



Integrated STEM Professional Development: Utilizing Best Practices in an Online Format

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Outline



Virtual Professional Development (PD) in iSTEM

- Designed using Desmione's Five Critical Features of PD
- Based on three dimensional learning model
- Targeting sources of self efficacy
- Synchronous and asynchronous components



Background

- Elementary school teachers often have low self-efficacy in teaching science (e.g., Brobst et al., 2017) and engineering (Hammack & Ivey, 2017)
- Many elementary teachers find their preservice teacher preparation does not prepare them to teach:
 - science (Banilower et al., 2018; Gess-Newsome, 1999; Trygstad et al. 2013)
 - engineering (Banilower et al., 2018; Custer & Daugherty, 2009; Reimers et al., 2015)



Self-Efficacy



- Self-efficacy predicts motivation and performance (Bandura, 1982; Pajares & Schunk, 2001), and is linked to:
 - Teacher effectiveness, persistence, and retention (e.g., Lakshmanan et al., 2011; Sang et al., 2012)
 - Commitment to teaching profession (Yost, 2006)
 - Teacher competence and decision making (Bandura, 1997)



Professional Development (PD)



- **participatory culture** allowing for adequate time to grapple with ideas and materials (Little, 1993)
- **interactive**, social and based in a community of practice (Desimone 2011)
- Online PD can be **synchronous**, where learning happens in real time, asynchronous, where teachers engage in their learning on their own time, or a hybrid of both synchronous and asynchronous (Elliott, 2017).



Professional Development (PD)



- **social presence**: interactions can take many forms including sharing work, asynchronous discussions, and real-time conversation (Holmes, Signer, & MacLeod, 2010).
- promote **ownership** as teachers determine valuable content (Darling-Hammond, Hyler, & Gardner, 2017; Macias, 2017)



Key Features of the Online PD



- Critical feature of online PD is instructor facilitation. Multiple studies highlight the importance of instructor facilitation for fostering productive interactions among teachers (Watkins, 2020)
- Online PDs may more efficiently afford and support teacher learning and professional practice while addressing the issues listed above along with other factors related to scalability, cost, and accessibility, while even reaching learners in isolated populations (Alqarni, 2015; Marrongelle et al., 2013).



Key Features of the Online PD



Desimone's (2009) five critical features:

1. content focus,
2. active learning,
3. coherence,
4. duration, and
5. collective participation.





How many hours?



- Some studies have found positive outcomes with as few as **11 contact hours** (Piasta et al., 2010) and studies with more than 65 contact hours (Garet et al., 2010)
- Estrella et al. (2018) analysis of over 26 studies found that PD programs with greater than **15 hours** showed positive significant treatment effects when compared with shorter durations (Estrella et al., 2018).



What did we do?



- **Barriers for online PD:** family time, vacation, travel time and the amount of time needed to attend the workshops
- **Our sustainable solution:** Summer Institute was held synchronous over 2 days with **3 contact hours** each day and one asynchronous day in between.



Summer PD Activities



Career Brain Dump



Enter STEM careers in the Jamboard.



How many different careers can we list?



Are there any patterns in what is represented (or not represented) in our list of careers?



