learning experiences. Workshop activities for teachers primarily occurred in the library of Centreville Elementary School in Fairfax County, VA. Three faculty members from George Mason University led the summer workshop activities. They were assisted by several graduate students and local teachers.

The workshop included problem based science, mathematics, and engineering problem solving and modeling activities. During the workshop, teachers worked in teams to engage in hands on activities and demonstrations about specific content such as air pressure, volume, motion, solar energy, and proportional thinking. Teamwork was supported by google doc forums where teachers were able to create joint documents and reflect on the contributions of others. Throughout the workshop teachers were asked to keep wonder journals where they could record observations, questions, or notes from the days' activities.

The SPARK STEM summer workshop was run in parallel with a workshop on similar STEM content for a group of ~20 K-6 students. This parallel structure allowed teachers the opportunity to work with students and reflect on student sense making around specific STEM activities and concepts. This included activities such as working in parallel on a Fermi problem dealing with volume and working in student/teacher teams to use their knowledge of air pressure to design and launch air powered rockets. The final day of the workshop included teachers leading science activities for the K-6students as part of a STEM festival hosted by The Children's Science Center.

The follow-up to the SPARK STEM summer workshop will occur in the Fall 2017 academic semester with five school-based evening meetings where participants will be supported as they design, implement, and share results of individual STEM PBL projects. Participants receive graduate credit for their participation in the semester-long SPARK STEM experience.

Evaluation Methods:

The evaluation methods for this report include both qualitative and quantitative measures to provide feedback to the SPARK STEM leadership team concerning the value of project activities, including the summer workshop and fall follow-ups. The evaluation team will investigate the program as it addresses needs in three major categories: 1) supports for ELLs, 2) ambitious STEM teaching and PBL and 3) lesson relevance to middle grades students.

The data collection instruments for this workshop cover dimensions including program content, program design, and participant dispositions. The evaluators acted as participant-observers during the institute, attending two days of the workshop for 5-7 hours each day. This schedule allowed for observations of activities, presentations, team problem solving, and teacher/student interactions. During the institute, the evaluators wrote field notes, conducted focus group interviews with participants and project leadership, had informal conversations, and reviewed online workshop agendas and support materials. Focus group interviews were conducted with two groups of 9-10 teachers and lasted approximately 45 minutes. Teachers were provided with written prompts to support the focus group interview and were asked to document their responses prior to the interview. This gave teachers the opportunity to reflect on the questions prior to providing a verbal response. Written responses to the focus group prompts were also collected and analyzed.

This preliminary report will describe findings for the summer workshop only. Data included in this report comes from an analysis of field notes, workshop materials, focus group interviews, and responses to a pre-workshop survey (100% response rate). The report offers summary findings, reflective questions, and formative recommendations for each of the project goals. These recommendations are not prescriptive but are provided to help project leadership consider a variety of methods for supporting participant development. Also included is data from the pre-workshop survey (Appendix A), general feedback for the leadership team from the teacher focus group (Appendix B), and selected images from the workshop (Appendix C).

Formative Evaluation:

Participant Demographics.

Demographics Summary.

Eighteen females and one male participated in the summer workshop on the days that were observed (August 3-4). Participants came from 14 Elementary Schools in the area. Of these schools, all but three (Sanders Corner ES, Hutchison Farm ES, and Leesburg ES) are from the Fairfax County School District. The others are from Loudoun County School District. Survey results indicate that the participants had a wide range of teaching experience with 10% of teachers having 3 years or less, 40% having 4-7 years of experience, 10% having 8-11 years of experience, 25% having 12-15 years of experience, and 15% having over 15 years teaching in the classroom. When asked about their teaching assignment for the 17-18 school year, participants responded with the following: 15% teach 3rd grade; 30% teach 4th grade; 25% teach 5th grade, and 30% teach multiple grades or were hired in some other capacity (STEAM Coach for example).

Themes from pre-survey data suggest that teachers chose to participate in SPARK STEM to support their classroom STEM instruction especially in regards to modeling, using PBL, and integrating STEM activities with the work of other disciplines. Though graduate credit is being offered for participating in SPARK STEM, few teachers mentioned that as a motivation. In the pre-workshop survey, participants indicated that strengthening their STEM content was an area where they needed high levels of support. Other themes included connecting STEM content to student lives and using PBL strategies. The survey indicates that teacher feel somewhat comfortable with their abilities to work with underserved populations and provide ELL support.

Goal 1: ELL supports and equitable teaching.

The district needs assessment indicated that teachers need additional supports for the high population of ELLs they serve. Below are the formative findings related to this goal.

Summary Findings for Goal 1.

	Summary Findings
Program Design	Hands on activities with potential to support ELLs were central to the workshop design
Program Content	A variety of activities modeled strategies that can support ELLs. Strategies such as working in groups, cooperative learning strategies, drawing and journaling were a regular part of the workshop.
Participant Dispositions	The pre-workshop survey indicates that many teacher participants have a high level of confidence in planning for ELL instruction. 70% of teacher participants either agreed or strongly agreed that they were comfortable in their abilities to support ELLs. Participant focus group responses suggest that though most teachers have rated themselves as comfortable working with ELLs, they would like more support in this area especially in regards to hands on STEM activities.

