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SCED 542
Sept. 25, 2019

Major Project: Engineering Design Challenge

Phase I – Research and Planning – Due Date: Midterm

1. **Identify the "Big" concept to be covered by the engineering design challenge.**

The "Big" Concept to be covered will be to have students utilize the engineering design steps through the theme of helping others. The students will experience how engineers solve problems to help improve disabled people's lives; specifically someone with FSH Muscular Dystrophy who cannot raise his hands above his head or easily pick something off the floor.

2. **Research appropriate learning standards associated with the topic.**

Olympia School District Strategic Plan Student Outcomes:
Our students will:

Outcome 1: Be compassionate and kind.

Outcome 3: Advocate for the social, physical and mental wellness of themselves and others and be hopeful about the future.

Next Generation Science Standards: (NGSS)
Engineering Design
Students who demonstrate understanding can:

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

3. Identify and discuss the different types of problem solving and declarative/procedural knowledge needed.

The design challenge/problem I am presenting to my students will be to produce an artifact/device (something to pick up an object from the floor). The problem is "structured & articulated" for the students by me, the teacher. There is no right or wrong artifact, just whether the artifact/device (artificial arm) is able to function and do a job. It will be "ill structured and problem situated" as defined by David H. Jonassen. The task I am giving the students has limited complexity, because I am giving them set material to choose from to build their arm in a set period of time. The student outcomes will be affected by each individuals "general problem-solving strategy, self-confidence, and motivation or perseverance" levels.The level of individual engagement will be affected by the students personal sleep deficients and if there are major disruptions in their homelife before attending school.

My students are novices in their declarative knowledge of fulcrums and levers. I will need to teach them factual, conceptual, and then physic principles first in order for them to complete the chosen design challenge. I will facilitate this through the use of three short, simple machine video. Then, I will model the actions of a lever pointing out the fulcrum using the choice materials needed to construct their "artificial arm". Finally, the students will attempt the challenge and try to make the "arm". In addition, I will give them a home challenge--- to interview a relative to identify a problem and then make a prototype to solve that problem. This will give individuals an opportunity to "add on" to their declarative knowledge and practice their new problem solving skills.

Class background:
My 5th-grade students lack the three highlighted skills in "Understanding STEM: Current Perceptions," problem-solving, critical thinking, and analytical thinking. The 5th-grade curriculum is vast and it is impossible to teach skills to mastery with all the scaffolding and differentiation needed. I can use the engineering design activities to increase the 5th grade material's relevance; bridge and connecting concepts between science, math and engineering. This also gives my students the opportunity to practice higher order thinking skills like analyzing and evaluating. The 5th-grade teachers are willing to collaborate and integrate science curriculum with the ELA curriculum. An added resource is a classroom Chromebook cart enabling the students to complete research and graphing projects. Our world has many complex problems that my students will need the personal fortitude to tackle. Offering my students engineering challenges will help them practice teamwork, verbal/ written communication skills, and encourage

personal self-discipline. In addition, this project/challenge will encourage empathy and compassion for people living with disabilities.

4. **Explore objectives and ancillary concepts/content covered by the project.**

Student objectives of teamwork:
-Students willdemonstrate the ability to lead and productively participate in group situations. (My students will complete the engineering design task in pairs. Each student will complete the project and complete their own notebook, but do it together in tandem.) I hope this will decrease anxiety and help each student to "just try" or engage.
-Students will be able to apply knowledge and make connections to make decisions and solve problems. (I will model the whole process saying my thinking processes outloud before letting the students explore and create.)
Student objectives of Growth Mindset and Grit:
-Students will be curious by "valuing questioning, investigating, and imagining" in a hands-on concept attainment setting.(I will have them watch some "What and Engineers Do." in their GOOGLE classroom to give motivation and "buy-in".)
-Students with gain engineering design knowledge and understanding through perseverance, hard work, and personal effort. (I will plan for enough time for each student to "process" the activity and then share the results,) Not moving on to quickly is one thing I struggle with when facilitating hands-on student activities.

Ancillary concepts covered by the project:
The practical application of a lever and fulcrum.
Learning about disabilities and how to design tools to overcome them,
Making real world connections to people with disabilities.

5. **Identify possible activities.**

1.) PBIS/NASA Design Squad CHALLENGE: "Design and build a robotic arm that can lift a cup off a table."
https://pbskids.org/designsquad/pdf/parentseducators/DSN_NASA_MissionSolarSystem_RoboArm.pdf

2.) 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

6. **Select the best activity for your classroom.**

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.”

This is the best activity because my husband has FSH Muscular Dystrophy and will come into the class and test each of their “devices.” Then, the students can redesign and rebuild their device and then retest it on my husband. He can give instant.real world feedback. An added benefit is the opportunity for students to ask direct questions about living with a disability. He will then challenge the students to create or modify their device, during a future class period, into an “arm” he can use to wash his hair alone in the shower. In conclusion, I will then share the Design Squad’s video-- a child with Cerebral Palsy designing her own walker/wheelchair. https://pbskids.org/designsquad/video/kid-engineer-walker-wheeler/ and facilitate a whole class discusssion. Finally, we will share out results (helpful devices) with one of the fourth grade classes.