Participant Sample

Computer
Programmer

data
analyst

zoologist

chemist

Sarah

physician

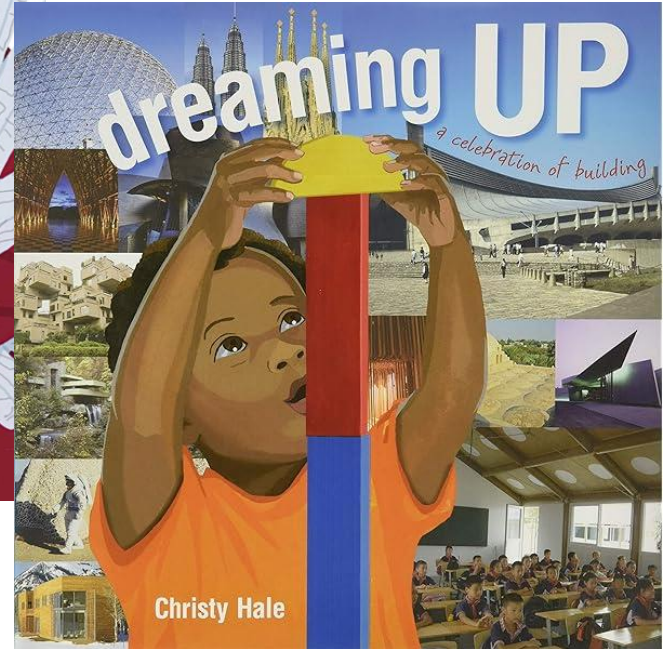
web
developer

teacher

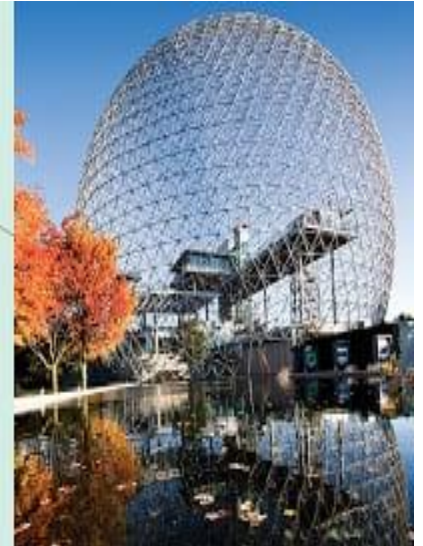
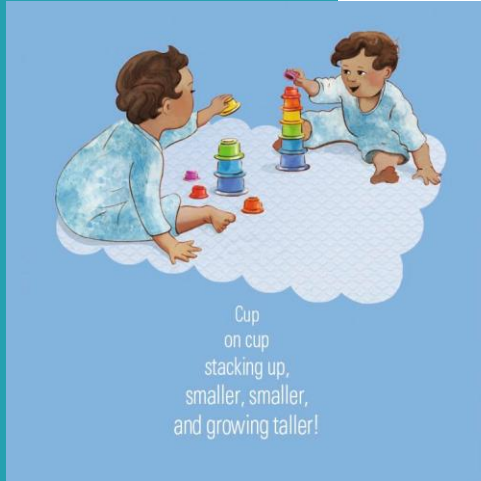
Farmer
Rancher



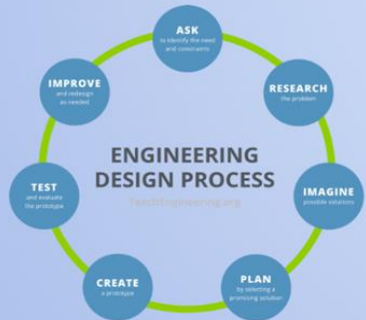
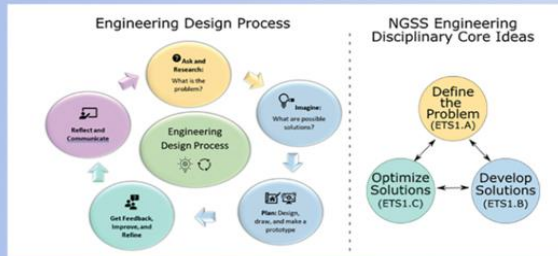
Leveraged Children's Literature



Images from “Dreaming Up”



- DEFINE THE PROBLEM
- DO YOUR RESEARCH
- DEVELOP A POSSIBLE SOLUTION
- DESIGN YOUR SOLUTION
- BUILD A PROTOTYPE
- TEST IT
- EVALUATE YOUR SOLUTIONS



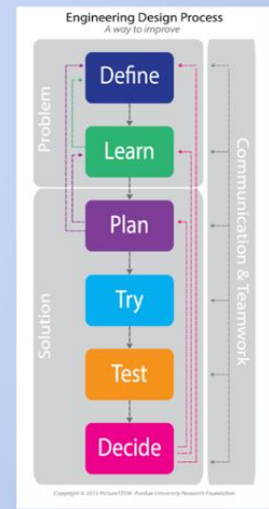
Explore. Find out more.
Children learn about the problem they need to solve and explore the available materials to find out more about them.



