Welcome & Overview

- CATALST Project
- Try an MEA: The iPod Shuffle Activity
- What is an MEA?
- How do MEAs compare to other activities?
- Follow-Up Activities
- Research foundation for MEAs
CATALST Project: Proposed Goals & Materials

• Develop new curriculum based on research and Cobb (2005, 2007) ideas, NSF projects
• Interesting, complex and current problems and data
• Radical content, radical pedagogy
• GAISE Goals for student outcomes
• Research, assessment, and evaluation components
Form groups of three to four

- Part 1: Read article and answer questions individually
- Part 2: Work as a group, develop set of rules
- Part 3: Test the rules with new data
- Part 4: Present solutions
Model Eliciting Activities (MEAs) are activities that
• Encourage students to invent and test models
• Pose open-ended problems
• To solve complex, real-world problems.
• Engage students in statistical reasoning and thinking
• Provide a means to better understand students' thinking.
Six Principles of MEAs (pp 8-9)

- **Model construction principle**: Problems must be designed to allow for the creation of a model dealing with patterns and rules governing these relationships.

- **The reality principle**: problems must be meaningful and relevant to the students and be based on real or slightly modified real data. The solution should be “real” and meaningful in the students’ everyday lives.

- **Self-assessment principle**: students must be able to self-assess or measure the usefulness of their solutions. The problem statement must strongly suggest appropriate criteria for assessing the usefulness of a solution. These criteria should promote selection, refinement, and elaboration of models.
Six Principles of MEAs (p 9)

• **Model documentation principle**: students must be able to reveal and document their thinking processes within their solution.

• **Model share-ability and reusability principle**: solutions created by students should be generalizable or easily adapted to other situations and usable by others. The model should represent a general way of thinking instead of a specific solution for a specific context.

• **Effective prototype principle**: ensures that the model produced will be as simple as possible yet still mathematically significant. The model should provide a useful prototype or metaphor for interpreting other situations (i.e., reusability). The activity should be designed to avoid the need for numerous procedures, especially computational procedures, that can circumvent conceptual understanding.
Comparison of MEAs to Activities (p 10)

- May use only a few throughout course
- Based on real situation and data
- Set foundation for conceptual learning
- No correct solution
  - Open-Ended
  - Can lead to many solutions and conclusions
- Promote group thinking and classroom discourse
iPod Shuffle Lesson Plan (pp 11-13)

- People’s intuitions about random events and randomly generated data are often incorrect or misleading.
- Focuses students’ attention on describing characteristics of random sequences.
- Introduction to ideas of randomness, random sequences and random samples.
Follow-Up Activity (pp 15-17)

One Son Modeling Activity

• Provides another opportunity to explore randomness, random samples and random sequences
• Extends iPod Shuffle MEA by introducing students to simulations
• Develops informal ideas about hypothesis testing
Other MEAs (p 19)

- Measuring Study Effectiveness
- Judging a Paper Airplane Contest
- Creating a SPAM Filter
- Identifying a Theft Suspect
- Judging Airlines

All can be found at
http://serc.carleton.edu/sp/library/mea/examples.html
Principles of Learning
(Lovett & Greenhouse, 2000)

- Learning occurs by integrating new knowledge with prior knowledge
- Students learn best what they practice on their own
- Knowledge tends to be specific to the context in which it is learned
- Real-time feedback is necessary for effective and efficient learning
- Learning becomes less efficient as mental load increases
Design Principles
(Cobb & McClain, 2004)

To develop students' statistical reasoning, activities should:

• Have students make conjectures about data that can be tested.
• Focus on central statistical ideas.
• Build on the investigative spirit of data analysis.
• Build on the range of data-based arguments that students produce.
• Develop students’ reasoning about data generation as well as data analysis.
• Integrate the use of technological tools to support students’ development of statistical reasoning and allow them to test their conjectures.
• Promote classroom discourse that includes statistical arguments and sustained exchanges that focus on significant statistical ideas.
• Challenge students to invent a method for a task that they do not have an immediate procedure for solving.
• Students create a new mental framework that relates two or more pieces of knowledge that are internally inconsistent.
Invention for Transfer: An Example (Schwartz et al., 2007)

**GOAL:** Invent a way to measure variability

**DATA:** Shot from a pitching machine

**TASK:** Invent a method to compute a measure of reliability (or accuracy) for each machine, to determine which one to buy
Use of task

• Prepares students to learn and appreciate the standard deviation as a measure of reliability/accuracy
Invention for Transfer: Instructional Model (Schwartz, 2004)

• Students solve carefully designed problems that:
  – Promote development of mental frameworks for connecting information
  – Prepare students to learn canonical solutions used in the discipline

• Research shows improved retention and transfer when using this approach
Prior Knowledge
(Schwartz, Sears, & Chang, 2007)

- Students’ prior knowledge and intuitions conflict with new learning
- Replacing this with new knowledge does not lead to better understanding of the concept
- Need for learning activities that help students work through inconsistencies in their prior knowledge and intuitions
MEAs: General Research Results

• Model-eliciting activities can be designed so that they lead to significant forms of learning (Lesh et al., 2000)
• Dramatic and positive results have been found in mathematics and engineering education (Moore, Diefes-Dux, & Imbrie, 2007, 2006; Diefes-Dux, Imbrie, & Moore, 2005; Zawojewski, Bowman, & Diefes-Dux, in press)
Thank You for Your Participation

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