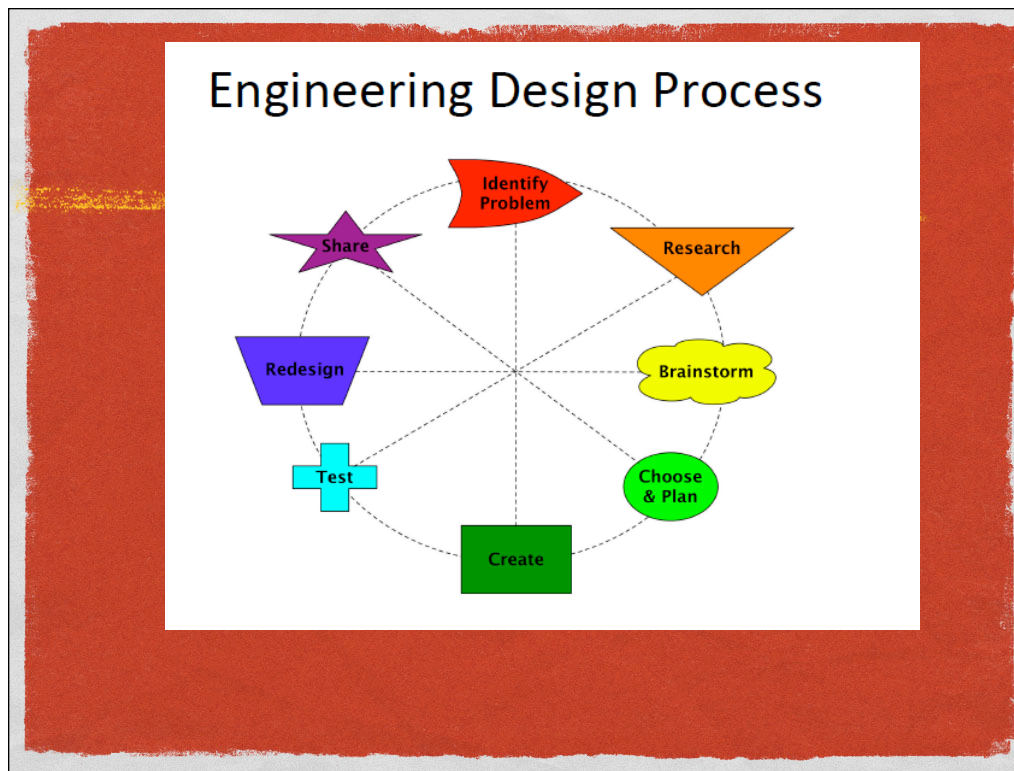


ELEMENTARY ROBOTICS
RATIONALE AND RESEARCH

JOHN HEFFERNAN

12//1912



Go over and explain: step 1 sometimes overlooked but critical. The same, in essence as other processes.

Lego Robots directly tap into the creative play urge of children in a healthy and educational way. A PK-6 robotics curriculum (such as Elementary Engineering Curriculum) is needed to support and sustain the natural engineering instincts of young children until formal engineering





What's going on here? Have you seen your kids doing something like this? What does this have to do with learning?

TAP CREATIVE PLAY

- Are we tapping into the so important creative play of children in school, especially the kind associated with building?

Isn't that where the urge to engineer comes from?

TAP CREATIVE PLAY

It's more fun to actually be building something. If you took a class in robots and just learned about things, if the teacher just drilled information into your head, it would not be as fun as building and experiencing it to learn.

