



*November 22, 2018*



# Innovative Technology Use in STEM Teacher Education

**Dr. Marina Milner-Bolotin**

**UBC Department of Curriculum and Pedagogy**

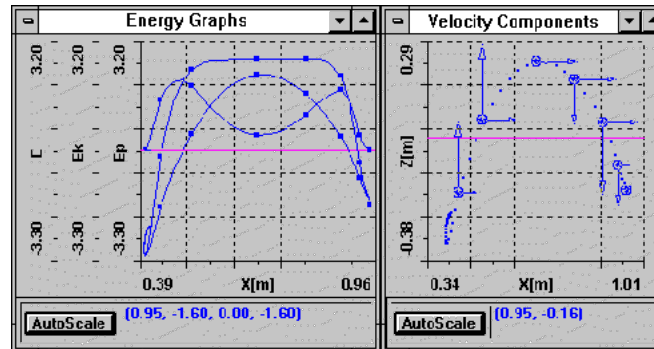
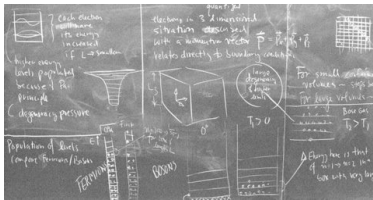
# Dr. Marina Milner-Bolotin



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Website: <http://blogs.ubc.ca/mmilner/>



# My Math & Science Education Trajectory



V-scope





# University of British Columbia



**16,188 international students  
from 140+ countries!**

## UBC Facts

- Public Uni. Est 1908
- 2 campuses: Vancouver & Kelowna
- ~65,000 students
- Academic staff: 5470+
- Acceptance rate: 64%
- Intern. ranking – 34<sup>th</sup> (U.S. News & World Rep. 2018) <sup>4</sup>



# Teacher Education in Canada

PHYSICS AND EDUCATION

## PROMOTING RESEARCH-BASED PHYSICS TEACHER EDUCATION IN CANADA: BUILDING BRIDGES BETWEEN THEORY AND PRACTICE

BY MARINA MILNER-BOLOTIN

**M**ore than 25 years ago, Lee S. Shulman, then president of the American Educational Research Association<sup>[1]</sup>, challenged us to re-think how we prepare teachers through focussing on *Pedagogical Content Knowledge* (PCK) - the knowledge of content and content-specific pedagogies. Shulman pointed out that in their attempt to incorporate generic educational research, many Teacher Education Programs suffered from the “missing paradigm” problem. They neglected the nature

content-specific professional development, teacher education programs should emphasize the development of teacher-candidates’ PCK.

Lastly, there is a significant gap between the findings of Physics Education Research (PER)<sup>[4]</sup> and current physics teaching practices. In the words of a  
Laureate, Prof. Carl Wieman

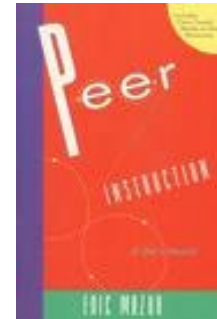


[Physics in Canada, 70(2), 99-101]

# 5 Workshop Goals

To introduce you to:

1. Peer Instruction & Peer Wise



2. PhET Computer Simulations

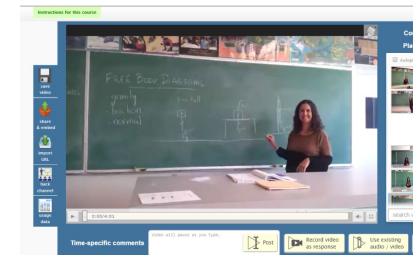


3. Data collection and analysis tools



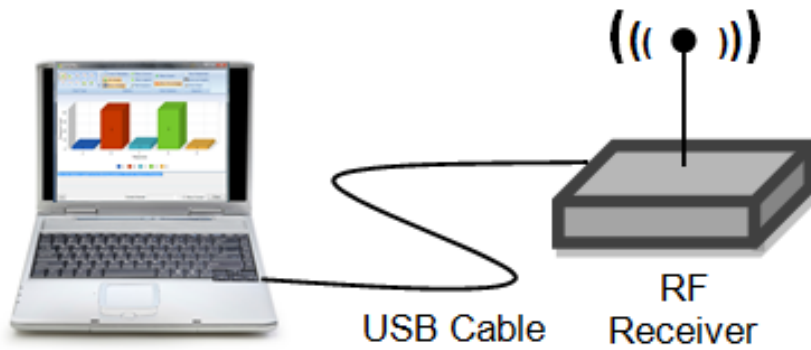
4. Collaborative Learning Annotation System