Reflective Questions:

- Which specific ELL support strategies were considered in the program design and what ELL support will occur in the fall follow-up?
- In what ways can ELL support and equitable teaching practices be made more explicit throughout STEM activities?
- How will teacher readiness for working with these populations be assessed?

Formative Recommendations:

- For the lessons prepared in the fall, consider asking teachers to include a description of how they will include, monitor, and assess the success of ELL students.
- Consider establishing forums for teachers who are well prepared in this area to share their expertise with others in the group. This would be especially useful for grade level teams working on similar content.

Goal 2: STEM PD - PBL/ambitious STEM teaching for under-represented populations

The district needs assessment indicated that teachers need to help underrepresented populations to access rigorous STEM content before they reach middle school and that teachers need time and resources for PBL. Below are the formative findings related to this goal.

Summary Findings for Goal 2.

	Summary Findings
Program Design	Program activities were designed to connect to various of STEM. Program activities were uniquely designed to have students explain STEM concepts to teachers and to facilitate co-learning. *Ex. During the air pressure demonstrations, student explained the phenomenon to teachers. Teachers and students compared wonder journals and discussed ideas with one another.*
Program Content	The workshop was rich with STEM content. Teachers and students were regularly engaged in STEM practices such as generating questions, making predictions, making measurements with accuracy, modeling and designing investigations, collecting data, using computational reasoning, interpreting graphs, and communicating conclusions. The workshop included activities and demonstrations about specific STEM content such as air pressure, volume, motion, solar energy, and proportional thinking.
Participant Dispositions	Results from the pre-workshop survey indicate that teacher participants were looking for the workshop to improve their math and science instruction and engage students. Teachers also expressed an interest in PBL. 45% of teacher participants indicated that they do not feel comfortable in their ability to implement PBL

	and real-world problem solving. There were limited references to PBL in focus group responses however several teachers mentioned hoping that tools for helping them design integrated STEM lessons would be part of the fall. Focus group responses indicate that the SPARK STEM activities to date have increased teacher confidence in tackling hands on STEM activities. The activities have helped them see connections between different content areas making them feel more justified in spending time on them. The integrated nature of the instructional team was noted as a plus. Some teachers expressed concern about their level of understanding with regards to some of the science content from the workshop. Teacher participants expressed a more in-depth understanding of the integrated nature of STEM and an enthusiasm for implementing the activities they participated in. Teachers reported understanding the role of curiosity in fostering engagement (ex. Don't give away the answer). They also recognized the importance of wondering and questioning rather than focusing on right/wrong answers. Teachers expressed concern about the practical limitations of the school system. Some specific concerns were getting buy-in from others on their campus, connecting math and science concepts in a way that aligns with their scope and sequence, and finding the time, supplies, and other resources needed to this type of instruction. There was also some uncertainty about what would be included as a part of the fall SPARK STEM program.

Reflective Questions:

- How might the STEM content presented in this workshop manifest in teacher practice?
- What additional opportunities are there to incorporate student/teacher co-learning?
- To what extent are teachers aware of the distinction between problem and project based instruction?

Formative Recommendations:

- Provide teachers with a materials list (including ordering information and cost) for each of the activities used in the workshop and during fall activities. Help teachers pool their grant funds for materials in strategic ways (ex. Consider providing a model for sharing resources to help provide teachers with access to needed materials).

- Reassess teacher understanding of the STEM concepts presented in the workshop. Spend additional time unpacking abstract or difficult concepts (ex. Help teachers to revisit connections between workshop activities and the disciplinary core ideas running through them).
- Consider working with an established PBL framework to support teachers in understanding the core elements of PBL.

Goal 3: Context and relevance for students

The district needs assessment indicated that students in their district need lessons infused with context and relevance. Below are the formative findings related to this goal.

Summary Findings for Goal 3.

	Summary Findings
Program Design	Program activities were designed around established hands-on STEM activities with real world connections such as: rocket launches, a roller coaster challenge, and working with solar panels. Activities were designed to provide a shared experience for teachers and students.
Program Content	Working directly with students provided teachers with an opportunity to experience a student perspective and listen closely to student ideas. Student questions and ideas were a central focus of the workshop. There was acknowledgment that challenges need to be realistic for students and address the question "When would this ever happen?" After the popcorn problem, teachers were asked to reflect on "how does this problem become personally meaningful, engaging, and applicable?"
Participant Dispositions	In the pre-workshop survey, 35% of teacher participants reported feeling confident in providing STEM instruction that is relevant for underrepresented populations. Teacher comments about working with students during the SPARK STEM workshop were overwhelmingly positive. Teachers reported that the parallel teaching and learning experiences were beneficial in helping them see concepts from a student's perspective and revisit important content as a learner. In the focus group, teachers reported feeling that the hands-on activities and models, like the Fermi

	problems, would increase student engagement. Teachers expressed some uncertainty with how to connect to real world examples and to the lives and interests of their students.

Reflective Questions:

- What specific strategies can be used to support teachers in tailoring these activities to connect to the lives and interests of the students they serve?
- What opportunities are there to bring in real world challenges facing the local community and help students engage in using their STEM knowledge and skills to contribute solutions?
- How can students and teachers come together to explore their respective personal values and experiences?

