Using PeerWise Online Collaboration Tool to Improve Physics Teacher-Candidates' Questioning Skills

Dr. Marina Milner-Bolotin

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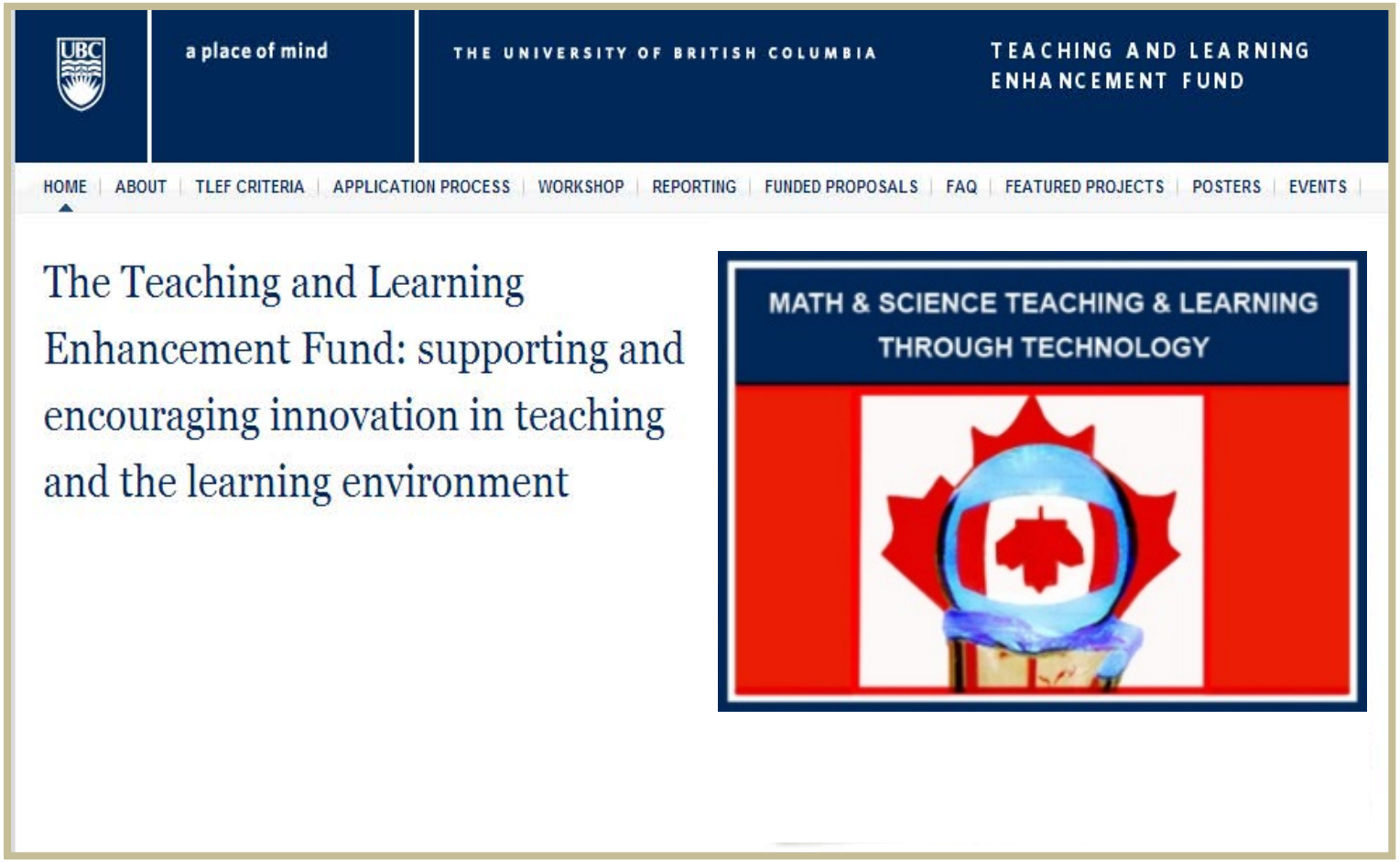
Acknowledgements



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Heather Fisher & Alex MacDonald – M.A. , August 2015

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Teacher Education in Canada

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

BY MARINA MILNER-BOLOTIN

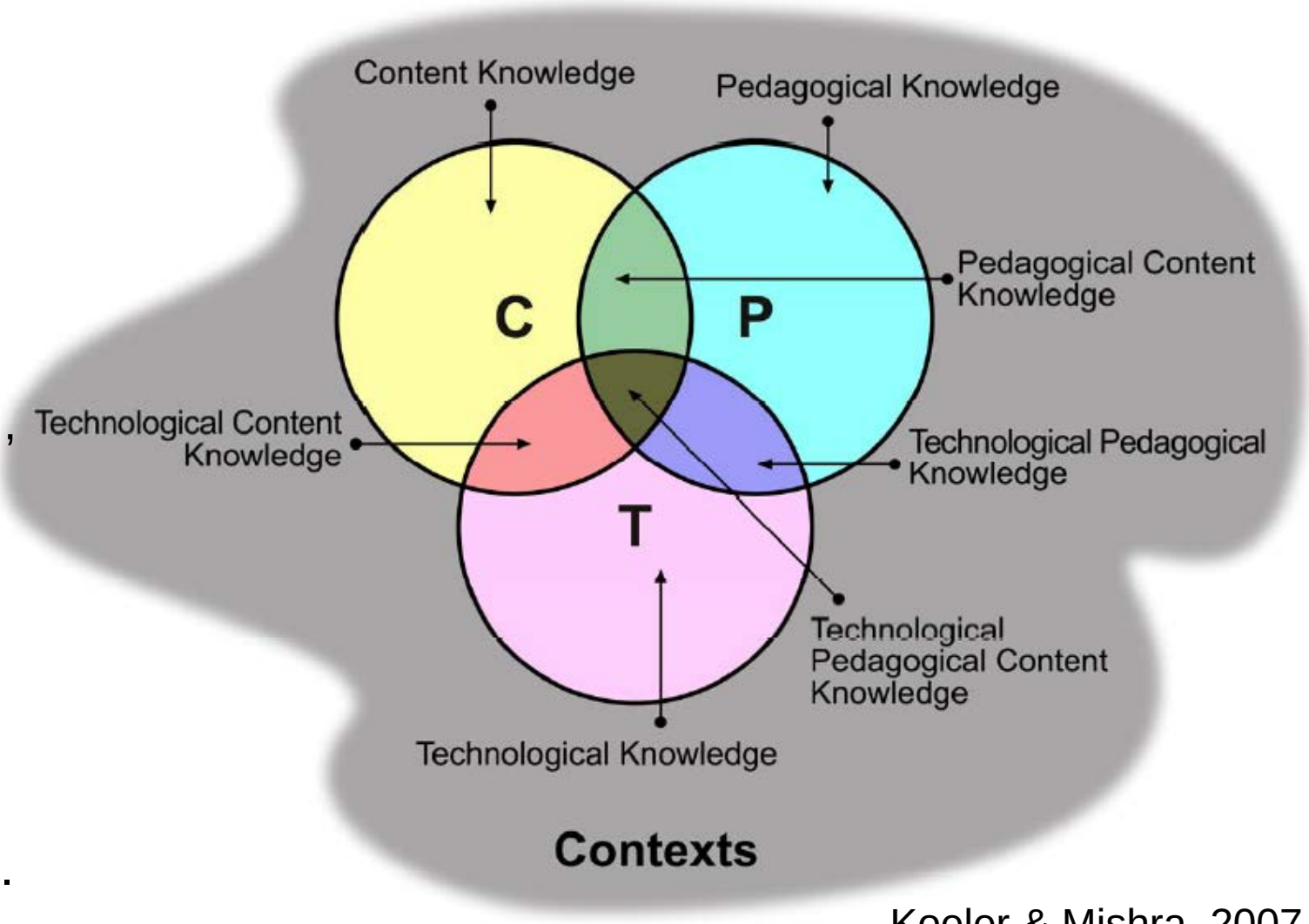
More than 25 years ago, Lee S. Shulman, then president of the American Educational Research Association [1], challenged us to re-think how we prepare teachers through focussing on *Pedagogical Content Knowledge* (PCK) - the knowledge of content and content-specific pedagogies. Shulman pointed out that 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) [4] and current physics teaching practices. In the words of [illegible] Laureate, Prof. Carl Wieman