5. Video Production of STEM demos



# 1

# Peer Instruction



Clickers used by the students

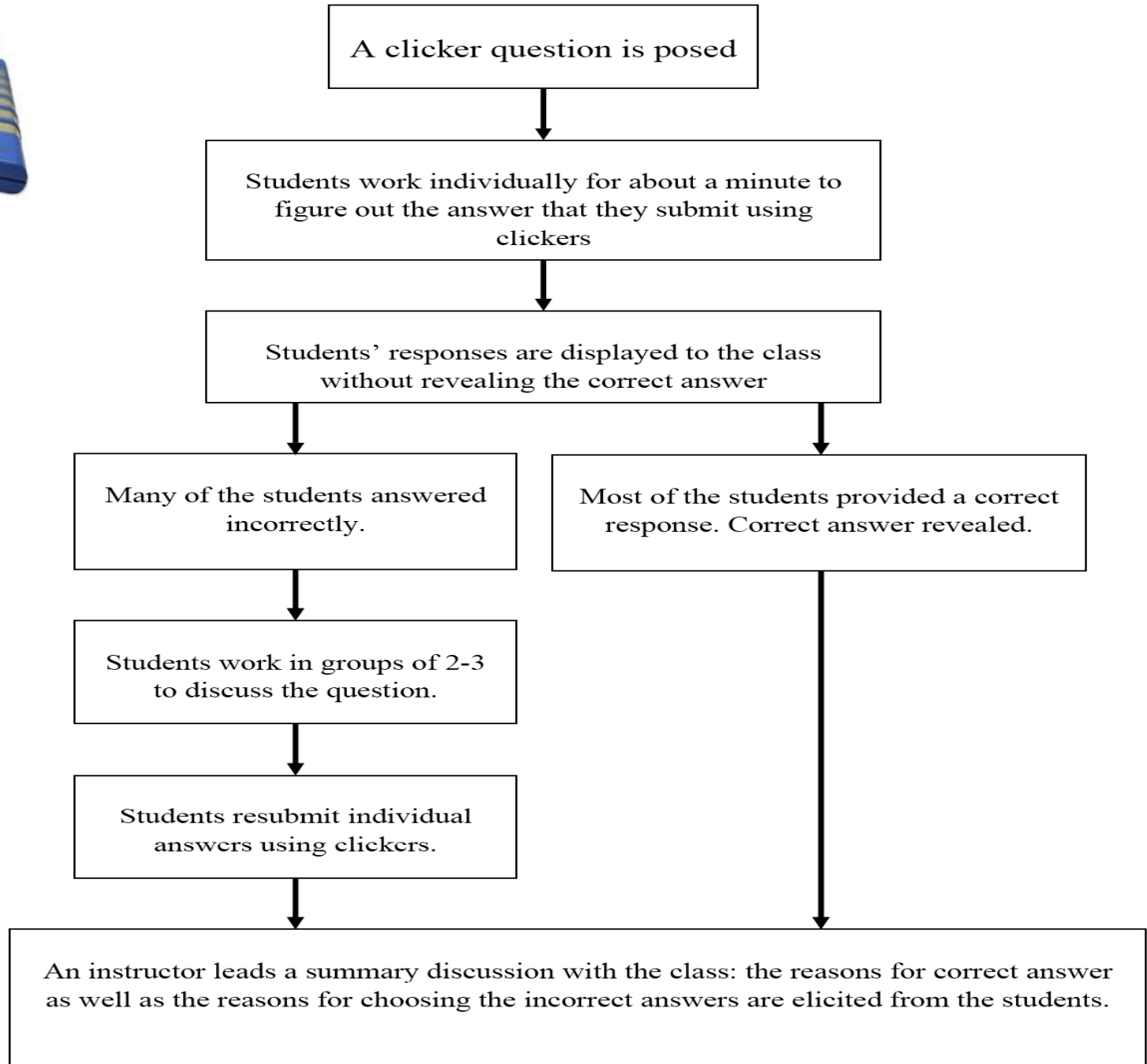
Software installed on the teacher's computer connected to a classroom projector



