

# Ends and Means

A Framework for

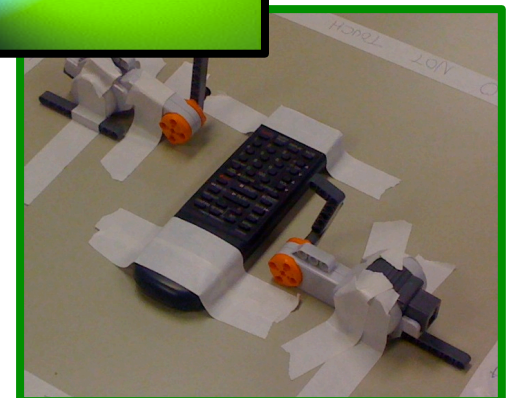
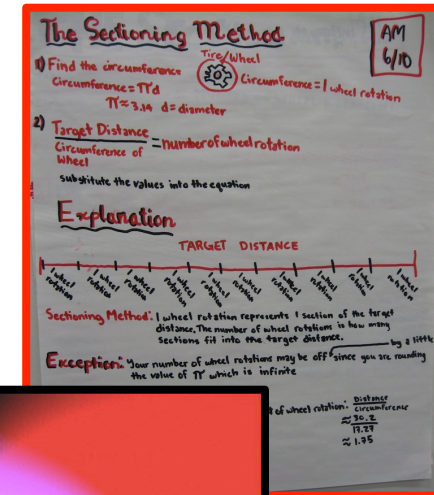
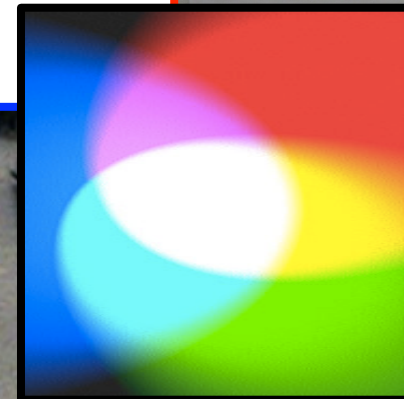
**DESIGN**, **MAKE**, and **PLAY**

Learning Activities

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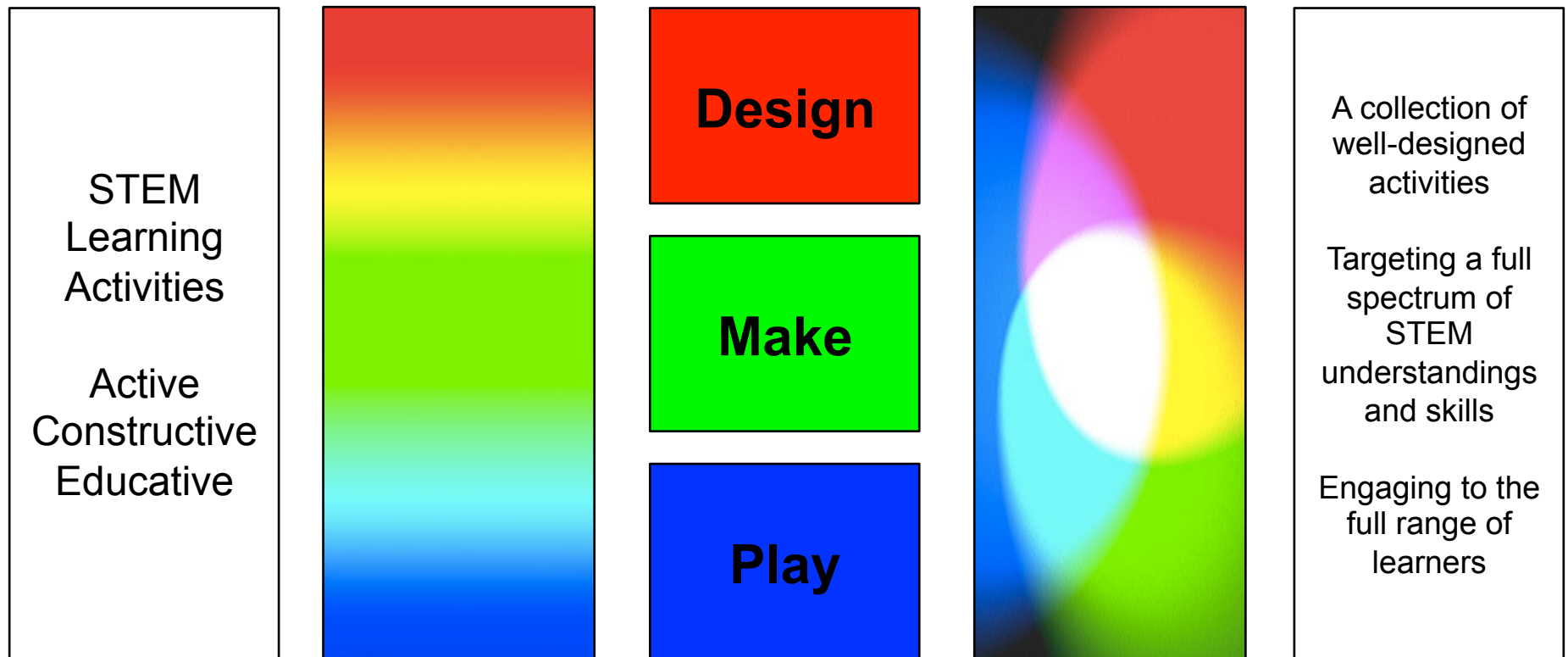
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Presentation at the *Design, Make, Play – Growing the Next Generation of Science Innovators* workshop at the New York Hall of Science, Queens, NY

