Mathematics and Science Teaching and Learning Through Technology

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Background

Student-Centred Pedagogies

Interactive Engagement[1] (IE) in Mathematics & Science Classrooms
Pedagogies designed to promote conceptual understanding of the subject in heads-on (always) and hands-on (often) activities which yield immediate feedback through discussions with peers and/or instructors

Examples of IE: Peer Instruction[2] using Electronic Response Systems (clickers); Interactive inquiry-driven lessons using SMART Boards

CREATE Program @ the Faculty of Education

- Focuses on inquiry in Teacher Education[3]
- Supports innovative pedagogies and reflective practice

The Need for MSTLTT Resource

- There is a lack of research-proven mathematics and science resources for K-12 classrooms linked to BC K-12 Curriculum
- Teachers have little input over textbook choices; supplemental resources helps them incorporate student-centered teaching and learning methods into their classrooms

Bridging the Gap

- Modeling inquiry in science and mathematics methods courses
- Discussing how to apply inquiry in real-world contexts
  Ex.: low technology options

Objectives

Assist teacher-candidates (TC) via four platforms:

1. **Within their B. Ed Methods Courses (TC's as learners):**
   a. Modeling inquiry-based teaching
   b. Experiencing designing and evaluating resources
   c. Fostering deep learning in safe & positive learning environments
2. **Developing personal teaching style:**
   a. Hands-on experience with inquiry-based learning
   b. Next generation of leaders in educational technology
3. **Providing teaching resources for (TC's as teachers):**
   a. Short and Long Practicum experiences
   b. Post-graduation classroom teaching experiences
4. **Creating a stronger connection to the UBC community:**
   a. Provide a support network for TCs after graduation
   b. Extending TCs' sense of community beyond graduation

Methods

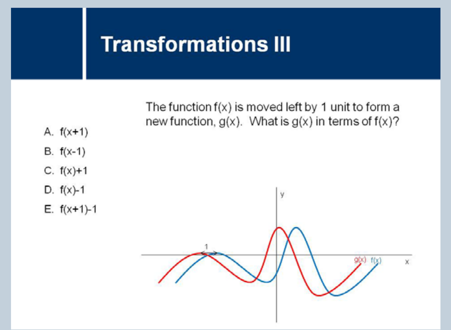
The Resource

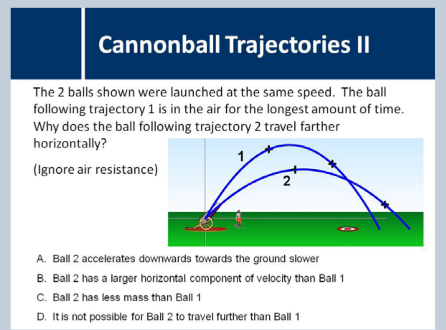
- Available online
- Downloadable PPT slides
- Sequences of questions within a topic: from recall to complex knowledge transfer
- Emphasis on concepts
- Topics based on BC IRPs