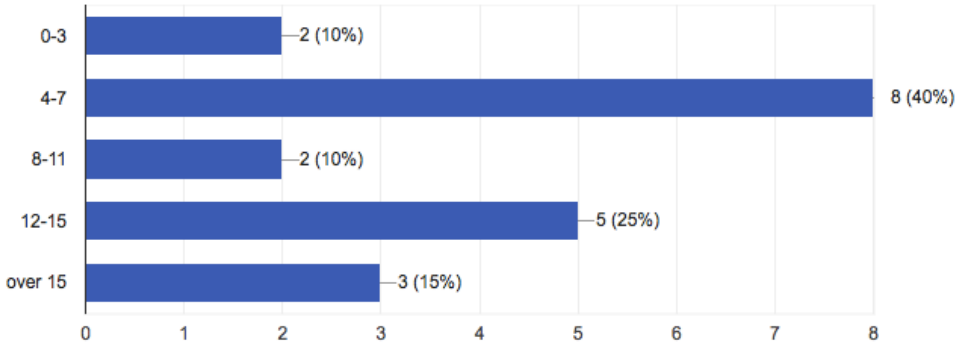
Formative Recommendations:

- Provide additional time for teachers to develop on connections between the workshop content and the students they serve. How do they envision these activities (or similar) going in their classrooms?
- Provide opportunities for teachers to share the strategies they use to uncover the interests and experiences of their students.
- Support teachers in creating open-ended lessons that allow students to demonstrate their understanding in a variety of ways and that encourage students to generate and reflect on connections between the content and their own interests/experiences.

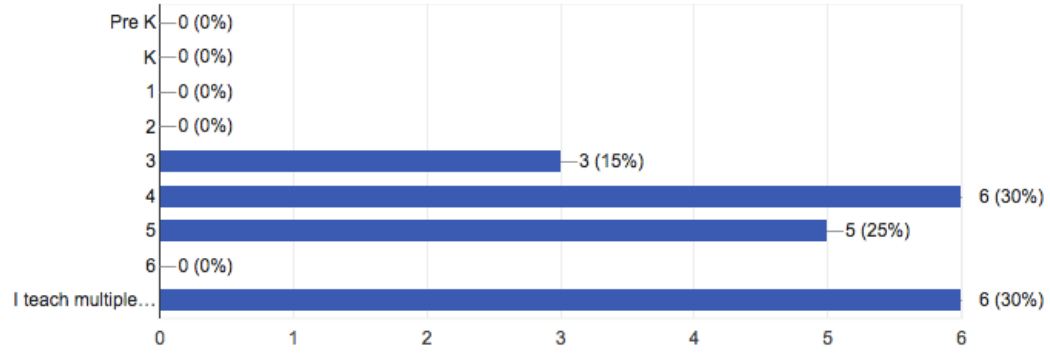
Appendix A. Pre-workshop survey results.

Data from Pre-Workshop Survey related to demographics.

Question: How many years have you been a teacher?



Question: What grade level do you currently teach?



Question: What are your reasons for participating in SPARK STEM?

As science lead for my school, I want to take back all that I learn to my whole school.

To improve my math instruction and better engage my students, to learn how to incorporate real world problems and professions/professionals into my instruction

To learn about it and to possibly organize it for next summer at our school

I am looking for ways to develop meaningful STEAM Lab curricula for students in grades K-6 and ways to support teachers in my school in my secondary role as the lead math teacher for the school.

STEM engages kids in science in math in a way that traditional direct instruction does not. I am hoping to be able to learn methods and project ideas that I can apply immediately in my classroom to get kids excited about learning, creating, and finding different solutions to problems.

Learning how to integrate science and math with the PBL model.

Usually my instruction has been devoted to Language Arts. But I've started teaching math and would like to know how to teach science. I'm particularly interested in interactive lessons.

Learning more activities/ideas to teach science while integrating technology more

I've worked with Immersion/Math Modeling, and I'm interested in integrating science into my math projects in a more cohesive, meaningful way.

One reason for participating in SPARK STEM is to learn about ways to incorporate STEM activities through Problem Based Learning. Another reason for participating is to acquire of repertoire of STEM activities. Lastly, to require resources and methods on how to help my colleagues understand how to incorporate STEM into their instruction.

To improve instruction for my students

I am really interested in math modeling tasks, and I want to get some ideas of what project based learning can look like when incorporating math and science. I want to become more comfortable presenting these tasks to my students as more of an everyday thing instead of something that is viewed as a special activity.

Strong interest

We have several teachers in our school who use the PBL model in their classrooms, and I felt this course would help me support those teachers in my role as a math resource teacher.

To further my knowledge of STEM in my classroom!

to SPARK students learning and knowing how things can be integrated in a more hands on way

To grow as a teacher who integrates curriculum fitting for 21st century learners

I'm very interested in STEM education and hope to use it as a tool to reach all my learners and motivate them.

Learn more about STEM and math modeling
Wanting to learn more about STEM and how to implement and integrate STEM and PBL in my classroom

Question: What type of instructional support and activities are you hoping that the SPARK STEM experience will provide?