UBC Science Teacher Education

Theoretical Framework



Shulman, L.S., *Those who understand: Knowledge growth in teaching.* Educational Researcher, 1986. **15**(2): p. 4-14.

Koeler & Mishra, 2007

Research Objectives

Investigate the effect of Technology Enhanced Pedagogy (TEP) on teacher-candidates' (TCs') TPCK

Explore possible mechanisms for TEP in physics methods courses

Engage TCs with technology as students and as teachers

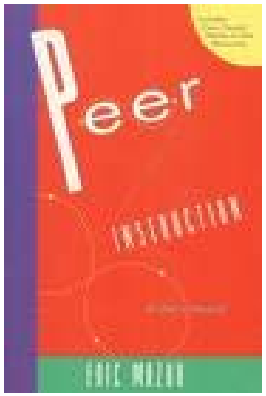
Focus on 2 Technology-Enhanced Pedagogies

1. Peer Instruction **(clickers)**

2. PeerWise online platform for

   design of conceptual

   questions **(PeerWise)**

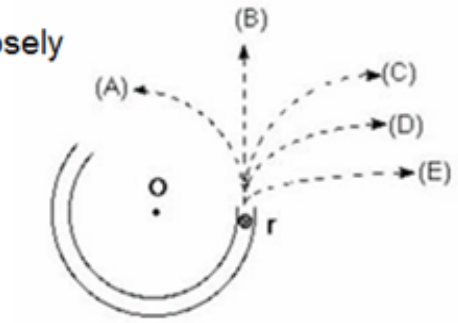


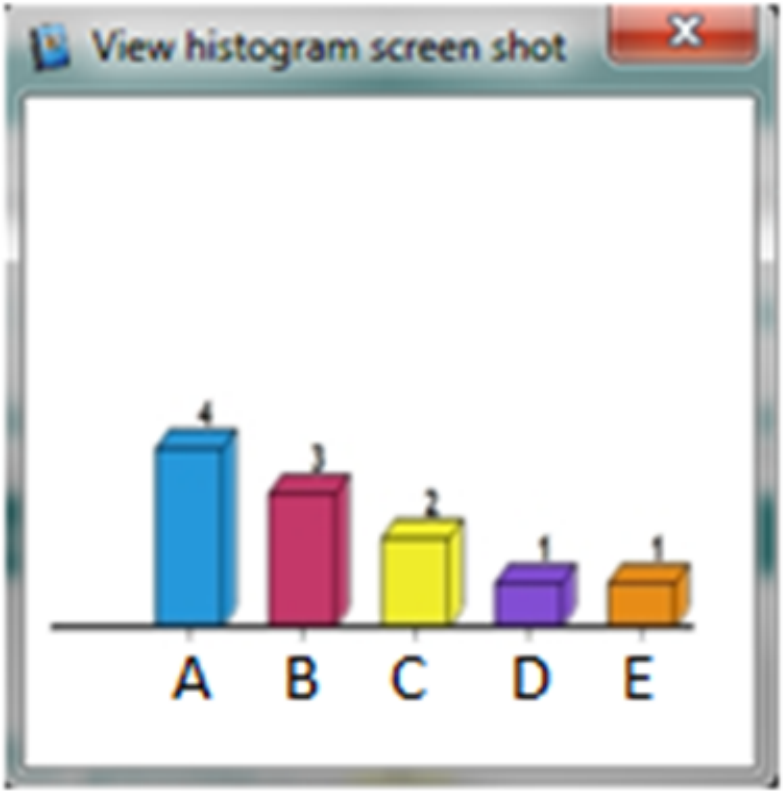
1. Peer Instruction (PI)

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?





Answers given by pre-service physics teachers

1. Peer Instruction

A clicker question is posed

Students work individually for about a minute to figure out the answer that they submit using clickers

Students' responses are displayed to the class without revealing the correct answer

Many of the students answered incorrectly.

Most of the students provided a correct response. Correct answer revealed.

Students work in groups of 2-3 to discuss the question.

