



# Exploring Technology- Enhanced Active Learning in Physics Teacher Education Part 1/2

Marina Milner-Bolotin, Heather Fisher & Alexandra  
MacDonald

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AAPT 2014 Orlando, Florida



# Modeling Active Engagement in Teacher Education

1. What are your **reasons for choosing active engagement pedagogies** in physics teacher education courses?
2. How do you know if these pedagogies are **having a positive impact** on teacher-candidates?
3. What is the **role of technology** in this process?

# Technology-Enhanced Active Engagement

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EDCP357 (Winter 1, 2013)

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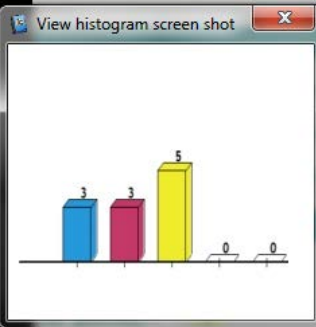
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### The Monty Hall Problem: Let Us Make a Deal

- A. Stick with the original choice
- B. Swap doors
- C. It doesn't matter



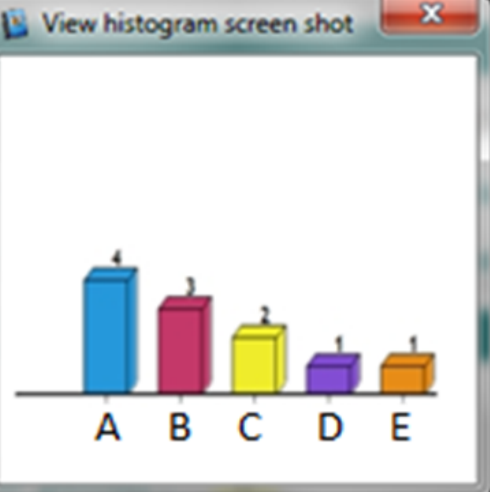
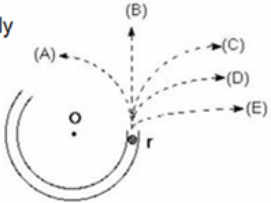
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### Question

A ball travels through the circular track until point  $r$ , at which point it leaves the channel to travel across a frictionless floor. Assume a bird's eye view, and that all motion is in the horizontal plane.

Which path will the ball most closely follow after it exits the channel?



A B C D E

# Research-Based Objectives

Investigate the effect of Active Engagement (AE) on teacher-candidates' (TCs') epistemologies

Explore a possible mechanism for AE pedagogy

Model AE in the context of the course content



# Course-Based Objectives

Experience learning science through AE

Value conceptual knowledge

Evaluate/develop resources that match TCs' values

Create a long-term connection with UBC community

# Math & Science Teaching & Learning through Technology



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## Teacher Education

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THERMODYNAMICS

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WAVE MOTION AND OPTICS

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CREATE  
Community to Reimagine Educational Alternatives for Teacher Education

CREATE is a faculty-wide initiative established by [Dr. Rita Irwin](#), Associate Dean of Teacher Education programs, to inspire innovations in teacher education at UBC.

Seminars are held in [Neville Scarfe, Room 310](#) from 12:30 – 2:00 p.m. (unless otherwise noted).

### Presentation about MSTLTT Project

On October 16th Dr. Marina Milner-Bolotin was invited to present a seminar to faculty and students at UBC Teacher Education Program

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# Navigating the Resource



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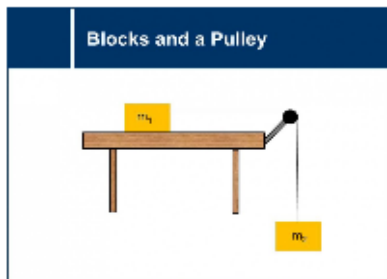
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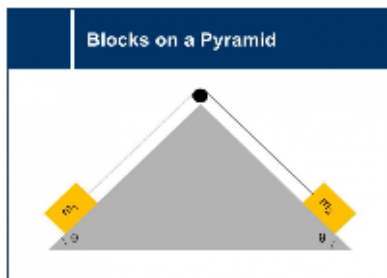
## FORCES



Exploration of free body diagrams, two body acceleration, and Newton's law through the system of two blocks attached through a pulley and one of them resting on a table.

[acceleration](#), [forces](#), [friction](#), [Newton's laws](#), [pulleys](#), [string tension](#)

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Exploration of free body diagrams, two body acceleration, and newton's laws through the system of two blocks resting on a pyramid and attached by a pulley.

[acceleration](#), [forces](#), [friction](#), [gravitational acceleration](#), [net force](#), [normal force](#), [weight](#)

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+ Mathematics

- Physics

» Vectors

+ Kinematics

- Dynamics

» Forces

» Springs

» Newton's Laws

+ Momentum

» Work,Energy,Power

» Thermodynamics

» Circular Motion

» Gravitation

» Wave motion and Optics

» Particle and Nuclear Physics

# Navigating the Resource



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**Cruising Car**

A diagram showing a light blue car moving to the right. An arrow points to the right from the car, labeled "60 km/h".