How to integrate STEM with other subjects and ideas that I can tweak for different grade levels
How to structure and support students through stem lessons, resources for these lessons
Support in initiating it at my school and other schools
Strategies for ensuring coverage of discreet standards as part of larger, meaningful learning activities
I'm hoping to get some lesson plan ideas and possibly some mentoring in implementation in the classroom.
More science content and instructional strategies
Hands- on, interesting science and math lessons.
Learning more engaging ways to motivate students academically
I'm hoping that SPARK STEM will provide me with new ideas and inspiration for math & STEM integration, and I'm also hoping to meet like-minded educators for collaboration.
I am hoping that they will teach us the ease of incorporating STEM in our day to day teacher. As I said above, I am hoping that a variety of activities will be provided, especially ones that incorporate all aspects of STEM.
Ideas and strategies for implementing engaging activities in science.
I am hoping the support will take the form of giving examples and showing what this type of teaching and learning can look like. I also greatly appreciate any example activities that are things that I can immediately take and use in my classroom.
Math and science integration. Problem based learning. Real life application
any support and activities would be beneficial
I am hoping to learn more about integrating Science into my math and reading curriculum and provide hands on engaging learning experiences for my students.
connecting PBL and STEM activities
Ideas, materials
Lesson ideas and ways I can incorporate it into my curriculum and make it more fun.
Ways to support teachers in my school to integrate math and science; ideas about what defines a STEM lesson or activity and how to move beyond "Pinterest-type" STEM projects. My school is an arts and science magnet school so I also hope to learn about the A for arts in STEAM.

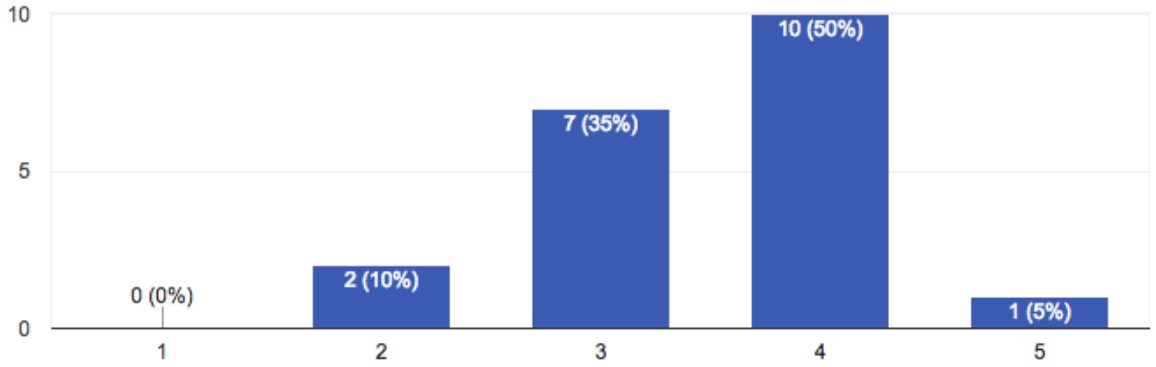
Where to get supplies, how to integrate STEM and get it in sync with standards of learning

Prompt: I'm looking for instructional support in the following areas: *(1=need little/no support - 5=need extensive support)*

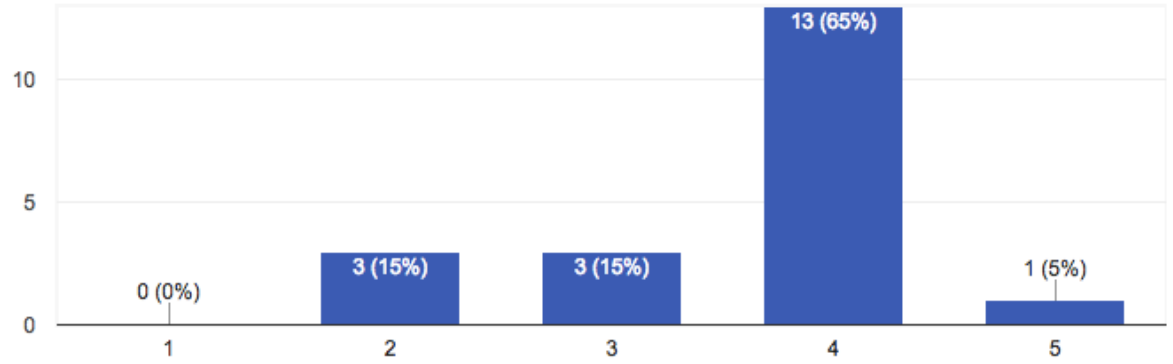
ELL strategies (Average Score: 2.75)
Problem/Project-Based learning strategies (Average Score: 3.35)
Working with underserved students (Average Score: 2.7)
STEM content (Average Score: 4.0)
Connecting STEM content to lives and experiences of students (Average Score: 3.8)

Data from Pre-Workshop Survey related to Goal 1.

Question: How would you rate your level of experience in planning instruction for ELL students? *Please indicate your level using the scale below. 1= none, 2 = little, 3 = some, 4 = considerable, 5 = extensive*



Prompt: Please respond to the following statement. "I am comfortable in my abilities to support ELL students effectively." *1= strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree*



Question: In what ways do you currently support ELLs in your classroom? Please provide examples to support your response.