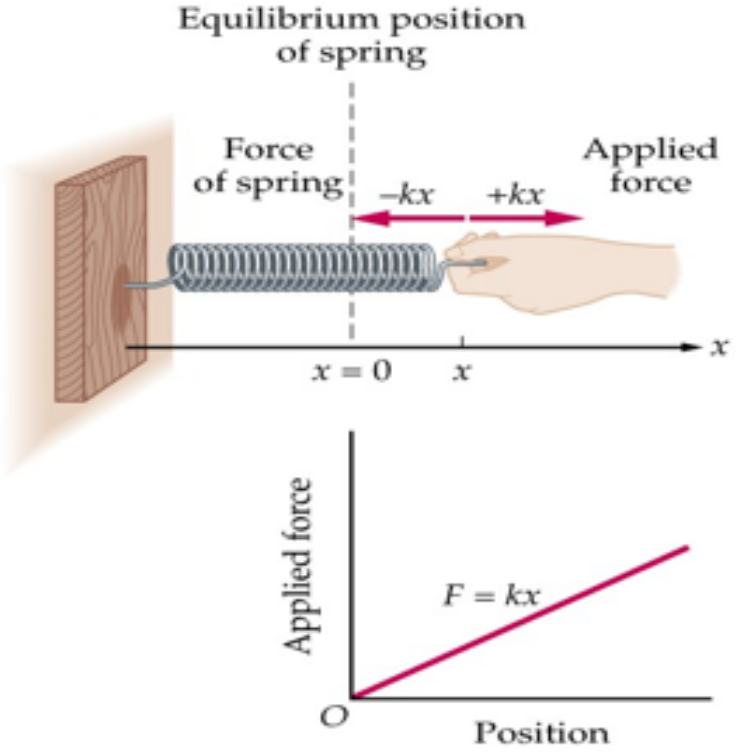
Students resubmit individual answers using clickers.

An instructor leads a summary discussion with the class: the reasons for correct answer as well as the reasons for choosing the incorrect answers are elicited from the students.

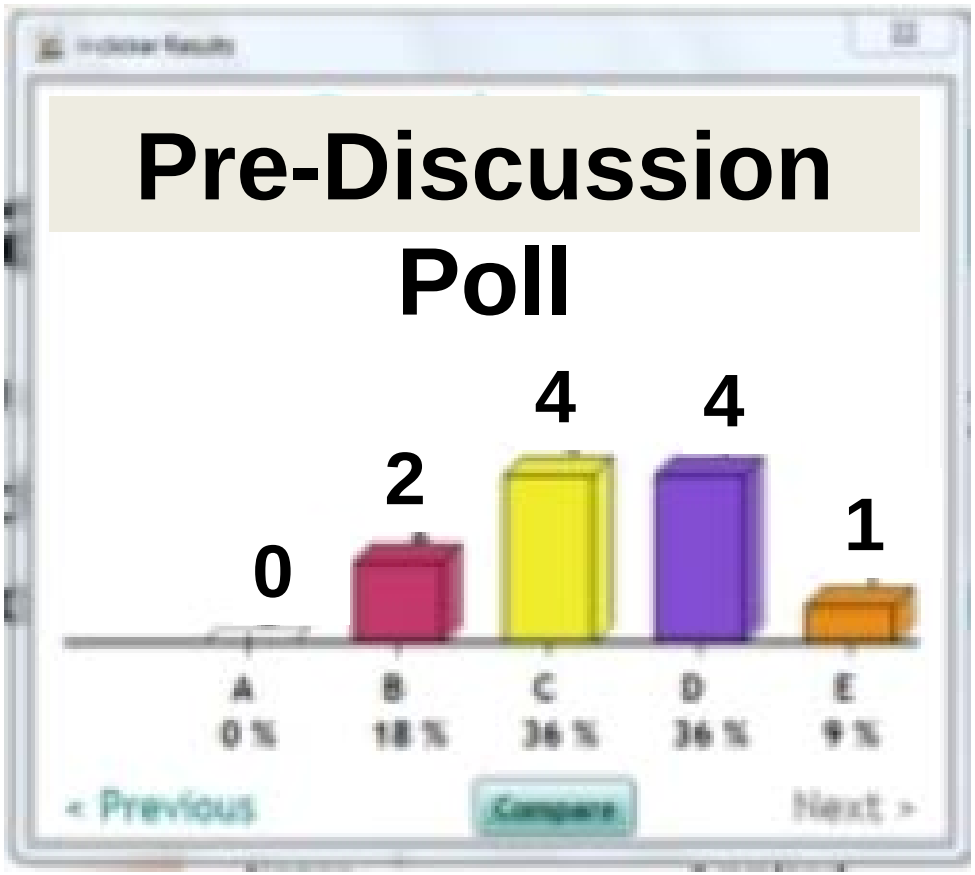
Peer Instruction Example

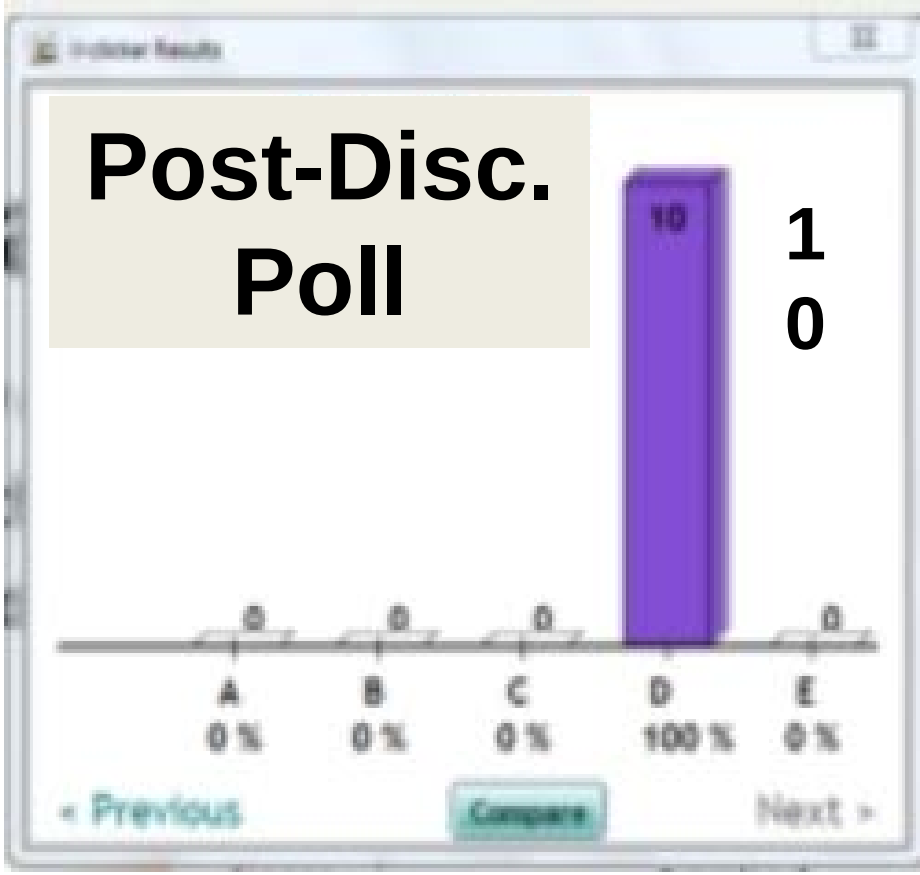
The work needed to stretch a spring **10 cm** from equilibrium (from $x_1 = 0$ m to $x_2 = 0.1$ m) is **10 J**. How much work needs to be done to stretch the spring additional **10 cm** (from $x_2 = 0.1$ m to $x_3 = 0.2$ m) ?

