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SCED 542
November 6, 2019

Phase II – Implementation of the Engineering Design Process

1. Select an engineering design process to be used in your class.

Selected Design Process Student Challenge:
Helping Hands PBIS/NASA Design Squad CHALLENGE: "Design and build a device that lets you grab different objects and drop them into a container that's at least two feet away from you."

Helping Hand . DESIGN SQUAD GLOBAL | PBS KIDS

2. Develop an implementation timeline.

Procedure timeline:

I will buy the needed design challenge supplies and bring them to school. **(Completed: 10/5/2019)**

I will select the students to work in pairs with one group of three. Each student will complete their own notebook. **(10/6/18, reworked pairs 10/11/19 for both 5th grade classes.)**

I will need 4 parent volunteers on the day we build the original designs. **(Used school intervention time to pull-in the 3 paraeducators, special education teacher, the math and reading coaches instead of parent volunteers. 10/16/19)**

My husband, who has FSH MD, will test the designs then the students will redesign and build their devise again letting my husband retest their new "prototype." **(Tested the student prototypes and student revised them per his suggestions. 10/17/19)**

The students will present and share their results with Mrs. Walters 4th grade class and Principal Hayes. **(Shared only with paraeducators and Rob Farrar)**
Students can choose to share their results on the online PBIS Design Squad forum page. **(Completed: 10/22-25/19, One student choice to do this.)**

I will take pictures of the students during each stage of the activity to share with the classroom parents in my weekly email/texting using ClassTag **(Messages sent: 10/6;10/15;/10/18;10/25)** and to document progress for my final master's project report. **(11/6/19)**

I will complete the whole Design Challenge with Matt Hazel's 5th grade class making modifications as needed. I will teach each section to this class during my classes library time. **(Introduction and Class Brainstorm 10/7/19; Library research time 10/9/19; Sketching lesson 10/15/19: Building first prototype 10/16/19; tested and revised 10/18/19; shared with 4th grade/Principal 10/18/19 AM: Written, individual personal reflection 10/1819 PM; share on Design Squad online formun 10/21/19 and complete at home choice project 10-22-25; Share home challenge with individual class.10/25/19)**

3. Perform the engineering design activity with my students. **(Completed: 10/17-10/18)**

Timeline/Implementation Lesson Plan:

Day 1: Students watch the video clips in their Google classroom "What do Engineers do?" https://svs.gsfc.nasa.gov/cgi-bin/details.cgi?aid=10515
--Hand out their student design notebooks with their name label already on the front. Let the students look through the notebook and ask questions.
--Share the Engineering Design process poster and discuss the Engineering design process versus the science fair project/experiment.
--Present the Gantt template and Microsoft project used by engineers to organize a large project--Budget, materials, team members, timeline, individual jobs, ect….

Day 2: Personal student research on the Chrome books. Add to student notebook. Completed in the library during library time. **(Added dictionary definitions of fulcrum and lever)**
****Read two books on children with disabilities to connect this engineering design project to October Disability Month.****
Showed more video clips about disabilities and design challenge "The Walker/Wheelchair.
https://pbskids.org/designsquad/video/kid-engineer-walker-wheeler/

Day 3: Show more videos about what real engineers do with “real world challenges to get “buy-in” from my reluctant students.

“What Does an Engineer Do?
Engineers solve real world problems. Use this series of short video clips to introduce students to the engineering design process and watch as DESIGN SQUAD host Nate solves his cat feeding dilemma!

Cat Feeder: Part 1 Watch as Nate sketches ideas for his cat feeder. (2:30)
https://pbskids.org/designsquad/video/cat-feeder-part-1/ (Link not working 10/14/19)
Cat Feeder: Part 2 What is a prototype? Watch Nate build a prototype of his cat feeder! (3:11)
https://pbskids.org/designsquad/video/build-cat-feeder-part-2/
Cat Feeder: Part 3 From prototype to finished product, watch as Nate puts the finishing touches on his cat feeder project! (3:24)”
https://pbskids.org/designsquad/video/build-cat-feeder-part-3/

--Whole class discussion then show the Robot Arm clip to build more background knowledge about related design challenge.
https://pbskids.org/designsquad/pdf/parentseducators/DSN_NASA_MissionSolarSystem_RoboArm.pdf

Day 4: Whole class Brainstorm session with students/Imagine/Ask questions--40 minutes **(Used large post-it note paper on whiteboard)**
--Complete individual (4) brainstorm questions in their student notebooks. **(Added after whole class brainstorm to narrow the brainstorm results.)**

Day 5: Teach needed physics background knowledge with simple machines by showing 3 video clips and have a whole class discussion. Fulcrum | Science Experiments For Kids | Science Projects | Science Tricks - YouTube
Super Simple Machines: Levers - YouTube
Simple Machines for Kids: Science and Engineering for Children - FreeSchool - YouTube
-- Students add to video notes and background notes.