Using captions on video clips, using both their native language and English whenever possible, using visuals and hands-on experiences
Preteaching vocabulary, visuals, sentence/ discussion starters, peer buddy to help model, one on one and small group extra support
Differentiating instruction and making sure curriculum is culturally sensitive. For example, during our Poetry unit, making sure that not only ELLs, but all students are exposed to literature from other countries.
I generally have not had ELLs in my classroom, so I have little experience with this.
We do not have a big ELL population at our school. Those that we have had are typically on a monitoring or consult level and just need some assistance with vocabulary as any other science student would need.
Lessons with lots of visual support and scaffolding. Activities are differentiated by process and product. Students are collaborating most of the time.
Mostly devoted to teaching Language Arts, particularly guided reading; writing workshop; modifying teacher-made assessments for ELLs
ELL teacher planning/collaboration/ extra time w/ teacher support, ELL teacher comes into general education classroom to assist with classwork and small group instruction with herself and the classroom teacher
Collaboration w/ELL support staff, word walls, sentence frames, technology assisted translation as needed, audio/visual presentations as much as possible, selectively grouping students, parent/community volunteers, software.

Collaboration with the ELL teacher to support push in and pull out services. Provide accommodations as necessary, i.e. read aloud, word banks, scaffolded notes, etc.

I mostly work with Special Education but when I do have the random ELL student, I use as many visuals as possible and try to buddy them up with another student that speaks the same language.

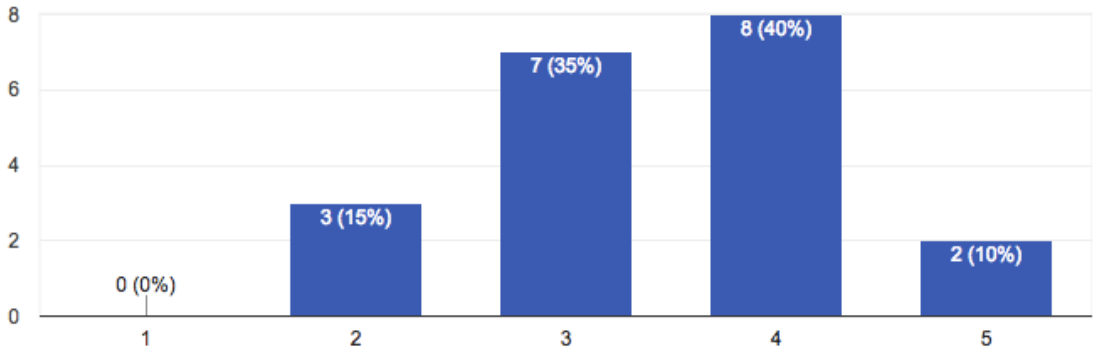
I work with the ELL teacher to provide common math vocabulary words that will be helpful in the classroom that can be practiced during math and also reading time. I also commonly translate all activities into the student's native language. My co-teacher and I also allow the student to make great use of an iPad as a way to translate. I would also say that I teach with my hands and use motions, and I also try to draw pictures on the board. I think these things provide visuals that the student can use to learn a new concept even when all the vocabulary might not be completely understood.

Background knowledge; sentence frames; wait time; environment

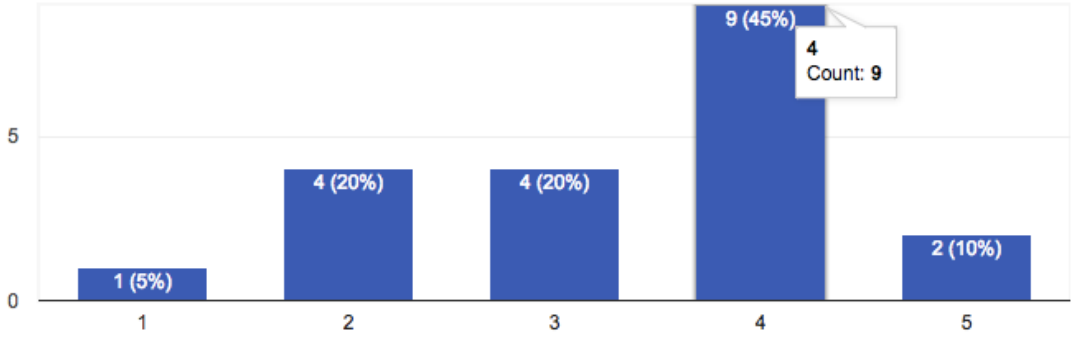
I have taken the SIOP course and have used that model when supporting teachers in their math lesson planning. I also work closely with our ESOL teachers when planning lessons.

Data from Pre-Workshop Survey related to Goal 2.

Question: What is your level of experience implementing problem/project based learning? *Please indicate your level using the scale below. 1=none, 2 = little, 3 = some, 4 = considerable, 5 = extensive*



Please respond to the following statement. "I am confident in my abilities to implement problem/project based learning and help my students engage in real-world problem solving." *1= strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree*



Question: What, if any, strategies do you currently use to support your students in working on long-term, collaborative STEM projects? *Please provide examples to support your response.*

Break the project into chunks work deadlines to help pace students, conferencing with groups to provide feedback and support, online collaboration space for students to interact with their group during and after school

Provide opportunities for check-ins and self-evaluation, so that students can re-group if necessary

I have not done these types of projects yet

I took a training on PBLs last summer and did one landforms web site and one social studies children's book with my kids last year that went over well. I could use some more practice on setting up the big idea and ensuring they are getting the content along the way.

Multiplied check ins. Immediate feedback. Formative assessments.