A. 5 J
B. 10 J
C. 20 J
D. 30 J
E. 40 J



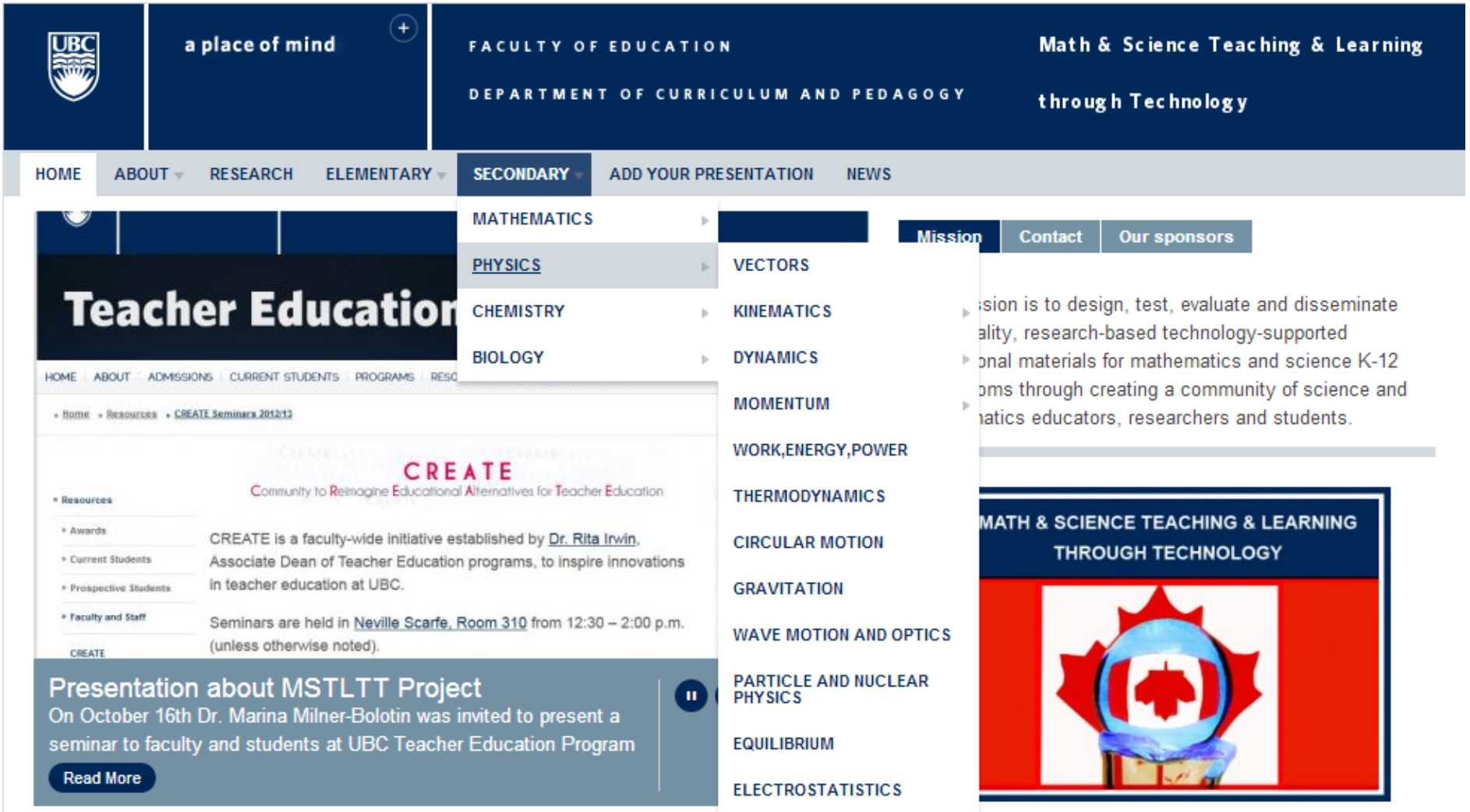
Peer Instruction in Action





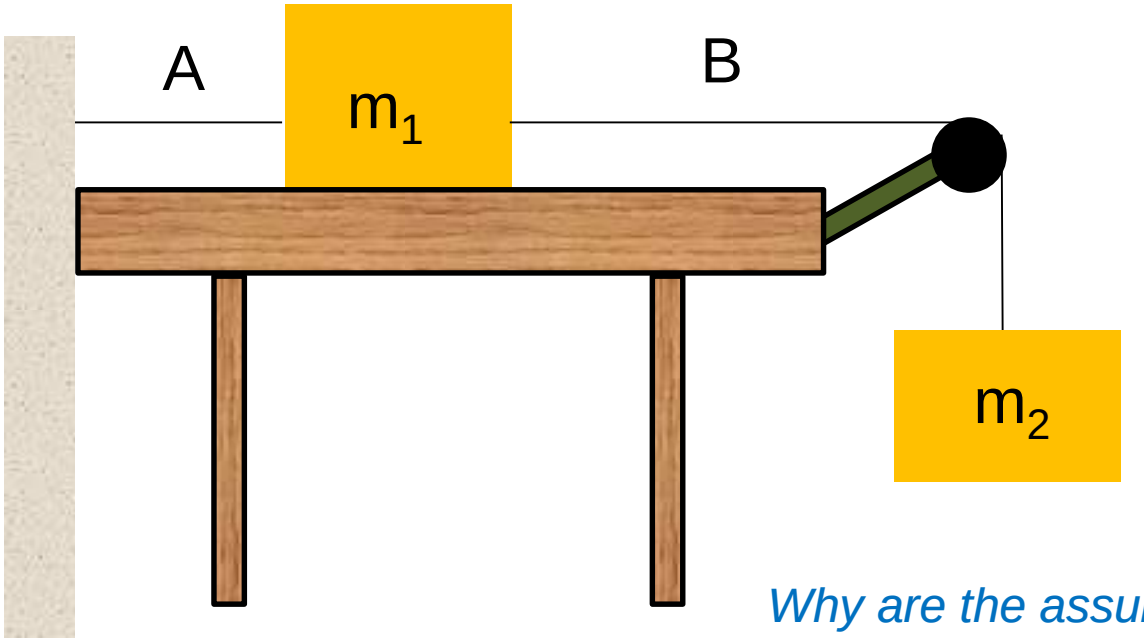
Respondents: Physics Teacher-Candidates

Math & Science Teaching & Learning through Technology



Blocks and a Pulley

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:

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

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.