# A Spectrum of Learning Activities

Framework → separate spectrum into components



→ guide principled design choices in isolation and in combination

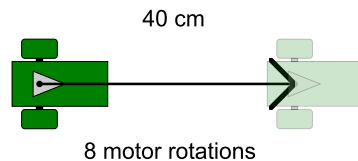


# An Illustrative Narrative Example

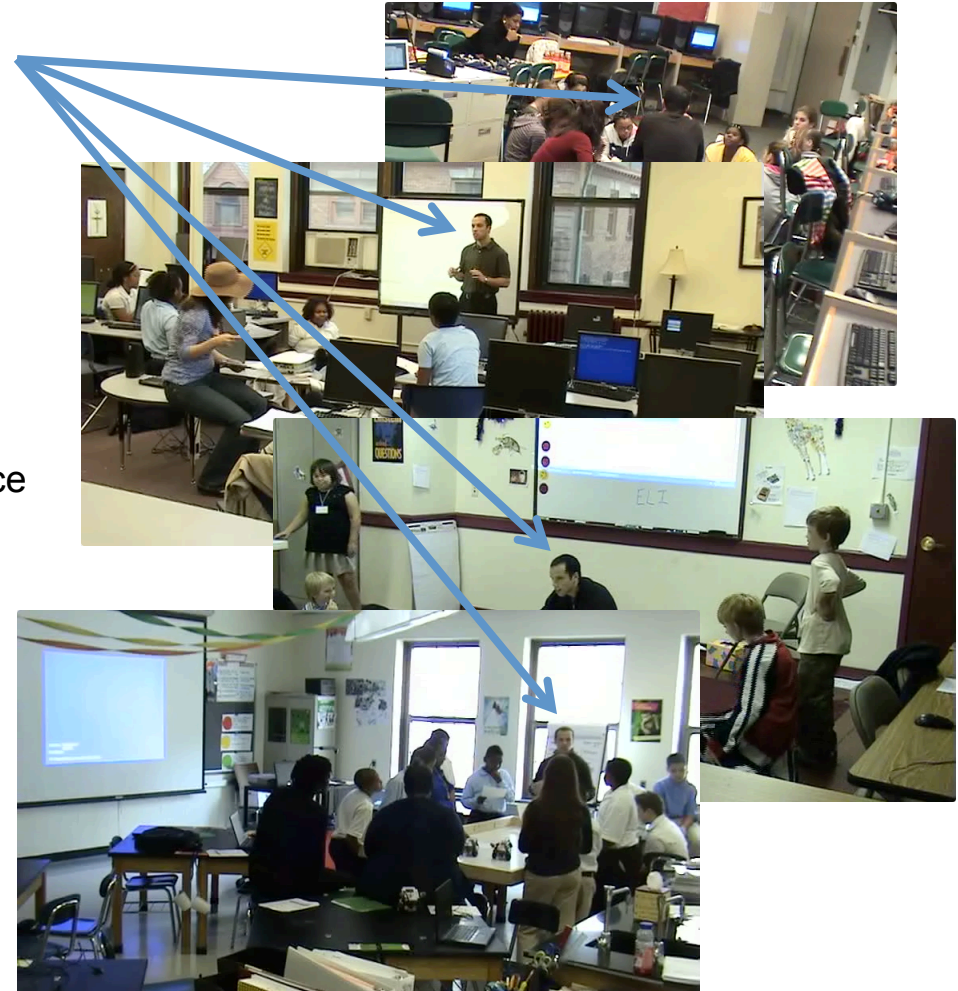
## Robot Synchronized Dancing (RSD)

- Series of design experiments
  - Range of settings
  - Iteratively revised
- Help students learn to control robot movements using math

