Engineering Elephants: Storybooks and Activities to Improve STEM Education in the Early Years

Aaron S. Hunt
Education
West Texas A&M University
Canyon, TX 79016

Emily M. Hunt
Engineering and Computer Science
West Texas A&M University
Canyon, TX 79016

Michelle L. Pantoya
Mechanical Engineering
Texas Tech University
Lubbock, TX 79409

Oliver K. Mulamba
Mechanical Engineering
Texas Tech University
Lubbock, TX 79409
What is an Engineer?

- Surveyed over 200 children ages K-5th grade
- 2nd most common response: “someone who drives a train”
- 1st: “I don’t know”

Engineering Elephants
Goal:
inspire future generations of engineers by creating a fun and engaging book communicating to a young audience the significant contributions that engineers can have on our way of life.
Children exhibit naturally scientific traits: not only are they inquisitive and energetic, but they also like to experiment.

Teach science through their language:
- Asking questions

The goal of science education at the earliest levels should be:
- to encourage children’s innate love of exploring the world around them
- to promote that enthusiastic behavior grow into true scientific literacy
Scientific Inquiry

Engineers make elephants with long, swinging trunks
Wait a minute...

Do engineers really make elephants?
No, but they do make roller coasters!
Introducing New Vocabulary

Up and down, around again
Roller coasters are so much fun!
Engineers design the loops
Sometimes two...or just one!

Momentum holds you in your seat
And keeps the car on the right path
Engineers make it all work
Using science and math!
Early STEM Literacy

- Educational psychology researchers developed an approach for teaching science in elementary school by integrating science with language and literacy skills.
- Reading is the centerpiece of intellectual development in all disciplines.
- It is absolutely necessary to integrate reading and language arts with the increased involvement of students in the STEM fields.
K-12 ENGINEERING

- Engineering is now a part of the K-12 curriculum in Texas.
- Texas Essential Knowledge and Skills (TEKS)
- STAAR testing—depth of learning
The student applies knowledge of science and mathematics and the tools of technology to solve engineering design problems. The student is expected to:

(A) apply scientific processes and concepts outlined in the biology, chemistry, or physics TEKS relevant to engineering design problems;

(B) apply concepts, procedures, and functions outlined in the Algebra I, Geometry, or Algebra II TEKS relevant to engineering design problems;

(C) select appropriate mathematical models and proofs to develop solutions to engineering design problems;

(D) integrate advanced math and science skills as necessary to develop solutions to engineering design problems;

(E) judge the reasonableness of mathematical models and solutions;

(F) investigate and apply relevant chemical, mechanical, biological, electrical, and physical properties of materials to engineering design problems;
Slaton ISD implemented a summer school curriculum with *Engineering Elephants* as the main text

- 65 3rd-5th grade students

Each week is designed around selected topics from the book including vocabulary introduction and integration, hands-on science activities and relevant field trips.

100% of these students had failed the TAKS test previously. After completing their summer school EE curriculum, 80% of students passed (48/60)
Enhance Creativity

- After reading EE, students from 3rd-5th grades were asked to draw what they would like to design when they become engineers.

- Concept sketch
We have learned that engineers design roller coasters, race cars, surfboards, helper hands, wind turbines, composites, fireworks, rocket ships, and new materials...

When you grow up to be an engineer, what new things will you create?
A skateboard roller coaster

Helmet
Knee pads
Straps

Hook
Jumping off point for further curriculum development

- Hands on activities to reinforce concepts introduced in Engineering Elephants
  - Aerodynamics with race car design and contest—Activity #1 Playdough race cars
  - Fluid material properties—Activity #2 Fluid density
  - Electricity generation—Activity #3 Fruit batteries
Growing STEMs: Children book series and computer games that engage and teach STEM concepts from an engineering perspective

Prof. Michelle Pantoya and Prof. Emily Hunt

Pre-K – 5th Grade:
Early Readers – Picture Books

Engage students with:
• Bright & Simplistic Watercolor Artwork
• Asking Questions
• Lyrical and rhyming text

Goals: Introduce engineering profession and STEM vocabulary

3rd – 5th Grade:
Middle Readers – Graphic Novels
Plot driven, chapter books

Designing Dandelions

Goals: Teach STEM concepts from an engineering (problem solving) perspective