Add new vocabulary words to student notebooks.
• **tension**: A pulling, stretching force
• **compression**: A pushing, squeezing force
• **friction**: A force that resists motion **(Adding these new vocabulary was effective.)**

Day 6: I will show the students the material for the Challenge and then, let them touch the various building materials, play with them for 5 minutes, and talk about how to safely use each during a design challenge. Finally, reviewing classroom group work expectations. **(Students need more practice with group work)**
--Time to finish any unfinished pages in student notebooks.

Day 7: Design/Sketch/Plan prototype design I will remind the students to use pen first then colored pencils and watching the video "How to sketch."
Show Videos https://pbskids.org/designsquad/video/engineering-human-body/
https://pbskids.org/designsquad/video/how-sketch/
(53) What is Isometric Sketching? | Design Squad - YouTube
https://www.youtube.com/watch?v=UEFEIq3umtw
Four videos:
Engineering for the human body
How to sketch
What is Isometric Sketching
What is a prototype
---Individual sketch time 40 minutes front and side view **(Added isometric sketch paper to the student engineering notebooks 10/14/19.)**

Day 8: Build original prototype with 4 parent volunteers helping supervise. **(Changed to paraeducators and other teachers 10/12/19)**
---Group build time 60 minutes

Day 9: Husband, Rob, (FSH MD) will test student's prototypes. They can then redesign, rebuild and then Rob can retest the new prototype or modified prototype.
----Group test and redesign (Duration: 60 minutes)

Email sent to team:

Dear IE 5th grade team,

Schedule for today;

9:20-9:30 ish Rob Farrar will talk to the whole 5th grade in my room 2 about the engineer design process at his Chemical plant.

9:30-10:15 In both room 2 and 4 one adult will watch a team of 5th graders present their "grabber" and give feedback. Each team of students is to attempt to pick up a tennis ball and a cotton ball and put it in the blue recycling container 2 feet away. Then, help each student team draw a redesign "Beta Prototype" on the correct page in their individual notebooks. There is a section for you, the observer, to give written feedback in the student's engineering design notebook. The focus is on design-redesign, draw-plan, and listening to feedback. Try to get the students to follow the directions not just "madly build" a new creation.

Use the words "engineers work in teams and compromise". Engineers use "certain set resources in a set time limit."

Rob Farrar will go around to each student team to "test" their grabber. This is a helping hands project. Our overall big idea was disability month and helping make an instrument to help someone with a disability-- like Rob Farrar with Muscular Dystrophy who cannot pick up "stuff" off is office floor when it falls. the best project grabber Rob will take to his job to use in his office.

Thanks for your help and support.

Beth Farrar 

Day 10: Share results with Mrs. Walter's 4th grade class/Principal Hayes in small groups. The younger students can "try the prototypes (Duration: 30 minutes) Students add to feedback section. (Quiet work time: 30 minutes.) **(I decided to skip this step**

and share a future project with the 4th grade class. My principal was not able to attend to give feedback.)

Day 11: Whole class discussion and reflection on each step of the Engineering Design process (Duration 30 minutes.)
--Students add written reflection to notebooks (Duration: 15 minutes)
Assign optional Home Challenge: to interview a relative to identify a problem and then make a prototype to solve that problem. **(Completed: 10/18)**

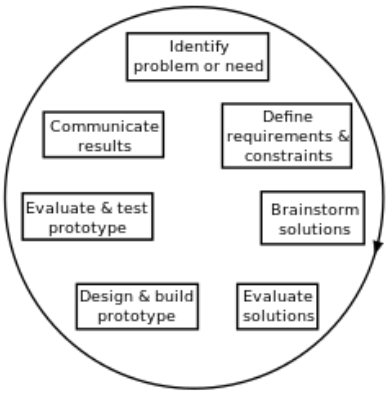
Grade (Teacher individual feedback): Individual projects with the Design Challenge Assessment Rubric page 6 of the RoboArm pdf project. (Works well for this challenge also.) **(Completed: 10/18-10-22)**
https://pbskids.org/designsquad/pdf/parentseducators/DSN_NASA_MissionSolarSystem_RoboArm.pdf