Distance = Motor Rotations × Wheel Circumference

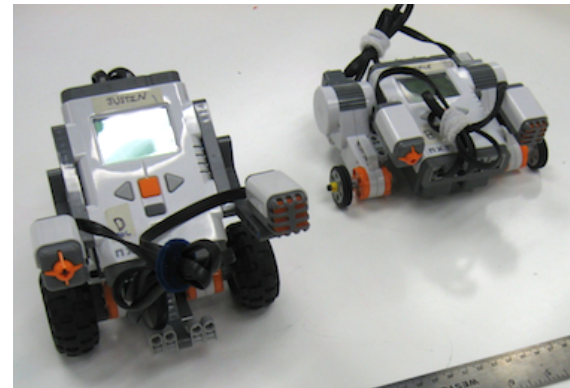


- Want learners to...
  - Have explicit understandings
  - Utilize systematic, analytical strategies (not guess & check)



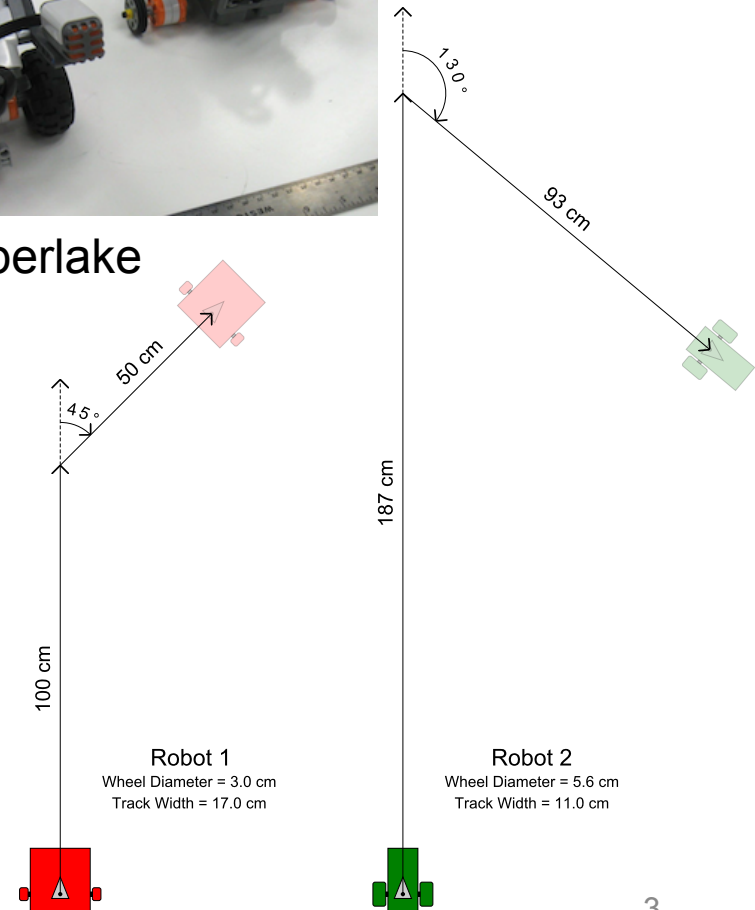
# RSD – An Initial Activity Design

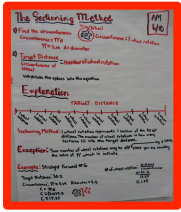
- Scripted Inquiry curriculum
  - Step-by-step verifications of the math
  - Lots of math activity, but disconnected from actual problem solving with robots
- Competition
  - Well-defined task, variable support
  - Lots of guess and check solutions tailored to the particular challenge
- Utilize a **DESIGN** problem to motivate learners to be systematic and to use math as a tool
  - Learners choose a short song and create their own dance
  - Challenge to get a different-size robot to do the dance in sync with the first



Madonna

Justin Timberlake





# DESIGN learning activities

## What is Design?

- “a purposeful, iterative process with an explicit goal governed by specifications and constraints”  
(Katehi, Pearson, & Feder, 2009)
- Different types of design
  - Focus here on engineering or technological design
- Not just hardware solutions, also software – plans, procedures, programs, and schedules (Benenson, 2001)