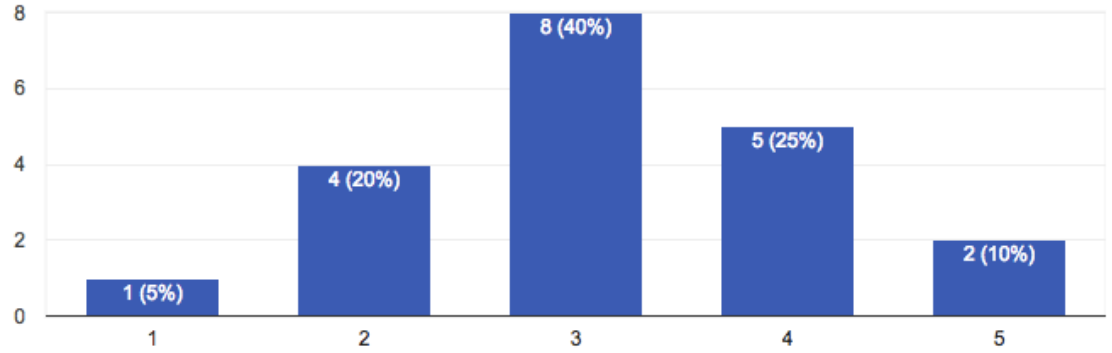
I have only assisted classroom teachers occasionally on long-term STEM projects. One specifically was the third graders designed and produced a carrying case for their recorders.

daily/weekly check-ins, each person has a role to do, make sure technology is available, library use, students bring their own device when none is available at school

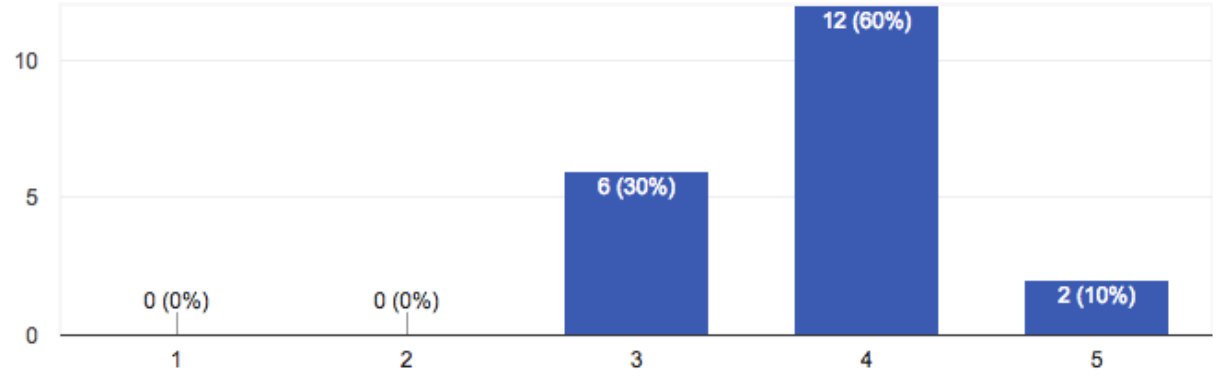
Given my experience with math modeling (also through GMU with Dr. Suh), my students completed a number of long term math projects during the past 2 years. We operated under the structure of PAVSAR- defining the PROBLEM, making ASSUMPTIONS, defining VARIABLES, creating a model and/or SOLUTION, ANALYZING results, sharing with the purpose of REVISITING & REVISING their work to come to a stopping point. Students had a structure to operate in, but understood it was more cyclic than linear. I used regular check-ins with student teams and individuals, used exit tickets to ensure understanding of math standards and competency and then would pull necessary students in need of support or enrichment. We would regularly reflect on our processes. Also, students would be able to provide feedback to teammates, to ensure open communication, collaboration and accountability. We did a few other STEAM projects that were more science based, but most of those were completed within a few class sessions (building a trebuchet, designing a hoop glider, etc.).
At this current time, I wouldn't say that any of the STEM projects that I have provided were long term.
We begin with a "hook" to gain student interest and then they work in groups using hyper-docs, graphic organizers, check-ins, and resources on numerous levels (both technology and books).
I really like to allow students many chances to fail, and I use a lot of questioning strategies to allow the students to come up with new ideas on their own (sometimes while being almost pointed in the right direction). I also like to allow the students to have certain checkpoints to check on their progress as they work through the process.
None
I have not taken on any long-term, collaborative STEM projects.
Most of my STEM projects are taught in engineering club and young scholars summer school. I am hoping that this class will help build my confidence to more comfortably integrate STEM into my 5th grade classroom.
modeling first
PBLs (project-based learning), real-life problems/connections, group-work, etc.
Small groups and technology as well as research and group activities.
Currently none
I've provided space to store projects and support our FLES teacher in her STEM projects with my class

Data from Pre-Workshop Survey related to Goal 3.

Prompt: Please respond to the following statement. "I feel well prepared to provide STEM instruction that is relevant for underrepresented students." *1= strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree*



Prompt: Please respond to the following statement. "I know how to effectively connect my instruction to the lives and experiences of my students." *1= strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree*



Question: What, if any, strategies do you currently use to connect STEM content to the lives and experiences of your students? Please provide examples to support your response.

Giving them an authentic audience whenever possible

Real life examples

Using culturally sensitive curriculum and exposing my Young Scholars to enrichment opportunities during the summer.