Grade 6 Girl 2

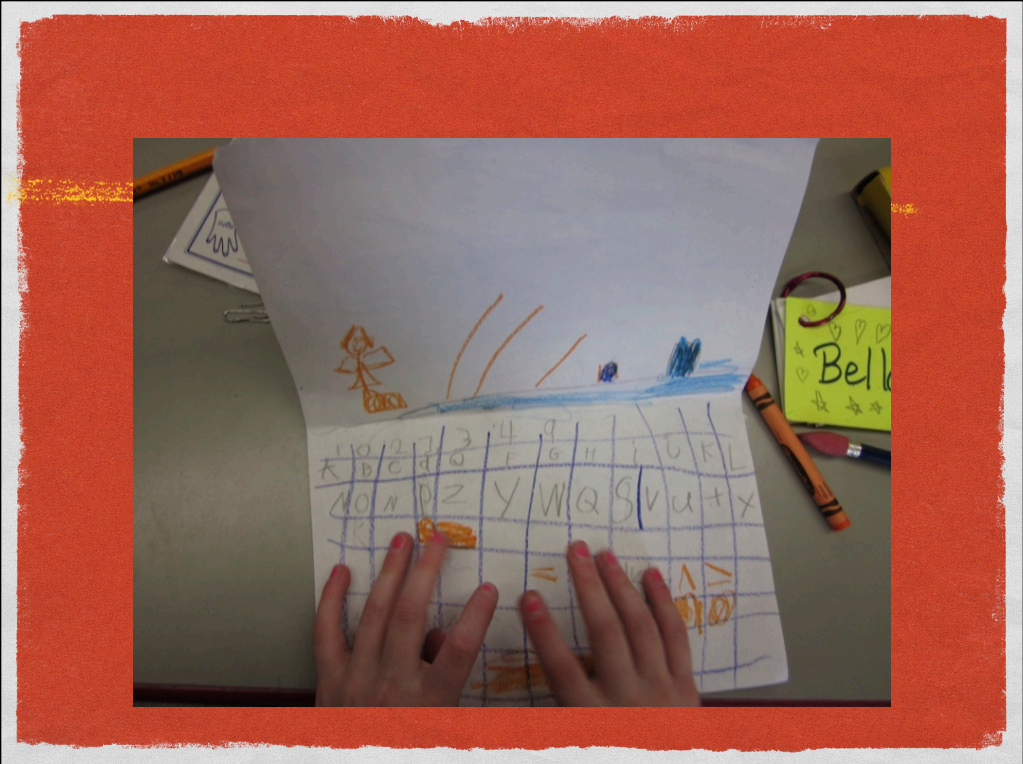
TAP CREATIVE PLAY



- Who is tapping into creative play? Are we?



What we see at recess? Are they not getting it at school?

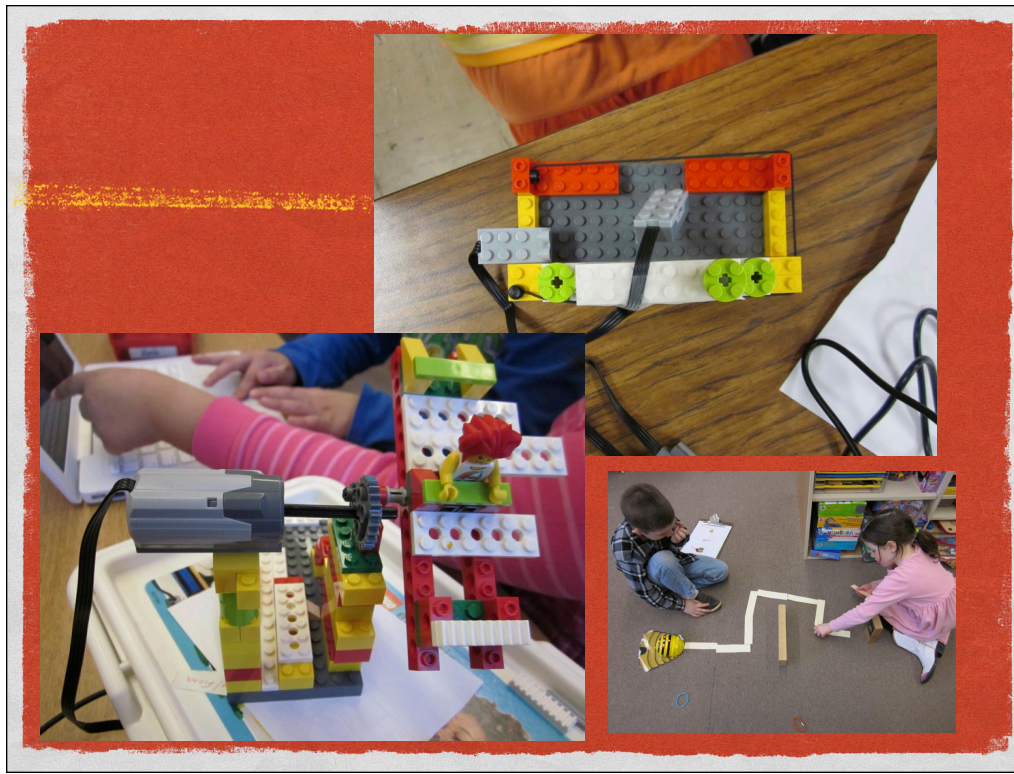


Lego Robots directly tap into the creative play urge of children in a healthy and educational way



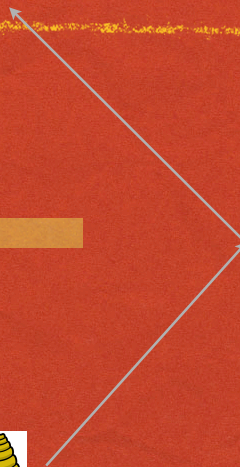
WHY ROBOTS?