Create. Try an idea.
Children work in small groups with an adult to create their first design. They then test their design to determine how well it meets the goal.



Improve. Make it better.
Children improve their designs, then come together to share what they've found out with the full group.



JW

Engineering Design Process



Engineering at home



STEM Observation Protocol (STEM-OP)

STEM OP

1	Relating Content to Students' Lives
<i>Students' everyday and personal experiences from outside the classroom are activated, meaningfully incorporated into the lesson, and related to the development of STEM knowledge.</i>	<ul style="list-style-type: none">• Are the experiences shared by the teacher? By students?• How strong is the connection between the experiences and lesson content?
2	Contextualizing Student Learning
<i>Learning is contextualized within an appropriate (e.g., age, gender, race, etc.) real-world problem or design challenge that connects to the content of the lesson. Connections between students' learning and the context are explicit so that students understand the importance of their learning.</i>	<ul style="list-style-type: none">• Does the teacher state a clear real-world problem or design challenge?• How strong is the connection between learning and context?
3	Developing Multiple Solutions
<i>The teacher promotes students' development of multiple solutions during the STEM lesson. Students are encouraged to develop multiple design alternatives and evaluate them, identifying the relative advantages and disadvantages of each possible solution.</i>	<ul style="list-style-type: none">• Does the teacher encourage divergent ideas for solutions?• Are design ideas evaluated by students?• Are there opportunities for engineering design and/or redesign?
4	Cognitive Engagement in STEM
<i>Students engage in learning within a STEM lesson at different cognitive levels. While it is appropriate for students to be expected to learn facts and definitions, it is important that students have opportunities to work at higher levels of cognitive engagement such as applying concepts in new situations, and evaluating and analyzing concepts. In other words, students should experience all levels of Bloom's taxonomy when in a STEM classroom.</i>	<ul style="list-style-type: none">• What expectations does the teacher have for what learning "looks like"?• What kind of opportunities are there for students to remember, understand, apply, analyze, and/or evaluate?



STEM Lesson Ideas



IMPLEMENTATION PLAN

LESSON PLAN SOURCE OR LINK:

<https://www.youtube.com/watch?v=dUKt1a6l3yw>

PARTS OF THE ORIGINAL LESSON I WILL KEEP FOR IMPLEMENTATION

After the Fall Read Aloud



Find the theme of the story and explain

Egg drop activity to help Humpty feel safe to climb the wall again. Students create a container to drop from a high place to protect Humpty.

YOUR NAME

Hillary

WHAT GRADE(S) I PLAN TO IMPLEMENT THIS IN

Fourth Grade

"BRAIN DUMP" - MODIFICATION IDEAS TO IMPROVE QUALITY OF STEM INTEGRATION

Break students into groups to create the egg drop containers.

Students can time how long it takes for each egg to hit the ground to see if it affects the outcome.

A graph will be created for time to the ground.

Students get to make choices of materials used from a variety in the room.

Students will present their group project and reasoning to the class. As well as a follow-up at the end about the effectiveness of the container.

Discuss how the students are being engineers in creating this container. Discuss other engineering jobs with the students.

4.RC.7 Paraphrase or summarize the main events in a story, myth, legend, or novel; identify the theme and provide evidence for the interpretation. (E)
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

Summary



- STEM Career focus
 - Children's literature integration
 - Resources shared on Canvas Site
 - Vicarious experiences - classroom video
- Engineering
 - Modeling of integrated STEM lessons with participants
 - Observe STEM lessons with STEM OP debrief
- Lesson plan design and feedback





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Thank you!

This material is based upon work supported by the National Science Foundation under Grant No. 2151045, 2151056, 2151057, and 2151012. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