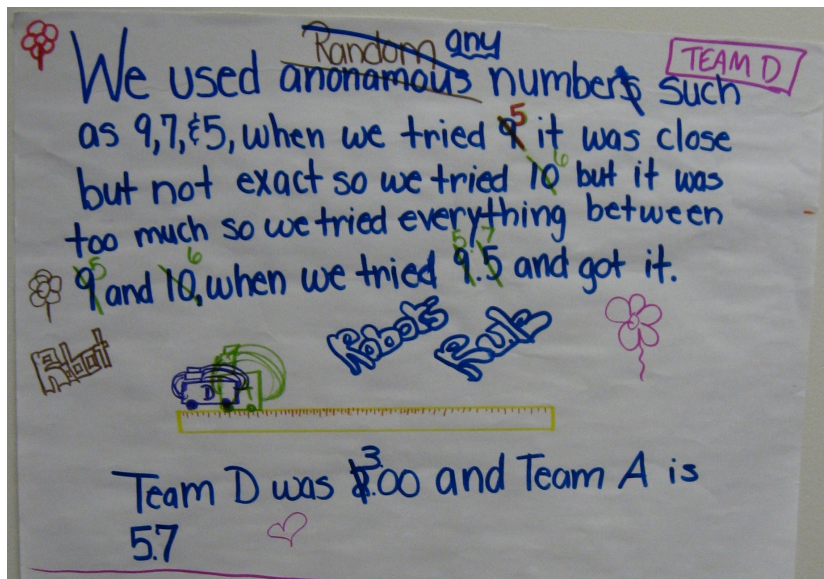
## Key Ideas

- Goals
  - Design is a “process”, but that process only makes sense in light of its goals
  - A working solution to a particular problem
- Processes
  - Understanding the problem and its constraints
  - Generating multiple solutions
  - Building and testing models
  - Analyzing solutions

# RSD – An Initial Activity Design

## Design Choices

- Utilize a **DESIGN** problem to motivate learners to be systematic and to use math as a tool
  - Learners choose a short song and create their own dance
  - Challenge to get a different-size robot to do the dance in sync with the first



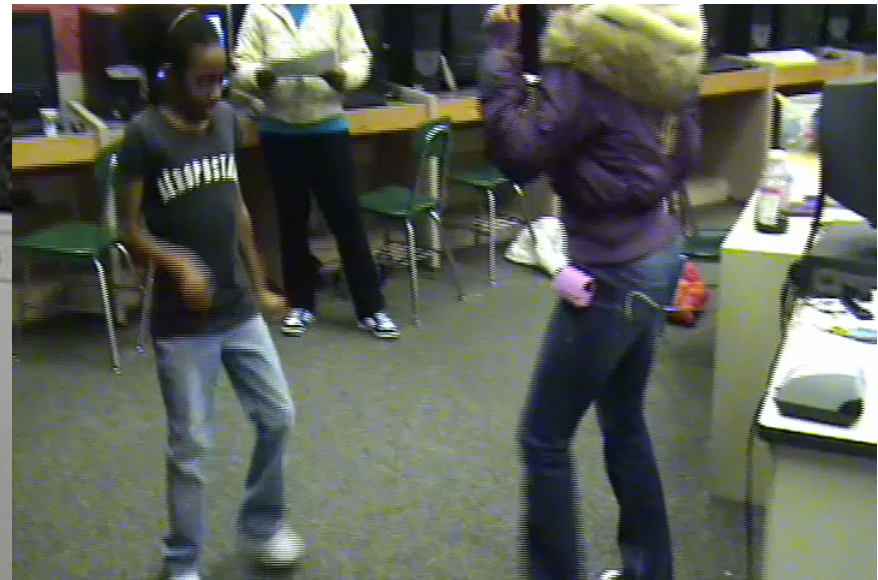
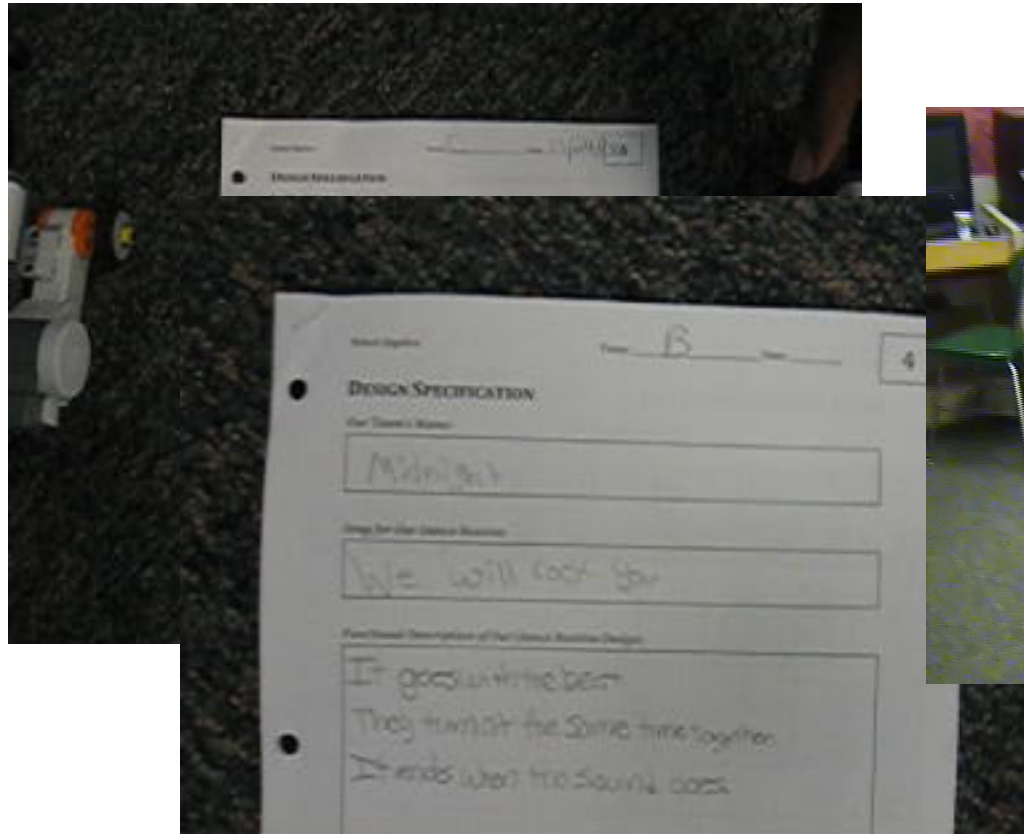
Design Make Play