In near future smart phones, i-pads and other devices will replace clickers, **but the basic pedagogy will remain the same...**



# Peer Instruction





LUMAT 1(5), 2013

## Modeling Active Engagement Pedagogy through Classroom Response Systems in a Physics Teacher Education Course

Marina Milner-Bolotin

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Heather Fisher

Department of Curriculum and Pedagogy, Faculty of Education, The University of British Columbia

Alexandra MacDonald

Department of Curriculum and Pedagogy, Faculty of Education, The University of British Columbia

**Abstract** One of the most commonly explored technologies in Science, Technology, Engineering, and Mathematics (STEM) education is Classroom Response Systems (CRS). In this study, we explore how instructors generate in-class discussion by soliciting student responses using CRS.

# Clickers & Active Learning

[2004, *The Physics Teacher*, 42(8), 47-48]

## Tips for Using a Peer Response System in a Large Introductory Physics Class

*Marina Milner-Bolotin*, Physics and Astronomy Department, Rutgers, The State University of New Jersey  
Piscataway, NJ 08854-8019; milnerm@physics.rutgers.edu

### Clickers beyond the First Year Science Classroom

Marina Milner-Bolotin

Tetyana Antimirova

Anna Petrov

[2010, *Journal of College Science Teaching*,  
40(2), 18-22]

Teach  
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### Abstract:

This case study's primary objective is to describe the implementation of the electronic response-system (clickers) in a small (N=25) second