Day 12: Optional: Individual posting online results by students to the PBIS Design Team website.
I will post an email on Classtag with attached pictures informing/sharing with the student's parents our classroom Engineering Design Challenge journey. **(Competed: 10/19)**

Finally, I will document and complete the masters class paper.
Page. **(11/6/19)**

4. Complete an engineering design notebook. (Blank Master)

My Engineering Design Notebook



Design Process from PBS Design Squad
Identify the Problem
Brainstorm
Design
Build
Test/Evaluate
Redesign
Build
Share Solution

Farrar Design synthesis model
Imagine
Design
Create
Redesign
Share

Background Information notes:

Video notes:

Identify the Problem/Imagine:

Brainstorming Rules

1. Write down all ideas, no matter how wild. The more ideas, the better!
2. Be creative and spontaneous. There are no wrong answers and lots of possible solutions.
3. Work as a team and respect every idea. Everyone should participate.

Class Brainstorm notes:

_____

_____

_____

_____

_____

_____

_____

_____

Draw Brainstorm ideas:

1. Using these materials, what can you build to grab objects that are two feet away from you?

2. How will your grabbing device open and close so it can grip an object and let it go?

3. How will you attach your grabber to the end of the stick?

4. How will you control your grabber when it’s at the end of the stick?

Personal research results:_____

Drawing/Design:

Sketch Design (top and side angles):

Redesign sketch (Top and Side Views):

Share Final Prototype:

4th Grader's Feedback:

Principal's Feedback:

Rob Farrar's Evaluation:

Personal Evaluation/Reflection:

Drawing of tested final prototype:

AT HOME

During this "At Home" challenge, students will interview friends or family to identify a problem, and then create a prototype to help solve it.

Make a Prototype

Students will make a prototype device that will help someone move, accomplish a task, or make work easier. First, they will conduct interviews with family or friends to identify the problem that their device will help solve. Then they will make a sketch or prototype of their device. Optionally, they can take photos or record video of their prototype being used by a family member or friend. Finally, they will bring their sketch or prototype to class to discuss the next day.

CLASSROOM WRAP-UP

Once all of the prototypes have been shared, students will discuss elements that could improve upon their design. Then, students will see how the teams on DESIGN SQUAD used engineering and the design process build specialized prostheses for an underwater dance performance.

Share

First, students can share results from the "At Home" challenge. (10-15 minutes) Then, students can demonstrate their project and discuss any changes that would improve their design. Optionally: take photos of student projects and share them in the DESIGN SQUAD website project galle

5. Reflect upon your experience.

Final Reflection Questions

a. What went well with the engineering design challenge?

-Whole group brainstorming went well. (I had the student complete and individual brainstorm, whole class brain storm, and a group brainstorm.)
- Reteaching each section to the other 5th grade class helped me refine the presentation for greater understanding after evaluating “what went well” the first time I taught it.
-I kept adding foundational videos and more vocabulary words as I taught each section and listened to the students questions. I also added more “quiet work time” to complete the written sections of the notebooks.
-Collaboration with the school Librarian to use library time for background research on “simple machines.”
-Rob Farrar as a guest speaking went well as he shared the Professional Engineering design process at his Chemical plant where he is employed as a scientist, and then giving each student group project feedback.
-It was extremely effective getting a disablitied person to test their project. The students were completely engaged and had buy-in.
-As a side benefit, the experience was personally freeing for Rob to share about muscular dystrophy in a positive way.

b. What did not go well with the engineering design challenge?

Some things that did not go well:
-The student pairs/trios struggled to effectively communicate and compromise and to build with the assigned project materials.

-I emailed directions and gave verbal directions/ instructions for the adult helpers, yet the adult helpers still struggled to effectively facilitate the groups to test, draw, and redesign pictures and/or help the students write down the feedback given to them.