## What Happened?

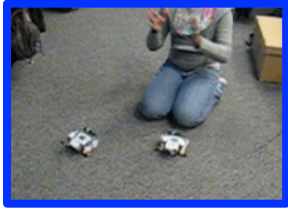
- Turned out to be 3 **different** activities
  1. Building their dance routines
    - Personalized, creative, and fun
  2. Measuring their movements
    - Lots of painful busy work
  3. Synchronizing to a different robot
    - Used mostly guess & test strategies
    - Learners saw the goal to be to design a single synchronized dance, not a general synchronizing strategy
- **DESIGN?** Sort of, but not ideal

# It Wasn't All Hard Work

- **Personal dances**
- **A lot of fun**



# PLAYING



# PLAY learning activities

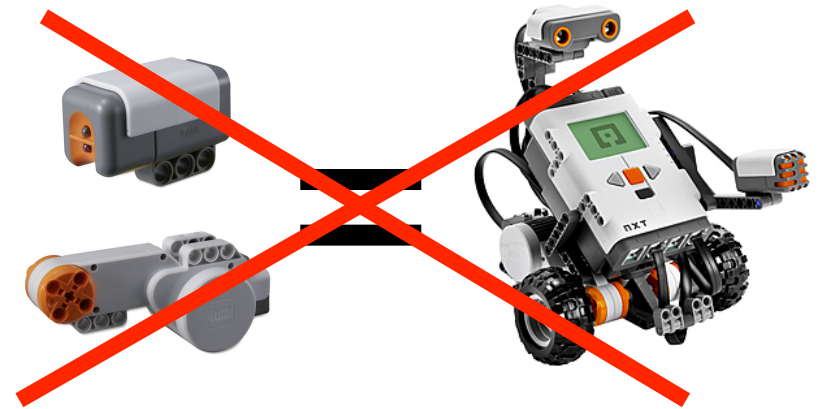
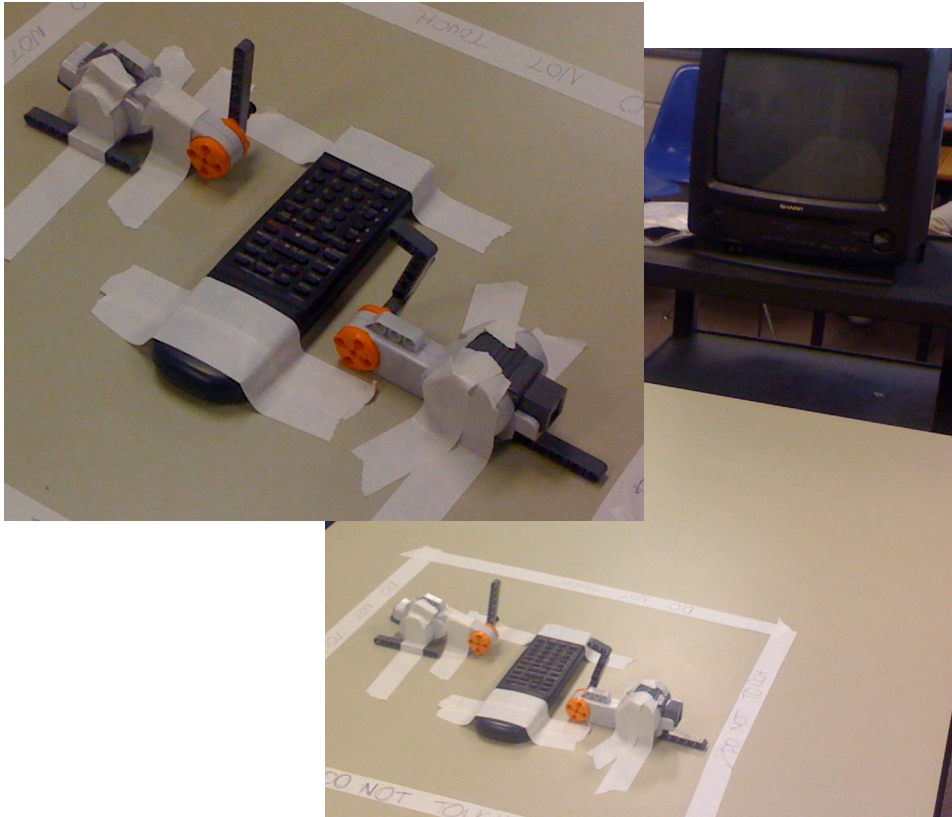
## What is Play?