2. PeerWise Online System

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

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/

PeerWise Question Design

Home | Main menu > Your questions > Question details

Question stats

This question has been answered by 5 people and has an average rating of 4.20 (based on 5 ratings)

YES The answer you suggested is the most popular answer

Your question

Roger Federer tosses a tennis ball up in the air during his match against Rafael Nadal. When the ball reaches its highest point, its:

Alternatives

You suggested B is the correct option

OPTION	ALTERNATIVE	FIRST ANSWERS	CONFIRMED ANSWERS
A	velocity is zero and acceleration is zero	1 (20.00%)	0 (0.00%)
B	velocity is zero and acceleration is non-zero	4 (80.00%)	3 (100.00%)
C	velocity is non-zero and acceleration is non-zero	0 (0.00%)	0 (0.00%)
D	velocity is non-zero and acceleration is zero	0 (0.00%)	0 (0.00%)
E	The answer depends on the initial speed of the ball.	0 (0.00%)	0 (0.00%)

Explanation

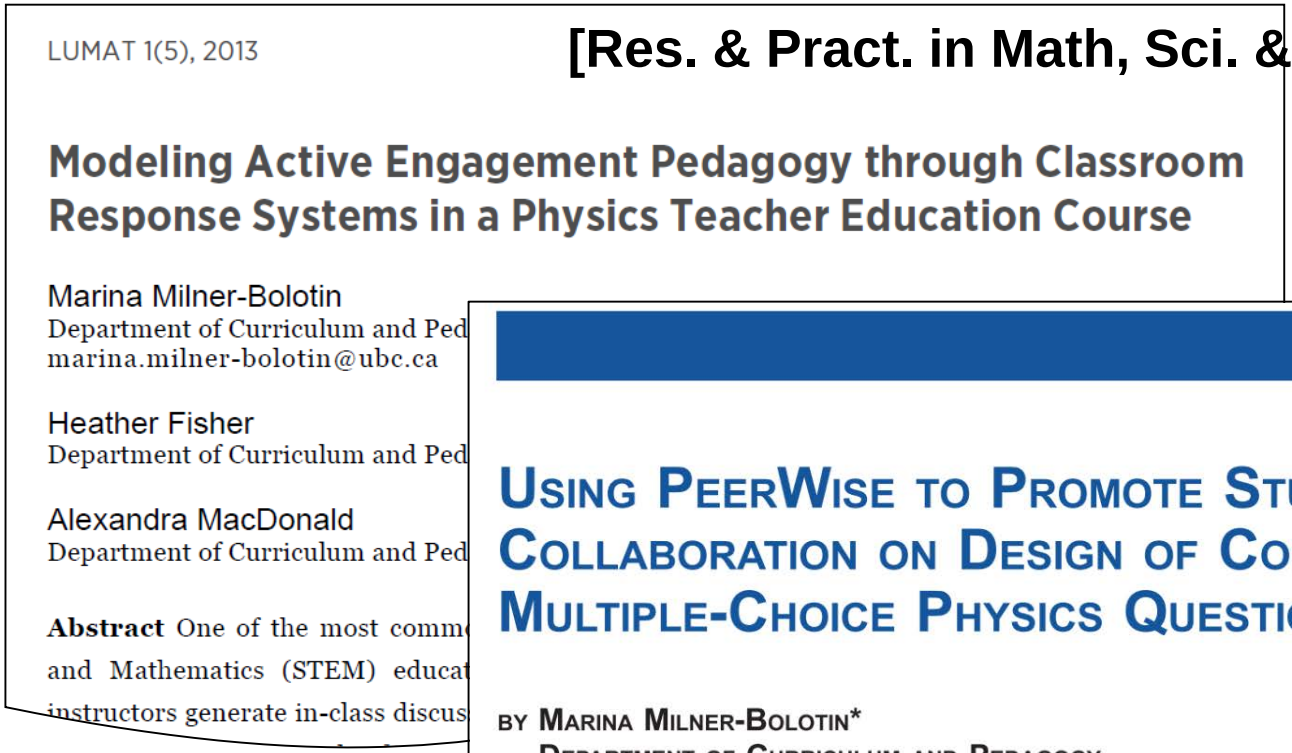
The following explanation has been provided relating to this question:

At its highest point the ball should stop (it has zero instanteneous velocity). However, its acceleration is non-zero. The earth is pulling the ball down equally hard along the way, so its acceleration in its highest point is 9.8 m/s^2, and it is directed downwards.

improve explanation

PeerWise Pedagogy

[Res. & Pract. in Math, Sci. & Techn. Ed., 2013. 1(5): p. 525-544.]



LUMAT 1(5), 2013

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

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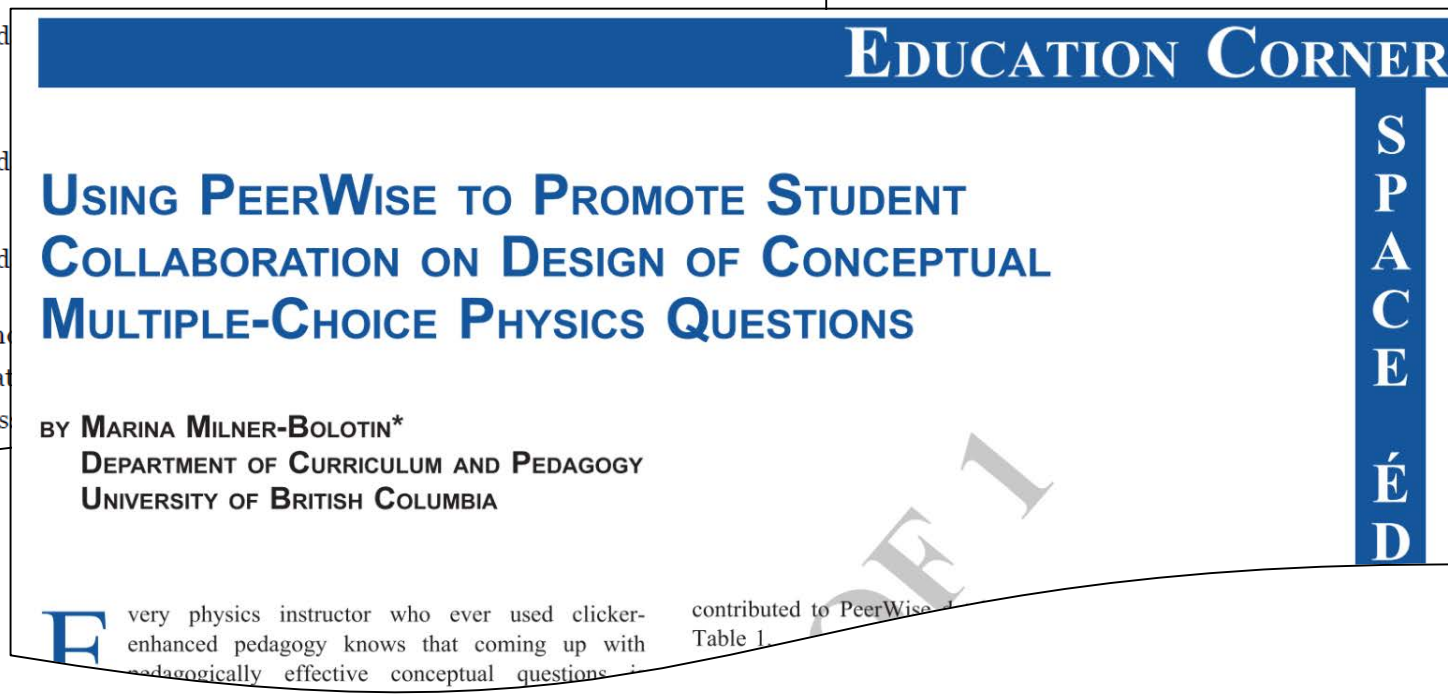
Abstract One of the most comm
and Mathematics (STEM) educat
instructors generate in-class discus