An introduction to acceleration and newton's laws using a demonstration of a commuting car.  
[acceleration](#), [displacement](#), [distance](#), [forces](#), [net force](#), [velocity](#)

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**Weight in an Elevator**

A graph showing force (F) on the y-axis and time (t) on the x-axis. The force fluctuates around a mean value. To the right of the graph is a scale with a weight on it, labeled "kg" and "a = ?".

How does a reading on a scale change when on a moving elevator? Scenarios with an elevator moving at different velocities and acceleration will be considered. The concepts learned will then be used to analyze data from a real-life experiment.  
[acceleration](#), [gravitational acceleration](#), [mass](#), [net force](#), [normal force](#), [real-life data](#), [velocity](#), [weight](#)

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**Tension Forces**

The following set of questions apply Newton's Second Law to scenarios with multiple blocks held together by the tension force from strings.

[acceleration](#) [area](#) [centripetal force](#) [common ratio](#)  
[conservation of energy](#) [conservation of momentum](#) [Conversion Factors](#) [counting](#) [current](#)  
[displacement](#) [distance](#) [elastic collisions](#) [forces](#)  
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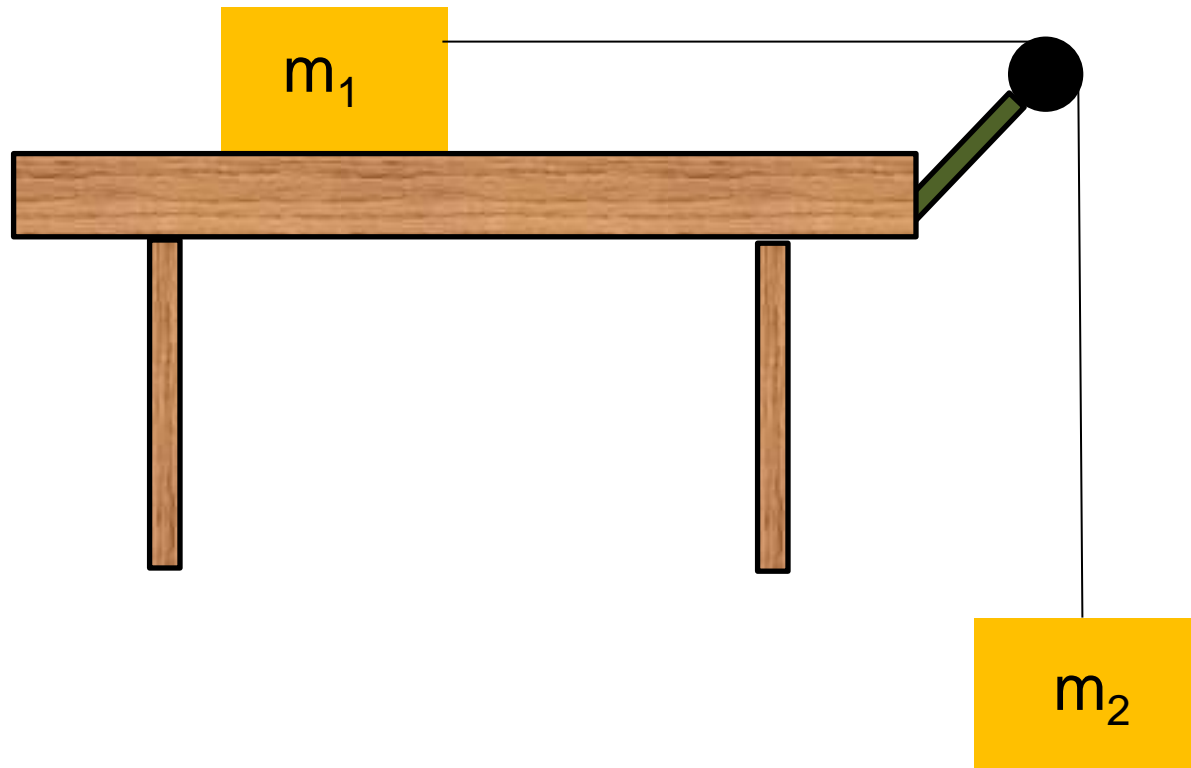