- Activities that are “fun, voluntary, flexible, involve active engagement, have no extrinsic goals, and often contain an element of make-believe”  
(Fisher et al., 2011, p. 343)

## Key Ideas

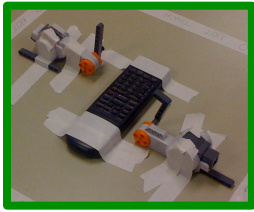
- Goals
  - No **extrinsic** goals
  - Yes **fun**
  - “mental attitude” (Dewey, 1990)
    - focused fully on own images and interests
- Processes
  - Minimally constrained so can flexibly pursue new directions
  - Lack of external judgment so can do things that might otherwise be unreasonable

# A Break in the Activity



- Transformative
  - Let's think about how to use these tools differently
- Personal
  - Let's use them however you want

# MAKING



# MAKE learning activities

## What is Making?

- Emphasis on getting things to work
- Exploratory tinkering
  - Manipulating objects **beyond their typical use**
- Tend to take on form of toolkits
  - Open source, use cheap and common materials
  - Built to encourage hacking and adapting

## Key Ideas

- Goals
  - Build things and figure out how
  - Driven by personal interests and concerns
- Processes
  - The doing is not just a means to an end, it has its own value
  - Doing isn't just cookbook doing, it is adapting and customizing
  - Share/open up the process so others can adapt

# RSD – Learning from My Experiences

## PLAY

← Take out!

Fun & engaging



- No more designing personal dance routines
  - Focus on **synchronization strategies** only
- Incorporate their interests
  - Cupid Shuffle and Justin Bieber

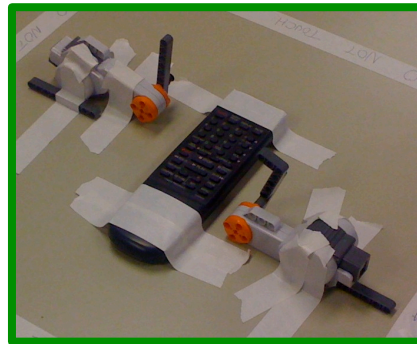
Designer



## MAKE

← Ignore!

Different thinking



- Didn't know what to make of it
  - Refocused on programming synchronized movements