EDUCATION CORNER

SPACE ÉD

USING PEERWISE TO PROMOTE STUDENT COLLABORATION ON DESIGN OF CONCEPTUAL MULTIPLE-CHOICE PHYSICS QUESTIONS

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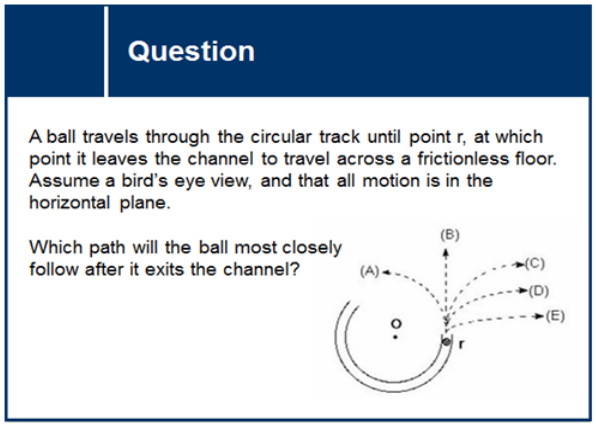
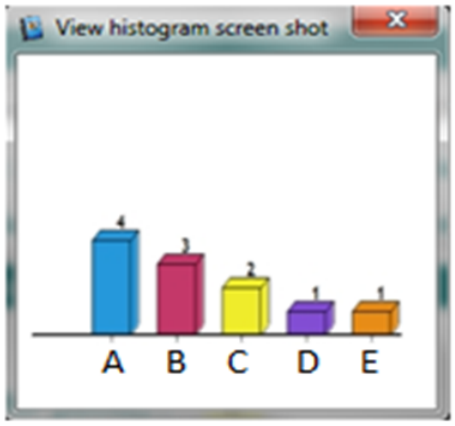
Every physics instructor who ever used clicker-enhanced pedagogy knows that coming up with pedagogically effective conceptual questions

contributed to PeerWise
Table 1.

[Physics in Canada., 2014, 70(3): p. 149-150]