# Integrating into the Classroom

Instructor modeling  
AE pedagogy

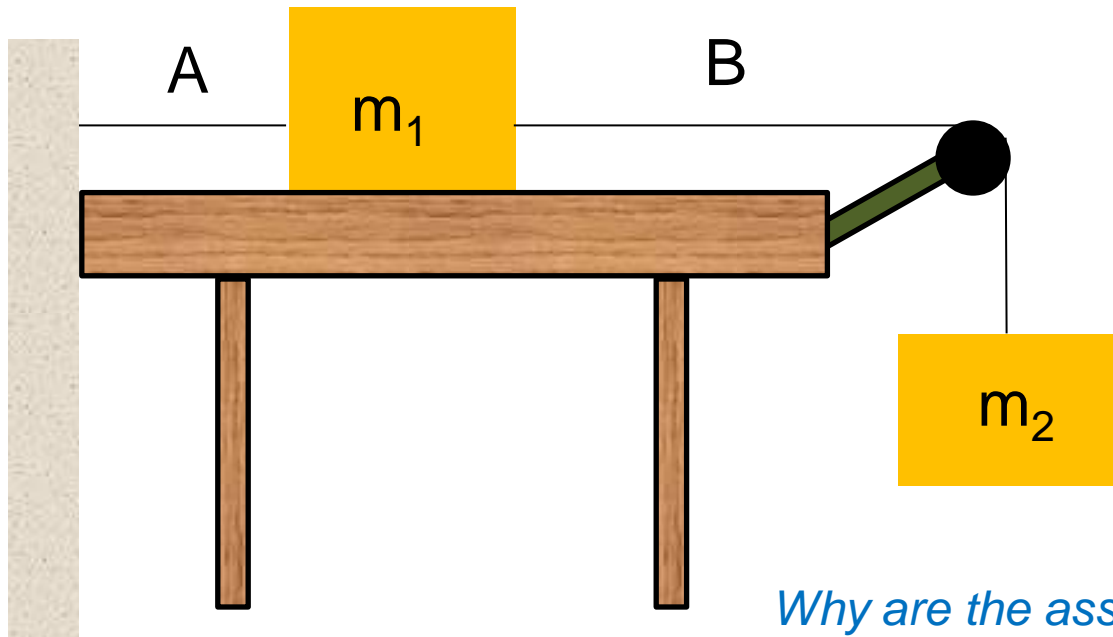
TCs experience  
developing  
questions

# Blocks and a Pulley



# Blocks and a Pulley II

Two blocks are connected via a pulley. The blocks are initially at rest as block  $m_1$  is attached to a wall. If string A breaks, what will the accelerations of the blocks be? (**Assume** friction is very small and strings don't stretch)



- A.  $a_1 = 0; a_2 = 0$
- B.  $a_1 = g; a_2 = g$
- C.  $a_1 = 0; a_2 = g$
- D.  $a_1 = g; a_2 = 0$
- E. None of the above

*Why are the assumptions above important?*

# Solution

**Answer:** E

**Justification:** None of the above answers is correct. Consider two blocks as one system: one can see that the system has a mass of  $(m_1+m_2)$ , while the net force pulling the system down is  $m_1g$ . Therefore, applying Newton's second law, one can see that the acceleration of the system must be less than  $g$ :

$$a = \frac{m_2g}{(m_1 + m_2)} = \frac{m_2}{(m_1 + m_2)} g < g$$

Some people think that the acceleration will be  $g$ . They forget that the system consists of two blocks (not just  $m_1$ ) and the only pulling force is  $m_1g$ . Thus the system is NOT in a free fall. Compare this questions to the previous one to see the difference.



# Integrating into the Classroom

Instructor modeling  
AE pedagogy

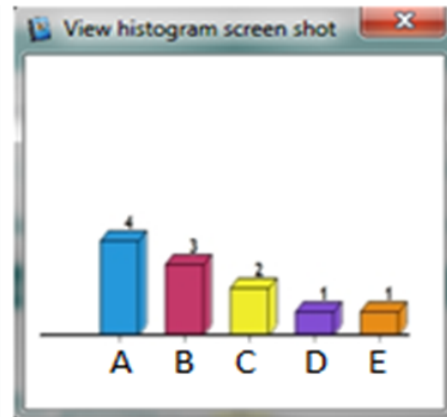
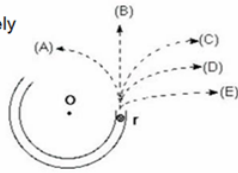
TCs experience  
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# Technology-Enhanced Active Engagement Integration

## Question

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**PI modeled in every class**

**PW used to design, critique, respond to Conceptual Questions as a community of future teachers**

# Resources

- Beatty, I., Gerace, W., Leonard, W., & Defresne, R. (2006). Designing Effective Questions for Classroom Response System Teaching. *American Journal of Physics*, 74(1), 31–39.
- CWSEI Clicker Resource Guide: An Instructors Guide to the Effective Use of Personal Response Systems (Clickers) in Teaching. (2009, June 1).
- Lasry, Nathaniel. (2008). Clickers or Flashcards: Is There Really a Difference? *The Physics Teacher*, 46(May), 242-244.
- Milner-Bolotin, Marina. (2004). Tips for Using a Peer Response System in the Large Introductory Physics Classroom. *The Physics Teacher*, 42(8), 47-48.
- Mishra, P., & Koehler, M. J. (2007). Technological pedagogical content knowledge (TPCK): Confronting the wicked problems of teaching with technology. In *Society for Information Technology & Teacher Education International Conference* (Vol. 2007, pp. 2214–2226). Retrieved from <http://www.editlib.org/p/24919/>