- Engineering can be taught in many ways, why Lego Robots?
- Familiar, fun, fantasy
- They can be programmed, adds “life”
- Tech component built in
- Math, science, ELA as well



Some open ended challenge design from grades K, 2, and 4. Name challenges. Challenges are important to really experience engineering and also to see where the students can take things. Critical for (underserved) students who need more challenges.

YEAR 1 CLEVER SOLUTION



DEPTH OF LEARNING

15.5

GRADE 5/6 LEGO LESSONS #2 - MOTORS - NO SENSORS

TEAM _____ DATE 4/6/11

Follow the checklist below.

- The car turns clockwise for 5 seconds. 8.375
- The car turns counterclockwise for 5 seconds. 1.25
- The car goes in a straight line for 3 seconds.
- The car goes forward for 2 seconds, makes a 90-degree turn, goes forward for 2 seconds and stops.
- The car follows a taped square on the floor. 16.74 $\frac{2}{3}$
- The car follows a taped path on the floor.

8.375

$$\begin{array}{r} 2 \overline{) 16.750} \\ \underline{-16} \\ 07 \\ \underline{-6} \\ 15 \\ \underline{-12} \\ 30 \\ \underline{-30} \\ 0 \end{array}$$

1.25

$$\begin{array}{r} 1 \overline{) 1.25} \\ \underline{-1} \\ 25 \\ \underline{-24} \\ 10 \\ \underline{-10} \\ 0 \end{array}$$

GRADE 6 VELOCITY WORKSHEET

NAME Cove DATE _____

- Measure 10 feet and mark the distance in some way.
- Create a program that goes indefinitely. Set the motor power to 75%.
- Using the wall clock's second hand or a stopwatch, record how long it takes to go 10 feet. 11 seconds

Calculate the velocity (rate) of your robot in feet per second. Distance = rate x time.

Rate = 11 feet/second

Compare your results with others.

Why are results different for different teams? lighter robots

What was the fastest speed? 1.016 sec

Extra credit

What is the velocity of a robot car with the power set to 100%? 8sec per 10 feet or

What is the slowest speed you can get the robot to go? .8 in 1 sec

$$\begin{array}{r} 200 \\ 11 \overline{) 1100} \\ \underline{-11} \\ 00 \\ \underline{-00} \\ 00 \\ \underline{-00} \\ 00 \end{array}$$

$$\begin{array}{r} 14 \\ 10 \overline{) 140} \\ \underline{-10} \\ 40 \\ \underline{-40} \\ 0 \end{array}$$

$$\begin{array}{r} 8 \\ 10 \overline{) 80} \\ \underline{-80} \\ 0 \end{array}$$

How much more meaningful is this than a workbook sheet on velocity, long division? Learning is in context of solving of problem. Saw many examples where deeper understanding was missing until they had to actual use their math. Think of one!???

MOTIVATING



FUN



It was hard so it made us jump up and down when it finally worked. *Grade 5 Girls Team 1*

Example of Scarlet running back and forth from computer to test area

HOW IS IT DIFFERENT?

[It's] Absolutely! [different from other schoolwork.] It's more interactive because mostly what we are doing in school is paperwork. With this you get to experiment, instead of just doing something, like math, you got a question, you figure it out. With this you can, change it up, experiment. *Grade 6 Boy 1*

It's fun and different in a different way. I just think it is more fun. The way you think - easier is some ways, harder in some ways. The way you think is more fun to think that way than the other way. *Grade 4 Boy Team 2*

Do you think this is fun and engaging for kids?

QUOTES

I didn't think you would use all that math and science to build that robot. Grade 6 Girl 2

It's more fun [than usual schoolwork.] It's a lot different – sometimes mathematical. You have to think in a different way. This would make this, would make this, happen. Each step is connected. Grade 4 Boy Team

Integration examples: solve a problem from a story (chair engineering, better mousetrap (Ralph), design an instrument, decorate robots

WHAT DID YOU LIKE ABOUT ROBOTICS?

What did you like about robotics?