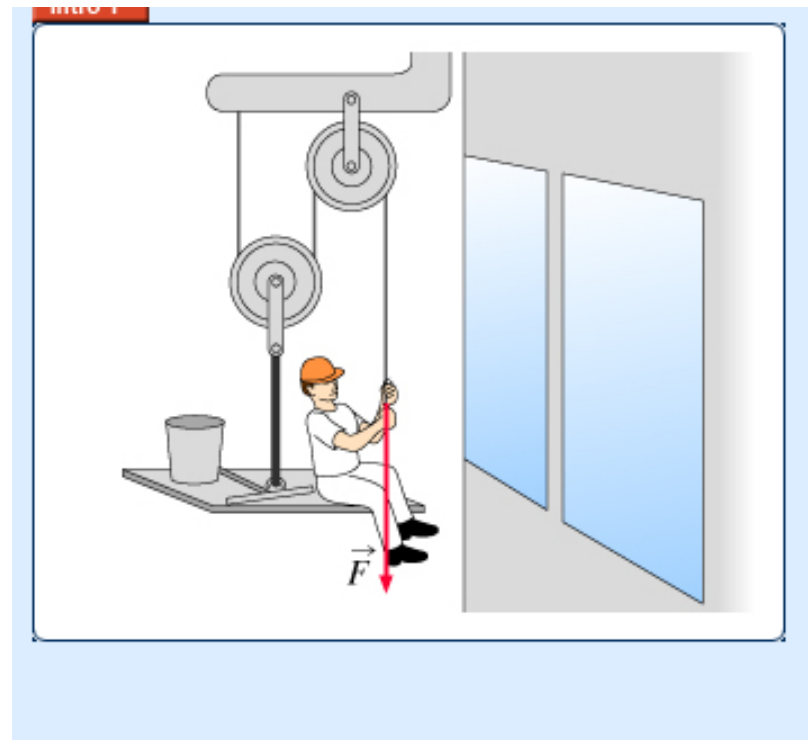


## 1

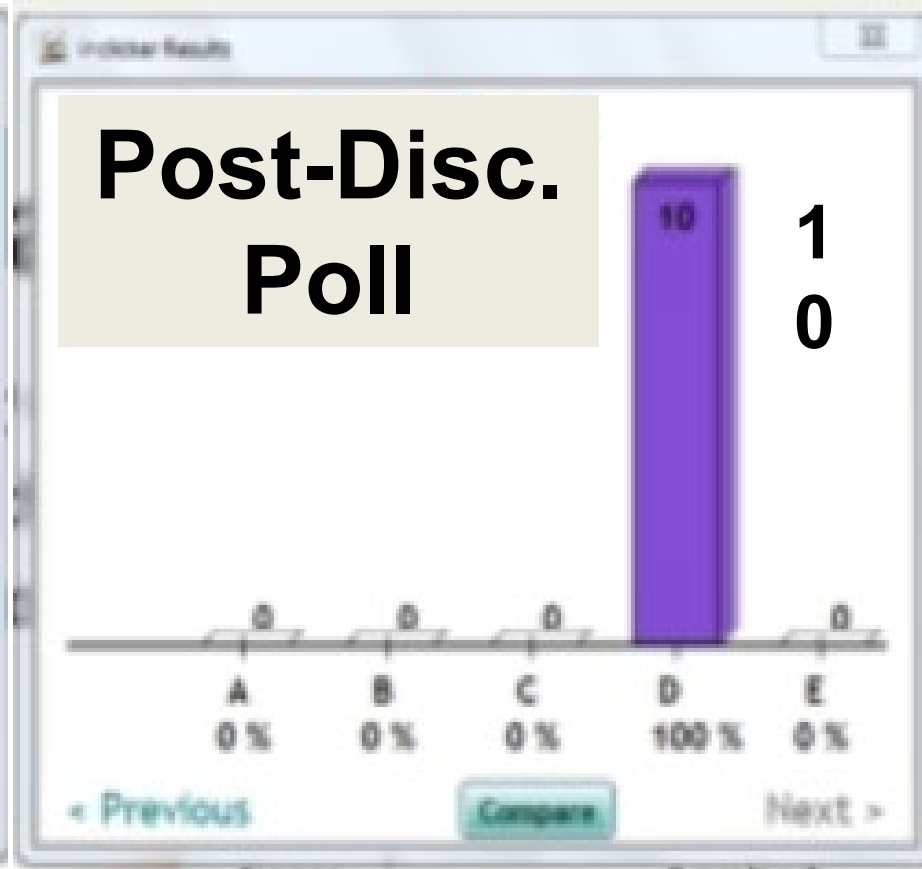
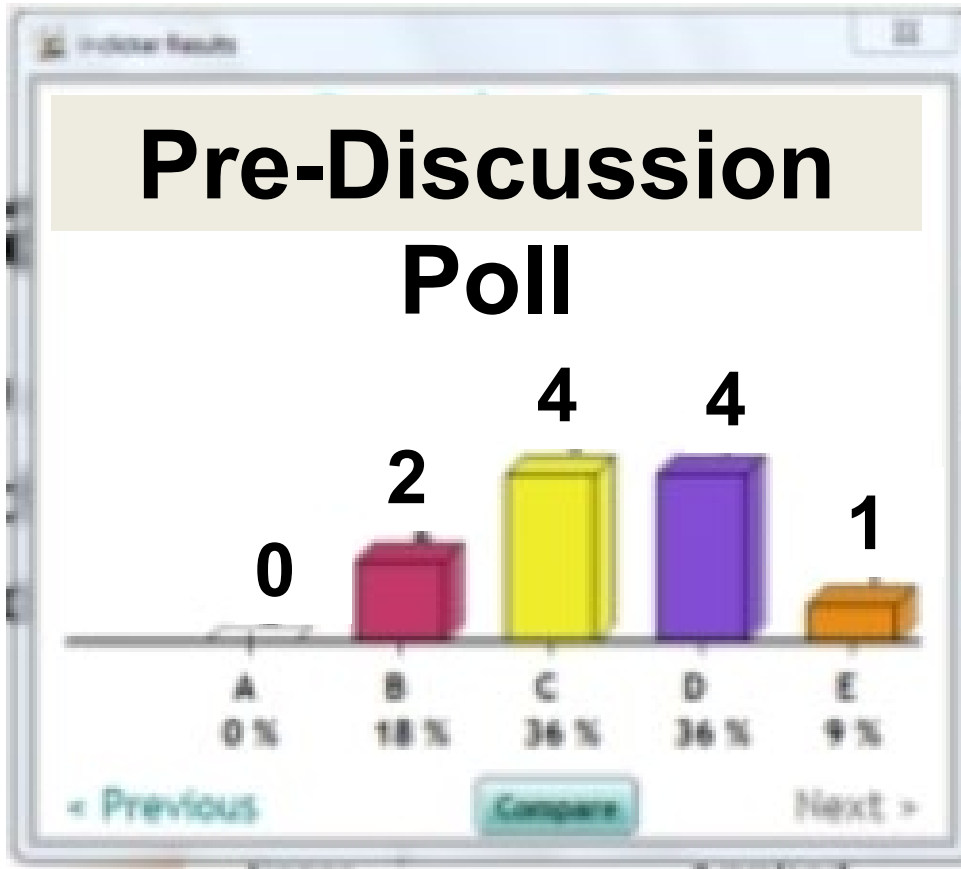
# Peer Instruction Example 1

Find the magnitude of the force a 60 kg person has to pull the rope with in order to pull himself upwards with a **constant speed**.