Getting to know students; giving students choice in learning paths; connecting lessons to local area (local watershed monitoring program); providing opportunities for self-directed learning (Genius Hour/20% time)

In almost every science lesson we link to real world experiences through discussions or current events.

Get to know my students interests. Have a strong entry event

I provide nonfiction reading materials to get children interested in STEM topics. I sponsor an after-school science club.

giving real life examples to students, ex. planning family vacations and teaching them how finding/comparing prices for projects are real life skills that parents/adults do regularly to find the best prices/deals.

Building relationships and understanding what they care about and/or are passionate about is essential to plan meaningful STEM projects. Then it becomes my job to take their feedback and passion, and align it with the standards I need to teach.

This past year when fidget spinners were the big craze, I allowed the students to complete a STEM activity in incorporate them.

STEM content is implemented through technology, experiments, and guest speakers (parents and grandparents especially)

I generally connect to the lives of the students by just making projects about things they talk about and things that they care about. I listen to their conversations at lunch time and at recess, and I attempt to design math lessons about things that are important to them. I also always try to incorporate their names as often as I can into any sort of problem situation.

None

I have not used the STEM before in my classroom.

Presenting the students with real world applicable problems is one way that I connect to my students lives and experiences. I also take an interest in my students lives and build relationships with each individual student in order to know more about them and what they need to be successful in the classroom.

n/a

Sharing time/space, home activities to connect real-life content outside of school settings, etc.

Problems or questions are open ended and can be about the students' interests.

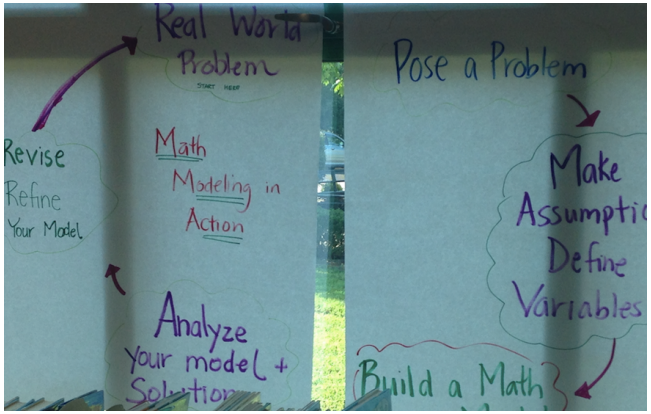
Bring in experts in the field, make experiences real-world (last year we got grant money to plant a garden students proposed through a PBL), share products with stakeholder

Appendix B: General Feedback from Teacher Focus Groups

- Teachers enjoyed working across grade levels and schools. Also appreciated working in school specific teams and are looking for opportunities to collaborate within their grade level
- Teachers would like the chance to work one on one or in small groups to unpack standards related to activities
- Mentally tough days made homework a challenge for some
- Teachers enjoyed the living lesson plan and collaboration on google docs. It allowed them to see different grade level modification and the perspectives of other teachers.
- Teachers need help with supplies and resources including personnel to help run activities. They do not have access to some higher-level equipment like (e.x. GoPro, altitude guns) and were wondering about a possible lending library. They wanted more training on how to use the specific technologies.
- Felt comfortable with relaxed structure of workshop but wanted to see a daily agenda in the morning as well as earlier posting of homework and discussion questions so they could complete them on time. Also requested a more explicit calendar and list of activities for fall follow up. They are unclear about what is going to happen.
- Hope to watch experts teach children to see how they ask questions and respond to student explanations.
- Request more alignment and time to link activities to standards and curricular goals.