The Pilot Project

- Piloted in the Physics Methods course for B. Ed students

Developing the Resource

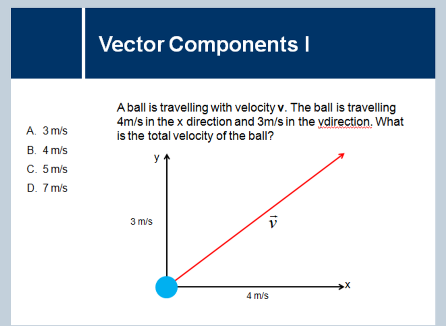


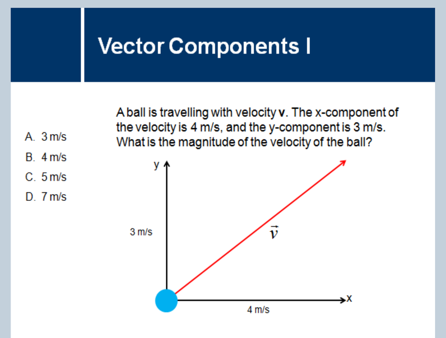


- Questions developed for K-12 mathematics and science

Sample of mathematics and science questions, respectively, to left

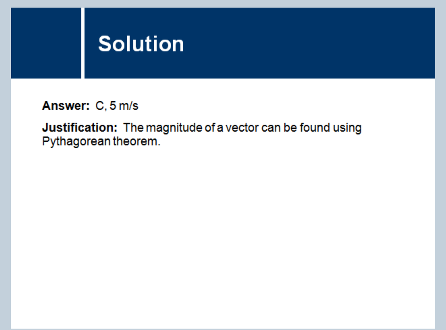
The Question Review Process

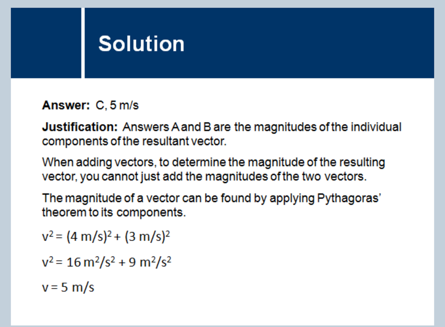




- Author develops initial draft of a question
- Collaborators check grammar, sense, and usefulness of question
- Author makes edits to produce final draft

Describing the Answers





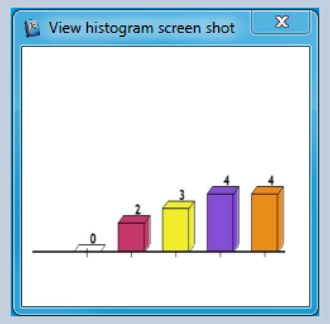
- Both correct and incorrect answers are described
- Collaborators check reasoning for answers (same categories as questions)

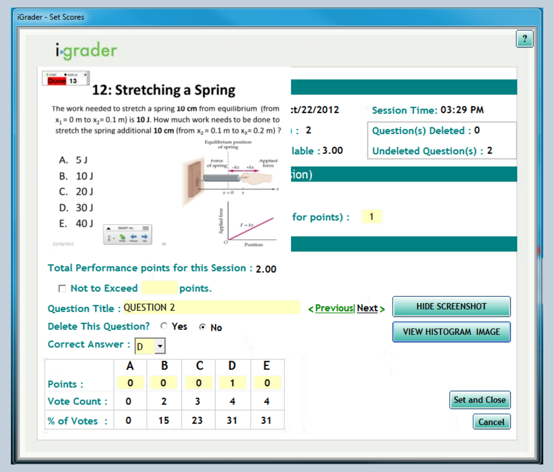
Preliminary Results

Using the Resource

- iclickers are used in Physics Methods course to model inquiry

Sample physics question and iclicker results, to right





- Created a user-friendly database of questions
- Database contains 400+ math and science questions
- Database helps teacher-candidates design effective lesson and unit plans for the Practicum

Feedback from Teacher-Candidates (Fall 2012)

"I have found the conceptual clicker questions from [the] classroom to be probably the most useful and illuminating part of my classes. This format provides an environment in which the class feels comfortable investigating and exposing their prior knowledge about physics."
~Adam Quiring

"The use of conceptual questions and clickers is very engaging and intellectually stimulating. The clickers create a safe learning environment where students do not have to fear giving an incorrect response to the teacher. I look forward to using this in my future classroom."
~Clement Law

Future Directions

1. Resources
   a. SMART Board resource development for K-12 classrooms
   b. Continue developing resources for K-7 math and science
2. Reach of the project
   a. Increase subset of B. Ed methods courses utilizing the resource
   b. Increase awareness of the resource within and outside of UBC

References

[1]Hake, R. R. (1998). Interactive-engagement versus traditional methods: A six-thousand-student survey of mechanics test data for introductory physics courses. *American Journal of Physics, 66*(1), 64-74.
[2]Mazur, E. (1997). *Peer Instruction: User's Manual*. Upper Saddle River, NJ: Prentice Hall.
[3]*About CREATE.* (2012). Retrieved 10/23, 2012, from http://teach.educ.ubc.ca/resources/faculty-staff/create/pdfs/About-CREATE.pdf

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