24 Mentioned the project as fun

15 Got to build/hands on

8 Different than other school work/special/exciting

7 Liked the programming even though it was hard

5 Cool

4 It was satisfying/exciting getting things to work

2 Liked the trial and error

2 Had to learn to compromise, work together

2 Got to move around, not stay in seat

RESEARCH - INTERVIEW RESULTS

- Student very aware of how they are being taught
- Prefer hands on activities and believe they learn better that way

Grade 6 Robots - Pre-Survey

NAME [redacted] DATE 3-30-11

What is a robot? a robot is a mechanical device that you can program to do different things.

What is engineering? Engineering is a type of work that involves mechanics

How much do you agree or disagree with these statements? Circle One.

I want to be an engineer or scientists when I am older.

Strongly Agree Agree Neither Agree or Disagree Disagree Strongly Disagree

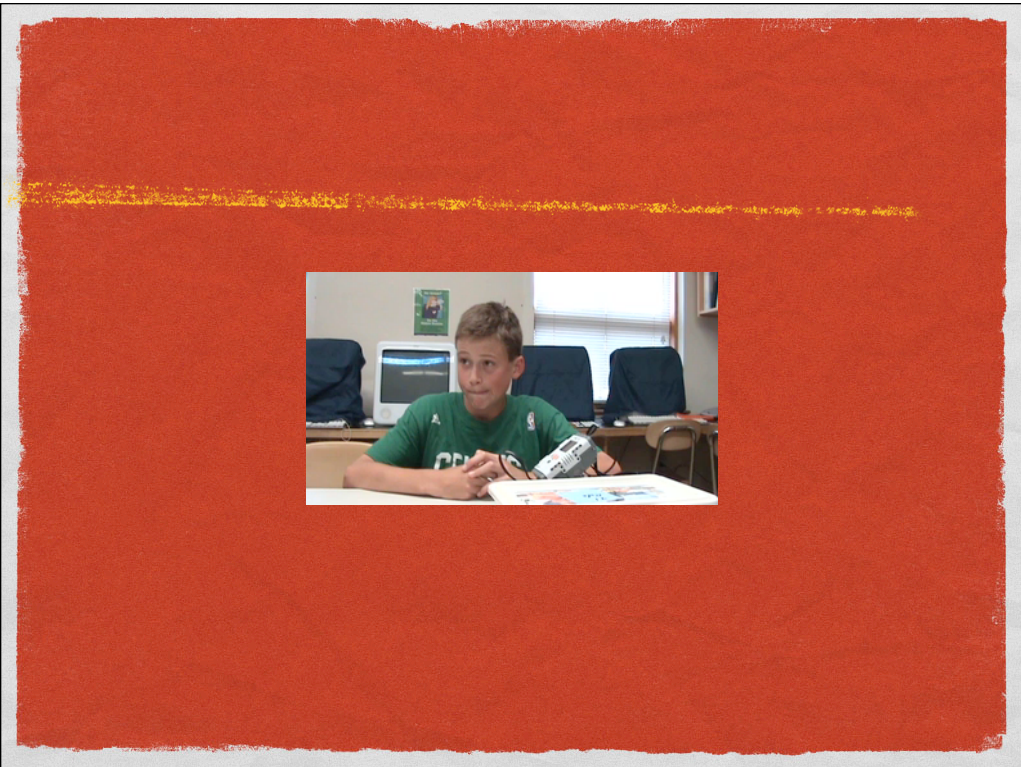
I like using computers and other technology.

Strongly Agree Agree Neither Agree or Disagree Disagree Strongly Disagree

Want to move the first question to the left so kids are not just consumers.

TEACHER INTERVIEW





DOCTOR OF EDUCATION PROGRAM

- UMASS AMHERST EDUCATION
- MATH, SCIENCE, AND LEARNING TECHNOLOGIES
- SURVEY METHODOLOGY
- RESEARCH IN MATH, SCIENCE, AND LEARNING TECHNOLOGIES

SEER GRANT

- Sustaining Elementary Engineering with Robotics
- 5 years, \$1.3M
- Holyoke, Williamsburg, Chesterfield-Goshen, Amherst, Westhampton
- Partners: Hampshire Regional, UMASS, Tufts CEEO, LEGO Education, Sage Fox Associates

SEER GRANT 2

- Curriculum development and PD
- Explore the impact of robotics-based engineering education on K-6 children's interest, motivation, and self-efficacy.
- Investigate K-6 students' understanding of core robotics, engineering, math, and science concepts using the engineering curriculum.
- Explore how the teachers' characteristics (e.g., content knowledge, interest in STEM) and their actual implementation of the engineering curriculum affect student achievement.

Resources

- jheffernan@hr-kl2.org
- <http://www.kidsengineer.com/>