-I had 6 adults listening to each group present their “grabber” and then tested by Rob Farrar for modifications as a disabled person with muscular dystrophy. (I needed 2 more adults for the groups of 47 students.) Just one group did not rotate to show their

challenge to Mr. Farrar. A few groups got upset when Mr. Farrar could not “work” their grabber and struggled to redesign it. Two of the groups were fighting over supplies and did not want to share the Duck Tape. (The adult helpers quickly intervened and redirected the individual students.)

This is the first experience this group of 5th graders has had to work in groups and design and redesign a challenge with very set, narrowed directions, (They just like to build their own thing ignoring the directions.)

c. What concepts were covered (list standards and topics where appropriate)

Concepts covered in during this student unit:
-Introduction and exposure to a person living with disabilities in celebration of October Disabilities Month.
-Introduction of what professional engineers do if you work for NASA or a local chemical plant--Ascensus Specialties Chemical (“Dream dreams” for the student while presenting various engineering careers.)
-An opportunity to explore the complete engineering design process using PBS Engineering Design Squad materials using the following *Next Generation Science Standards: (NGSS)*
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

-An opportunity to work in pairs or trios to practice communication skills and learning how to compromise using the following Common Core Communication standard:
CCSS.ELA-LITERACY.SL.5.1 Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on *grade 5 topics and texts*, building on others' ideas and expressing their own clearly.

-An opportunity to practice perseverance in finishing the project and having a growth mindset by accepting feedback and looking for resources,
-An opportunity to extend and share the challenge on the PBS Design Squad online gallery.
-An opportunity to understand the concept of “limited resources.”

-An opportunity to practice three Common Core Mathematical Practices: Make sense of problems and persevere in solving them. Use appropriate tools strategically. Attend to precision.

d. How did the ED process help teach science and mathematics concepts?

Science concepts covered:
Concepts of Physics: Simple machines: Use of the fulcrum and lever.

- **tension**: A pulling, stretching force
- **compression**: A pushing, squeezing force
- **friction**: A force that resists motion

Learning about the physics of simple machines allowed the students to understand the physics behind creating a "grabber."

Math concepts covered: measurement: centimeters or inches
The students correctly measuring with the yardstick 24" to test their grabber's ability to pick up and drop objects in a container 2 feet away.

It challenged me, as the teacher, to think more deeply about how to effectively combine math, science, and engineering--something I have rarely done before. I have combined math and science, but not engineering in a mindful way.

e. Did I choose an appropriate engineering design process? Should I simplify or make more complex?

Yes, I choose an appropriate design process. It was an achievable assignment within given time constraints. Each group was able to make the challenge as complex as they could imagine and create with the given materials. (This project allowed me an opportunity to effectively engaging *all* the students in my class in a "happy" productive way, therefore was personally extremely satisfying and a very good use of limited teaching time.)

f. How can I improve this activity to use with future students?

I would begin this unit with these big design Ideas:
Keep it Easy and Simple!

1. Simple
2. Easy to learn
3. Durable
4. Unintended Consequences

After Rob Farrar tested the challenge projects, he instructed the students to realize that each disabilited person might need individual adjustments to their design, for example he cannot use his right hand, so needs to use his left hand for the pinching motion of the grabber. I liked that the students could test their projects in a real world setting, but I would pre-teach this concept of “one size fits all” versus “made to order” products.

I would ask the Art teacher *earlier* to include a sketching class before I started this engineering design project. (My students have a 30 minute art class each week.The art teacher is open to add an engineering design sketch mini-unit for next year.)

It was a challenge to get the other 5th grade teacher to spend the needed class time to have his students complete all the steps of the design challenge. (I taught 3 mini-lessons to his class brainstorming, sketching, and the introduction of the engineering design process cycle.) Maybe after personally experiencing the whole engineering design process, he will have more”buy-in” next year. The other 5th grade teacher expressed real satisfaction with his students’ finished prototypes on the days the students built and rebuilt their designs. I thought I had done a better job of explaining what I needed from *his* students. I will have to be more patient with myself and my coworkers.

I would request the PTO, Donor’s Choice, or the classroom parents to help with the cost of supplies, so that the students would be able to completely rebuild their prototypes multiple times. (I spend $125.00 on supplies and I could have spent more money, so I would like to avoid this next year.)

I wish I had sent a GOOGLE calendar request for my principal to come during the rebuild/ feedback day. I sent her two emails and talked to her in person, but because it was not on her GOOGLE calendar she did not “show up.”