PeerWise and PI Integration

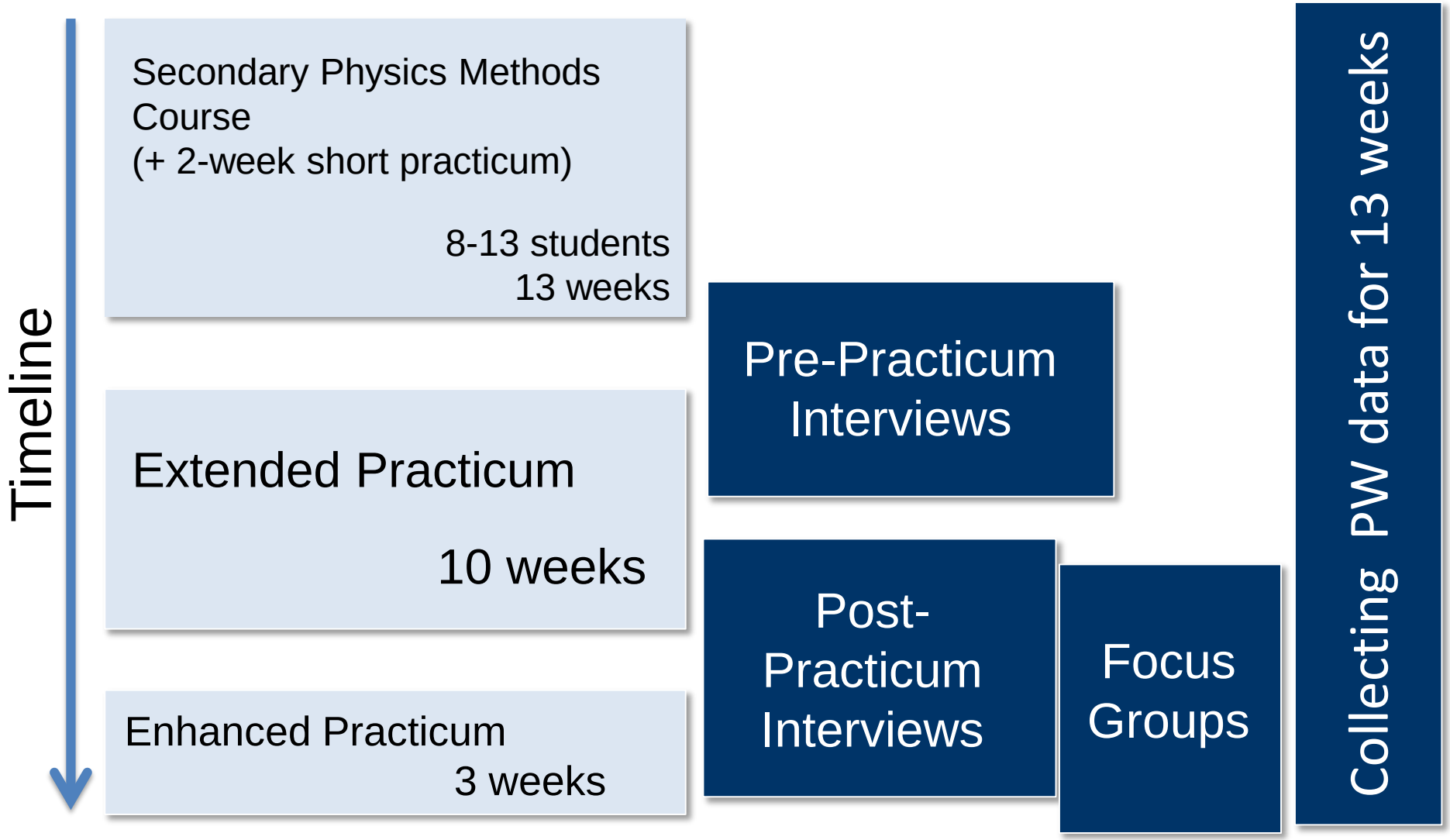




Peer Instruction modeled in every class

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

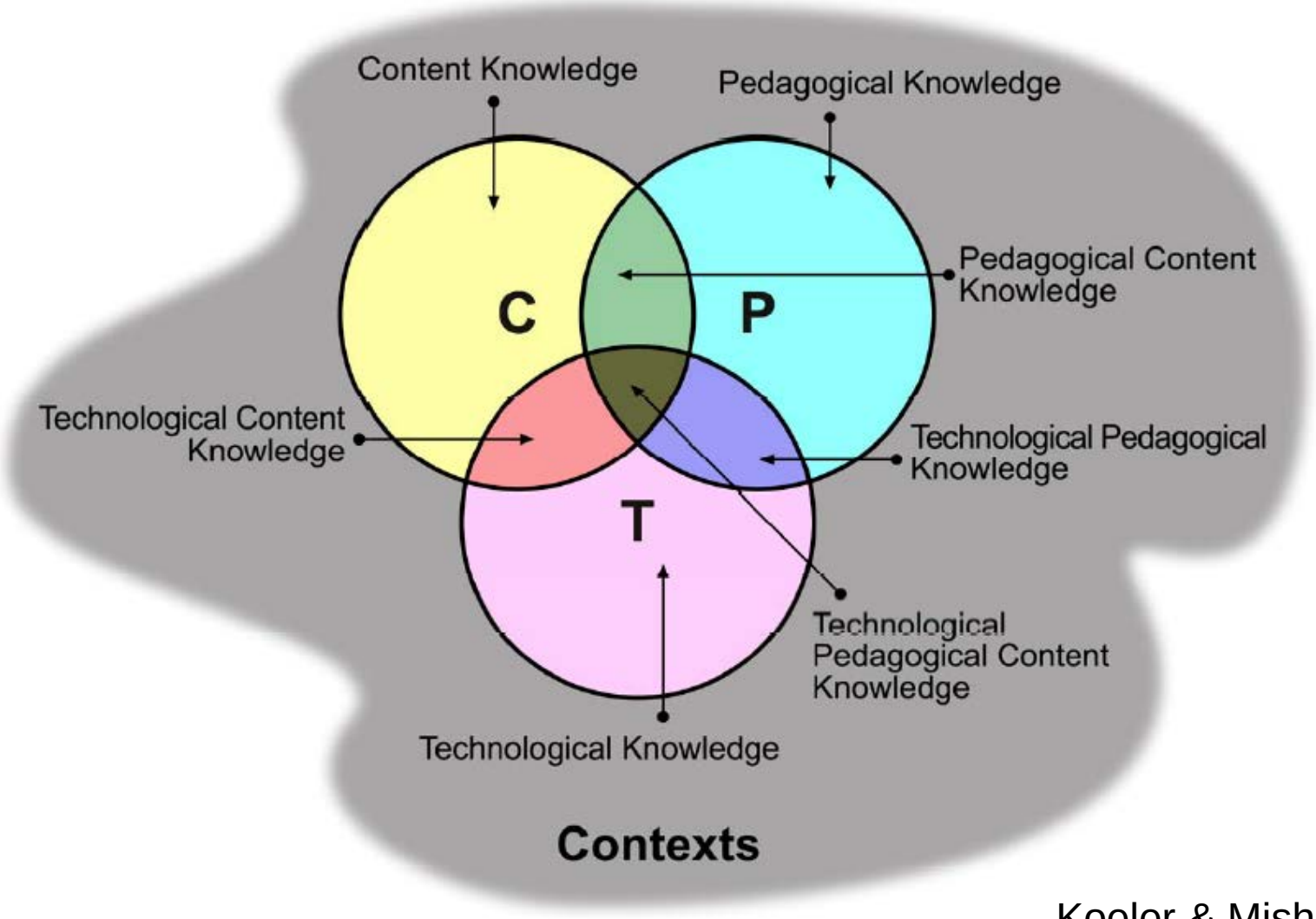
Research Design



Quantitative Data 2013: PeerWise

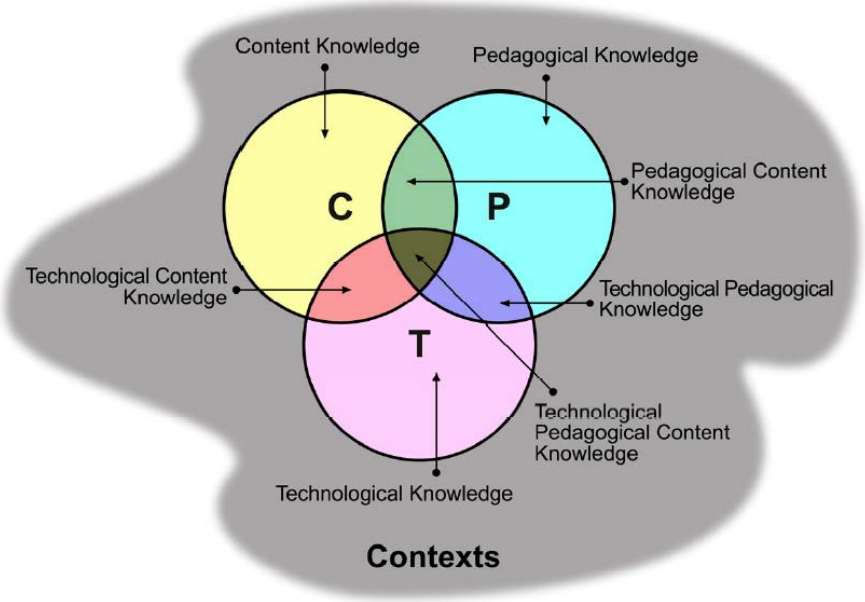
	Questions	Answers	Comments
1	50	110	52
2	50	85	40
3	51	115	74
4	50	90	34
5	60	110	79
6	50	112	82
7	57	109	107
8	50	192	14
9	50	91	81
10	50	100	50