Focused the **DESIGN** activity better

# RSD – Setting up the Problem

What it looks like when robots are “In-Sync”, the desired behavior



# RSD – Focusing the Problem

Illustrating robots “Out-of-Sync”, setting the task as adjusting programs



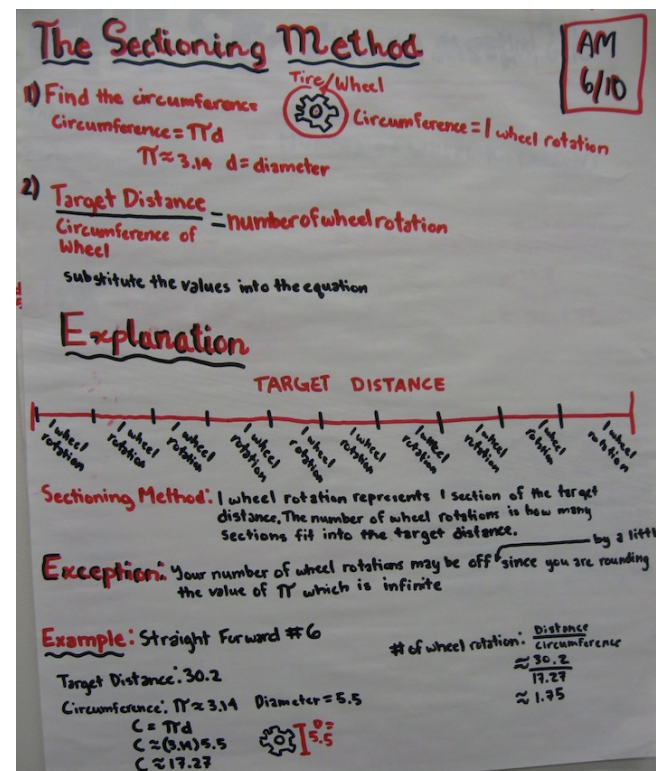
# RSD – Revising the Activity

## Design Choices

- Given robots and dance routine
  - Immediate focus on synchronization
  - Can personalize solution designs, **not** dance designs
- Incorporate their interests
  - Dancing, popular songs and artists
  - Maintain a reasonable level of interest
- A **DESIGN** activity
  - Focused on a well-defined and explicit, but also general, problem
    - Clear observable criteria for success
    - Motivated learning about and explaining how the robots work more generally
  - Reasonably engaging, but not fun

## What Happened?

- Developed sophisticated strategies in the first cycle (not guess & test)
  - And better ones in the second cycle
- Used math as a tool for modeling, analysis, and explanation



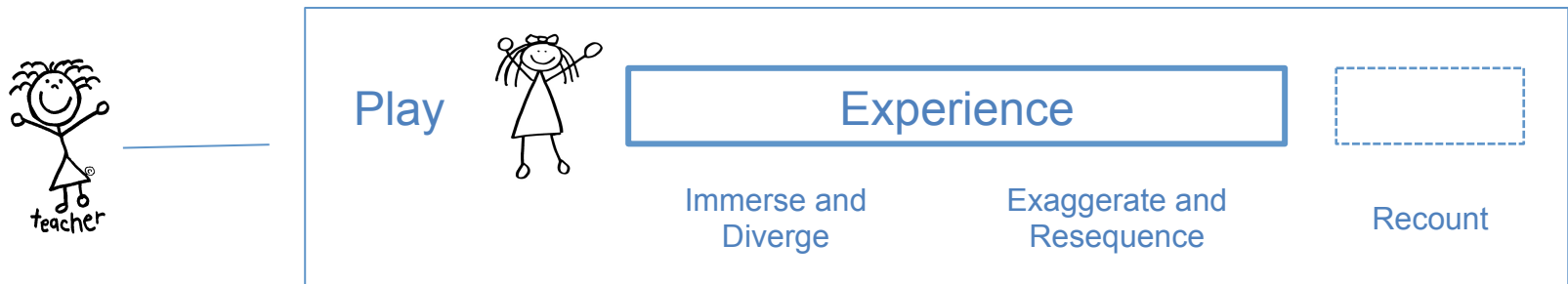
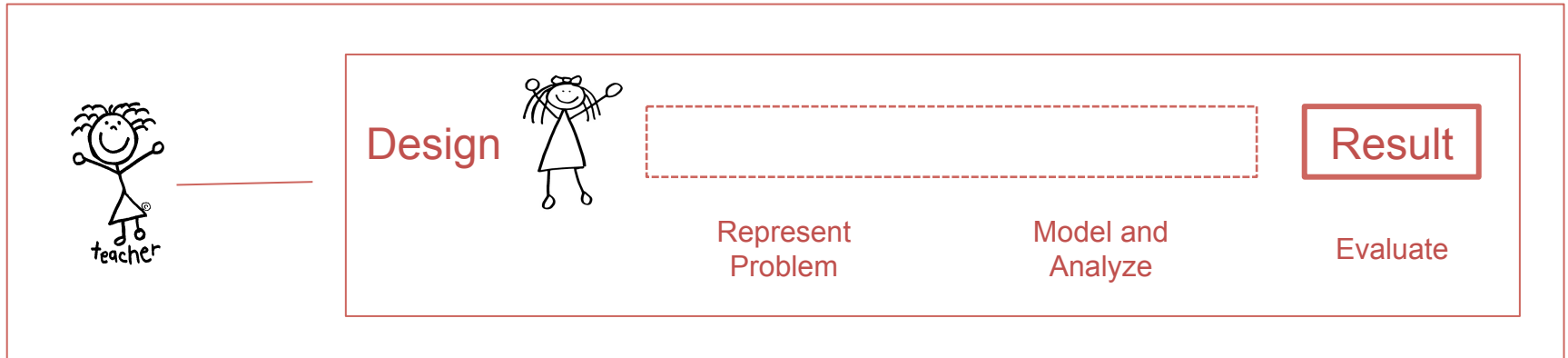
# Learning Activities