- A. 600 N
- B. 450 N
- C. 300 N
- D. 200 N
- E. 150 N



# 1 Peer Instruction in Action



**Respondents:** Physics Teacher-Candidates

1

# Math & Science Teaching & Learning through Technology

The screenshot displays the website for the UBC Faculty of Education, Department of Curriculum and Pedagogy. The header includes the UBC logo, the tagline "a place of mind", and the department name. The main navigation bar features links for HOME, ABOUT, RESEARCH, ELEMENTARY, SECONDARY, ADD YOUR PRESENTATION, and NEWS. A dropdown menu for "SECONDARY" is open, listing subjects: MATHEMATICS, PHYSICS, CHEMISTRY, and BIOLOGY. The "PHYSICS" dropdown is further expanded to show topics: VECTORS, KINEMATICS, DYNAMICS, MOMENTUM, WORK, ENERGY, POWER, THERMODYNAMICS, CIRCULAR MOTION, GRAVITATION, WAVE MOTION AND OPTICS, PARTICLE AND NUCLEAR PHYSICS, EQUILIBRIUM, and ELECTROSTATISTICS. The main content area features a "Teacher Education" banner and a "CREATE" section with the text: "Community to Reimagine Educational Alternatives for Teacher Education". Below this, it states: "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)." A "Presentation about MSTLTT Project" is also highlighted, mentioning Dr. Marina Milner-Bolotin. A sidebar on the right contains links for Mission, Contact, and Our sponsors, along with a partial view of a "MATH & SCIENCE TEACHING & LEARNING THROUGH TECHNOLOGY" banner featuring a globe and a Canadian maple leaf.

<http://scienceres-edcp-educ.sites.olt.ubc.ca/>

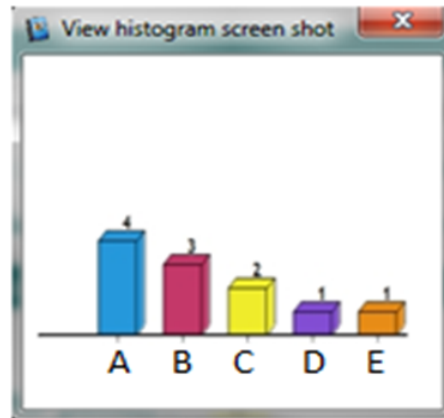
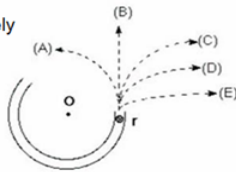


# Technology-Enhanced Science Education

## 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?



PeerWise

EDCP357 (Winter 1, 2013)

[Home](#) | [Main menu](#) > Comments written by you

## Comments written by you

Comments written by you, about questions you have answered, are shown below.

Select an order:

[New replies](#) [Most recent first](#) [Show agreements only](#) [Show disagreements only](#)

Showing new replies only

No comments to view

[Return to main menu](#)

# Peer Instruction and PeerWise integration

# 1 PeerWise Online System

EDCP357\_2018

[Home](#) | Main menu

## Your questions

[view »](#)

You are currently contributing **1** question  
You have deleted **0** of your questions

## Answered questions

[view »](#)

You have answered **240** questions (of these, **2** have been deleted)  
You have written **154** comments about these questions

## Unanswered questions

[view »](#)

There are currently **0** unanswered questions you may answer  
You are following **9** question authors



## What is PeerWise?

Students use PeerWise to create and to explain their understanding of course related assessment questions, and to answer and discuss questions created by their peers.

<http://peerwise.cs.auckland.ac.nz/>

# What is PhET?

FREE  
RESOURCES

PhET  
INTERACTIVE SIMULATIONS

Over 200 million simulations delivered

University of Colorado Boulder

Support PhET's Annual Campaign: [Donate Today](#) [HTML5 Sims](#)

INTERACTIVE SIMULATIONS FOR SCIENCE AND MATH

[Play with Simulations](#)

The Tech Awards

Faraday's Law

How to Run Simulations

- On Line
- Full Installation
- One at a Time
- Troubleshooting
- FAQs

For Teachers

- Tips for Using PhET
- Browse Activities
- Share your Activities
- Workshops
- Translate simulations
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PhET Computer simulations from the University of Colorado, Boulder

*You can download the simulations. They have translations.*

# 3

# Sensors in Physics Teaching



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Company



How many ways  
can you measure  
the acceleration  
due to gravity?