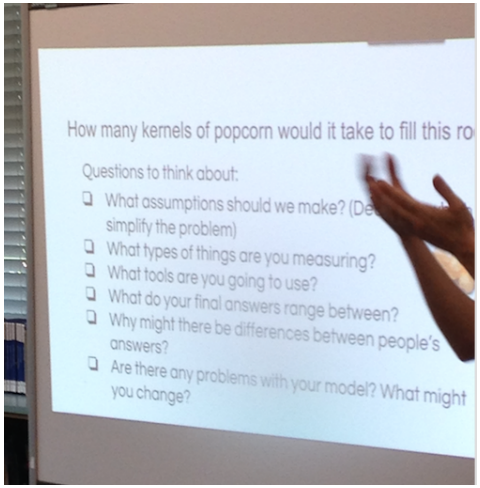
Appendix C: Workshop Images

Teachers discuss ideas in their wonder journals

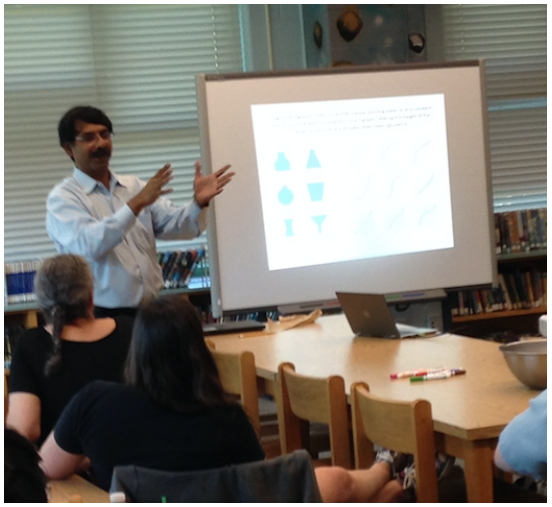


A framework for mathematics modeling presented to teachers

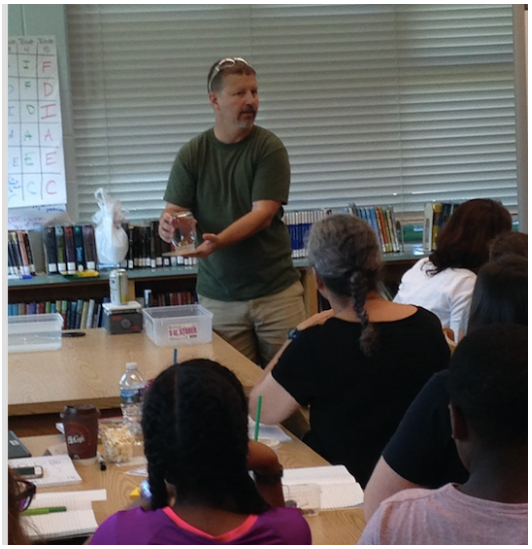
Dr. Suh works with students on the Fermi problem with popcorn



Discussion prompts for the Fermi problem with popcorn used during a debrief of the activity with teachers

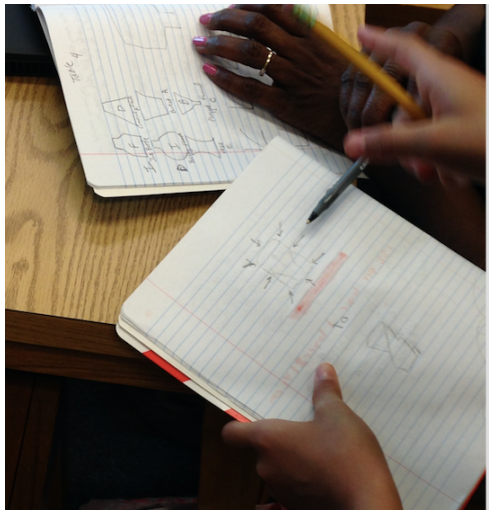


Dr. Seshaiyer poses a graphing challenge for teachers

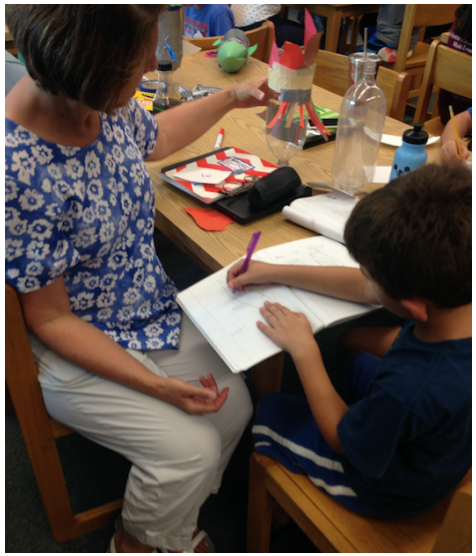


Dr. Gilbert does an air pressure demonstration for teachers and students

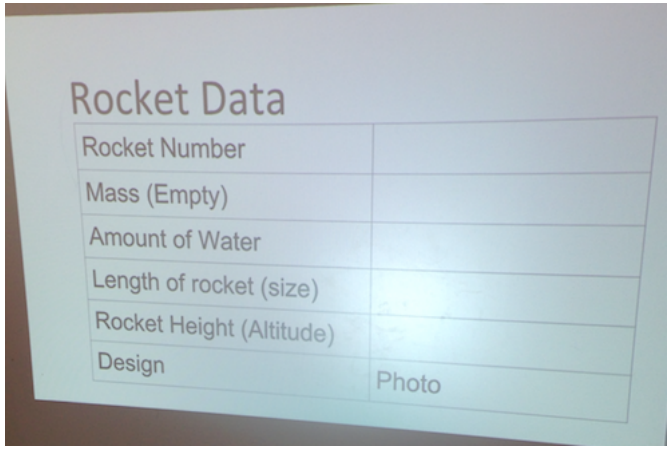
Teachers and students learn about air pressure together



Teachers and students share ideas in their wonder journals

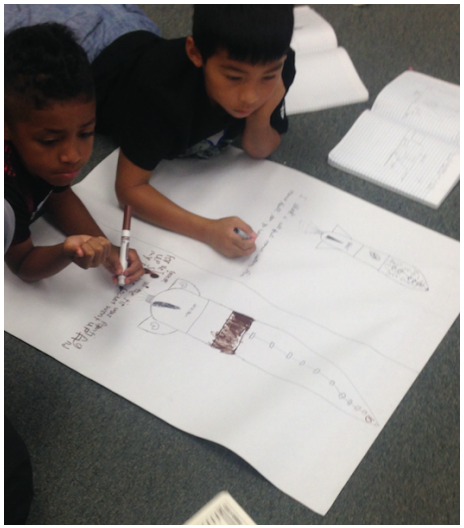


Teachers and students work together on design and construction of rockets for launch



Data collection prompts for rocket launch

Students use altimeters to measure the height of each rocket at apex



Students diagram explanations of forces involved in rocket launch.