Preliminary Results: Direct Impact on our TCs



Koeler & Mishra, 2007

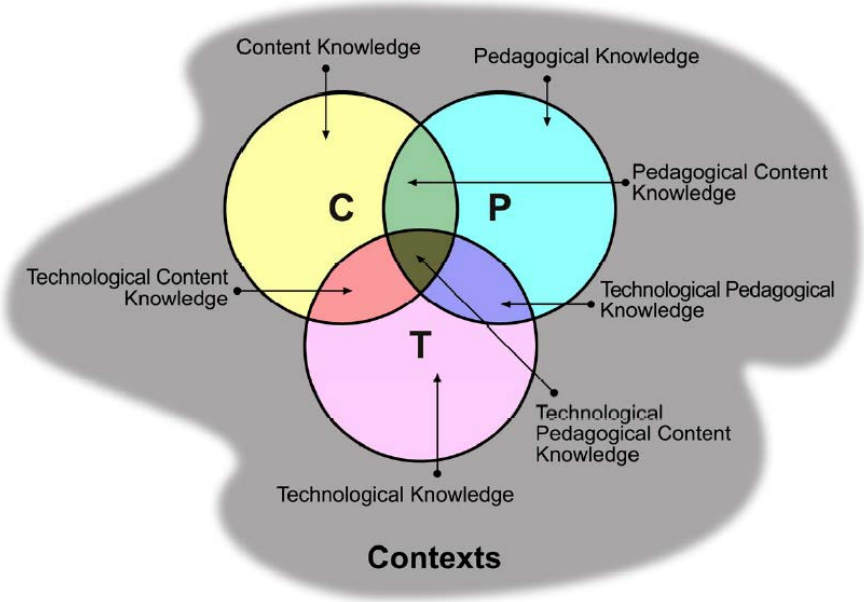
Direct Impact on our Teacher-Candidates



"It really opens the door for umm discussions between people. Um regarding a) you know, what is the right answer, and b) how would you explain that to uh either teacher-candidates or to your potential students."

Pre-Interview 2, Participant 9

Direct Impact on our Teacher-Candidates



"So, if you set it up in a dynamic where… different types of people have [different needs], so if you need to talk to someone, you still get that, if you need silence, you get to think on it on your own, and then people aren't so stressed… And they actually get to argue and talk back and forth and they'll remember it more. So for them, I think they'll master it more."

Post-Interview 2, Participant 20

Broad Impact for Teacher Education

Investigate the effect of TEP on teacher-candidates' epistemologies

Model TEP with the course content

Modeling impacts TCs' PCK & epistemologies, regardless of successes/challenges in the practicum

"I'm there as a teacher, (pause) but I'm also there as a student. Conversely, they're there as a student, but they're also there as a teacher. That doesn't mean they're teaching necessarily, teaching me. They're teaching each other... You're always a student-teacher, regardless of whether or not, what your position says. The-the moment you step out, and you meet someone, you now are both a teacher and a learner."

Post-Interview 1, Participant 15

Broad Impact for Teacher Education

Explore a possible mechanism for TEP in teacher ed.

PI and PeerWise work as a mechanism for TEP pedagogy in small methods classes

"Coming into the program, we were all sort of thought that we were expected to be masters, and if the instructor puts up a clicker question, you think 'Jeez, I don't actually know the answer' – immediately you think well, we're all supposed to be masters, I'm probably the only one who doesn't know. But uh when the responses come in, you see other people think like you, it's definitely reassuring."

Pre-Interview 2, Participant 9

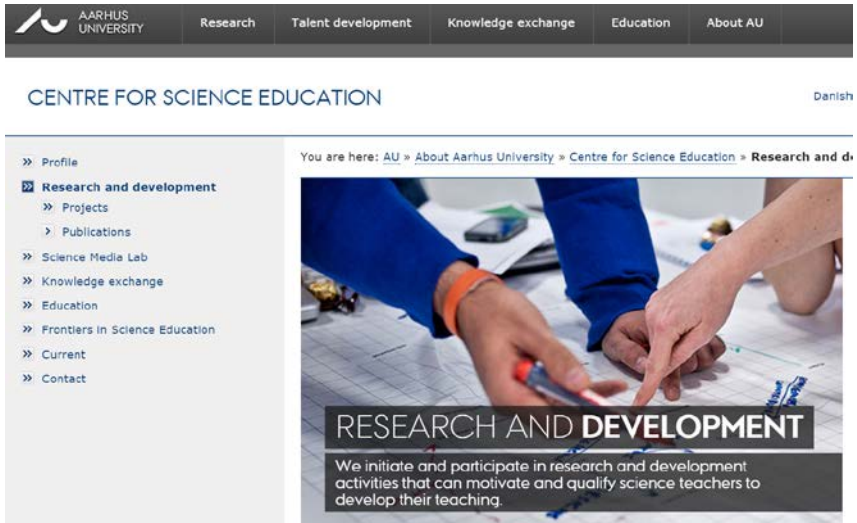
Quantitative Data Analysis

- **Collected:**
  - 500 + PeerWise questions
  - 300 + comments by students on peer questions
  - 500+ solutions by TCs
- **In the process of:**
  - Question analysis using PCK-based rubric
  - Comment analysis using PCK-based rubric

Preliminary results: significant change in the quality of TCs' questions, comments and explanations

Conclusions: Deliberate Pedagogical Thinking with Technology

Technology opens unprecedented opportunities for educators, but we have just scratched the surface. We have to explore how to use it to promote meaningful science education. Teacher education both at K-12 and post-secondary levels should model effective research-based uses of technology.



Bibliography

1. 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.
2. CWSEI Clicker Resource Guide: An Instructors Guide to the Effective Use of Personal Response Systems (Clickers) in Teaching. (2009, June 1).
3. Lasry, Nathaniel. (2008). Clickers or Flashcards: Is There Really a Difference? *The Physics Teacher, 46*(May), 242-244.
4. Milner-Bolotin, Marina. (2004). Tips for Using a Peer Response System in the Large Introductory Physics Classroom. *The Physics Teacher, 42*(8), 47-48.
5. 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/
6. Milner-Bolotin, Marina, Fisher, Heather, & MacDonald, Alexandra. (2013). Modeling active engagement pedagogy through classroom response systems in a physics teacher education course. *LUMAT: Research and Practice in Math, Science and Technology Education, 1*(5), 525-544