# 4

# Collaborative Learning Annotation System - CLAS

Instructions for this course

upload & manage videos

The screenshot displays the CLAS interface. On the left, a video player shows a woman in a classroom setting with a chalkboard titled "FREE BODY DIAGRAMS". The chalkboard contains handwritten notes: "gravity", "friction", "normal", and "net force". The video player has a progress bar at 0:00/4:01. To the right of the video player is a playlist titled "Course EDCP357 301 2015W" and "Playlist everyone in this course (42 items)". The playlist includes items like "Caitlin - Terminal Velocity 2", "Caitlin - Terminal Velocity 1", "Nadereh - Lesson 1", "Irit Teaching FBD - new version", and "Irit Teaching FBD - part 2". Below the video player is a "Time-specific comments" section with a search bar and buttons for "Post", "Record video as response", "Use existing audio / video", "Book mark", and "Hide my identity". A progress bar for comments is shown with markers at 25% (01:00), 50% (02:00), and 75% (03:00). Below the progress bar is a "General comments to the whole video" section with an "Add general comment" button. At the bottom, there is a footer with the UBC logo and the text "a place of mind THE UNIVERSITY OF BRITISH COLUMBIA".

Upload & manage videos  
Annotate them  
Collaborate  
Share  
Learn from each other  
Improve



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THE UNIVERSITY OF BRITISH COLUMBIA

<https://clas.sites.olt.ubc.ca/sign-in/>





Published Online: 18 April 2018

# Promoting Reflective Physics Teaching Through the Use of Collaborative Learning Annotation System

The Physics Teacher **56**, 313 (2018); <https://doi.org/10.1119/1.5033879>

Marina Milner-Bolotin

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## COLLECTIONS

- Papers

## AIP THESAURUS V1.2

- Educational aids
- Educational testing
- Classical mechanics
- Equipment and apparatus
- Physics teachers

## ABSTRACT

Effective physics teaching requires extensive knowledge of physics, relevant pedagogies, and modern educational technologies that can support student learning. Acquiring this knowledge is a challenging task, considering how fast modern technologies are changing. The expectations of student learning outcomes and of teachers are also changing. 21st-century physics teachers should be prepared to use technology in their classrooms. *[The Physics Teacher, 56(May), 313-316]*

# 5

# STEM Demonstrations

## FACULTY OF EDUCATION FAMILY MATH & SCIENCE DAY



Photo by  
Paul  
Joseph,  
UBC Brand  
& Marketing

# 5

# Video Production



Science & Math Education Videos for All

148 subscribers

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CHANNELS

ABOUT



Euler spins on a mirror

254 views • 1 year ago

Skaters can spin on a flat area of ice. Can they also spin on a flat area of a mirror? Or a bit trickier surface like a curve mirror i.e. concave mirror? Well, they can probably do it but definitely, only a mathematician and physicist like Euler can do it beautifully. Actually, not Euler, himself, but his disk's.

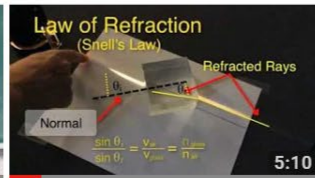
Popular uploads [PLAY ALL](#)



Galileo Thermometer  
11K views • 1 year ago



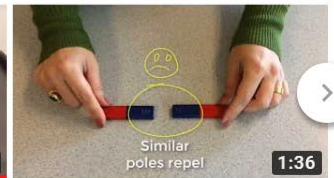
Making a light beam visible:  
Exploring light from a laser...  
2.2K views • 1 year ago



Reflection and Refraction of  
Light  
937 views • 1 year ago



Exploring Vibrations: Tuning  
forks and a Chinese bowl  
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Attraction  
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a place of mind

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TEACHING AND LEARNING  
ENHANCEMENT FUND

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The Teaching and Learning Enhancement Fund: supporting and encouraging innovation in teaching and the learning environment

**Generously supported  
by UBC TLEF 2012-  
2018: \$210,000**







# Workshop: Feedback

How satisfied are you with the day?

1

3

5