- **DESIGN**
  - An explicit goal governed by specifications and constraints leading to a purposeful, iterative solution **process** (Katehi, Pearson, & Feder, 2009)
- **MAKE**
  - Personalizing through transformation and reinvention (Margaret Honey)
- **PLAY**
  - Active engagement through fun, voluntary, and **flexible activity** (Fisher et al., 2011)

Designer



# Illustrating the Framework



# Key Points of the Framework

- What the learner thinks of as the point of the activity matters (**goals**)
  - Facilitators/developers (the adults who design the activities) influence these goals, but not always in direct and straightforward ways
- These goals are the drivers of what the learners do in the activity (**processes**)
  - Their goals affect how they approach the activity, which of their own conceptual and strategic resources they draw on, how they judge their success, and how they sustain their involvement

# Diverse Forms of “Learning Activities”

How can they complement each other?

- **From stages to styles** (Turkle & Papert, 1990)
  - “We differ from Piaget on an important point, however. Where he saw diverse forms of knowledge in terms of stages to a finite end point of formal reason, we see different approaches to knowledge as styles, each equally valid on its own terms.”
- **From styles to resources and frames** (Hammer et al., 2005)
  - Resources are “mini-generalizations from experience whose activation depends sensitively on context.”
  - “By a ‘frame’ we mean ... a set of expectations an individual has about the situation in which she finds herself that affect what she notices and how she thinks to act”
  - Encourage learners to build a range of resources that they can activate flexibly as appropriate

# I AM A MAKER.

I THINK WORK SHOULD BE ABOUT MAKING THINGS WORK. BETTER. FASTER. SMALLER. SMARTER. SO I BUILD BRIDGES BETWEEN WHAT'S KNOWN AND WHAT'S NOT. I TINKER. I TOIL. I WRITE POETICALLY IN AN ABUNDANCE OF LANGUAGES (INCLUDING CODE). I HACK. I DISSECT. I HAVE AN INSATIABLE DESIRE TO UN-COMPLICATE THE COMPLICATED. I AM EASILY INSPIRED. I BELIEVE THAT JUST BECAUSE IT HASN'T BEEN THOUGHT OF DOESN'T MEAN IT WON'T BE. POTENTIAL IS MY THRILL RIDE. IMAGINATION IS MY MOST-USED TOOL. **I AM A MAKER. AND I AM WHAT MOVES THE WORLD FORWARD.**

**WE ARE PURDUE.**  
**MAKERS, ALL.**



# I AM A DESIGNER.

I BUILD **DESIGN** LEARNING ACTIVITIES.

- Building the framework helped me understand my **design choices**
- **Not** advocating for design only
- I appreciate much more the diversity that exists and I want to **know more**

# WHAT DO YOU DO?

WHAT **KIND** OF LEARNING ACTIVITIES DO YOU BUILD?

HOW DO YOU MAKE YOUR ACTIVITY **DESIGN CHOICES**?

WHAT ARE THE **GOALS** THAT YOUR LEARNERS HAVE?

WHAT ARE THE **PROCESSES** THAT YOUR LEARNERS USE TO MEET THEIR GOALS?

Thank You

Questions?

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# References

- Benenson, G. (2001). The unrealized potential of everyday technology as a context for learning. *Journal of Research in Science Teaching*, 38(7), 730-745. doi: 10.1002/tea.1029
- Dewey, J. (1990). Froebel's educational principles. *Elementary School Record*, 1(5), 143-151.
- Fisher, K., Hirsh-Pasek, K., Golinkoff, R. M., Singer, D. G., & Berk, L. (2011). Playing around in school: Implications for learning and educational policy. In A. Pellegrini (Ed.), *The Oxford Handbook of Play* (pp. 341-363). New York: Oxford University Press.
- Hammer, D., Elby, A., Scherr, R. E., & Redish, E. F. (2005). Resources, framing, and transfer. In J. P. Mestre (Ed.), *Transfer of Learning from a Modern Multidisciplinary Perspective* (pp. 89-119). Greenwich, CT: Information Age Publishing.
- Katehi, L., Pearson, G., & Feder, M. (Eds.). (2009). *Engineering in K–12 Education: Understanding the Status and Improving the Prospects*. National Academies Press: Washington DC.
- Turkle, S., & Papert, S. (1990). Epistemological pluralism: Styles and voices within the computer culture. *Signs*, 16(1), 128-157.