Scaling the Investigative Science Learning Environment (ISLE) Online

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I. Introductory questions...

Context: Large (500+ students) second-semester introductory algebra-based physics class with lab, primarily taken by students specializing in life sciences, transitioned online for Winter 2021 due to COVID19 Pandemic

- Why are university physics classes important for students not intending to specialize in physics?
- What do you most hope students will learn from such a physics course?

  Share your answers in the chat!

See also: Lab Adaptations for this course
Interactive Poster by Emily Tyhurst on Friday 9:30am

II. Overall Learning Goals

To develop abilities to…
1. Make meaning out of physics and mathematics
   a. Interpret, generate, and translate among multiple representations of physics concepts, including diagrams, graphs, mathematical equations, and written explanations
2. Solve qualitative and quantitative physics problems
   a. Apply appropriate simplifications
   b. Apply multiple representations (e.g. diagrams, graphs, equations)
   c. Apply physics concepts to new situations or contexts
3. Make and evaluate scientific arguments
   a. Identify assumptions
   b. Apply hypothetico-deductive reasoning
   c. Design, conduct, and interpret experiments to test proposed explanations
4. Demonstrate resiliency in solving problems and making meaning out of new ideas
   a. Apply strategies to overcome common anxieties related to math/physics/tests/performance
5. Identify, read and comprehend relevant instructions

III. The Investigative Science Learning Environment (ISLE)

Two intentionalities:

1. Students learn physics through engaging in the practices of physics
2. The way students learn physics enhances their wellbeing

To learn more:
- Recent PhysRev article on ISLE
- Recent talk on ISLE at UBC
- Upcoming AAPT Workshop (W10A)

Etkina and Van Heuvelen, 2001, 2007; Etkina, 2015
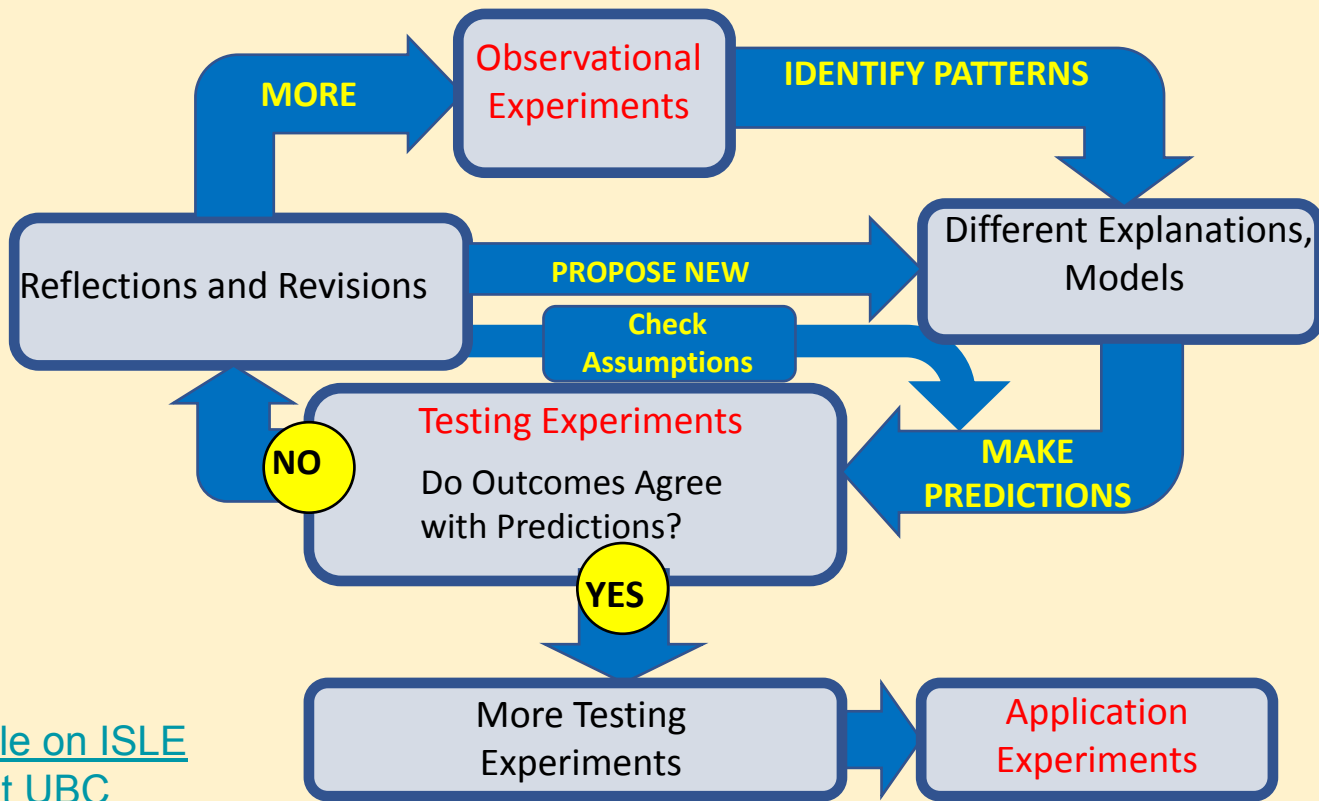
IV. Main Assessments

1. Online, timed, closed-response quizzes
   a. Question formats: multiple-select, multiple dropdown, multiple choice
   b. 6 questions in 25 minutes, completed individually
      i. 5 conceptual questions and 1 quantitative question
2. "Two stage exam" format
   a. "Context" provided in advance two days before each quiz.
   b. All questions on the quiz involve applying content learning goals to the context.
   c. Students are encouraged to collaboratively discuss context in advance of the quiz.
3. Practice opportunity as first version of quiz
   a. Content was divided into 6 main modules.
   b. Each module had a Quiz A and a Quiz B, at least 2 weeks apart (different contexts).
   c. Quiz B score would replace Quiz A score if it was higher.
   d. Marks and solutions would be released ASAP after each quiz (usually same day).

V. Learning Activities

1. Auto-graded on Perusall (for optional classwork credits)
   a. Textbook reading
   b. Active Learning Guide activities
      i. Enabled free-response questions to be answered collaboratively
2. Synchronous classes on Zoom, video-recorded
   a. 3 times a week for 50 minutes
   b. Questions asked verbally with responses requested in chat
   c. Occasional polls
   d. Review of learning goals, exposition, video-demonstrations, simulations, example problems
3. Collaborative multiple-choice questions on Team Up! (for optional classwork credits)
   a. 3-5 questions paired with each class, initially with time allotted in class with breakout rooms
   b. Students can form groups and choose a "driver". The driver answers questions for the whole group
   c. Partial credit awarded for correct answer on 2nd or 3rd try.
4. Underrepresentation Curriculum
   a. 4 classes; discussion and break-out rooms
5. Practicals (labs) -- see poster on labs

VI. Challenges

1. Communication and feedback loops in virtual environment
   a. Lack of feedback on Perusall led many to find it not useful
      i. Participation in homework dropped around midterms
   b. Lower-than-usual engagement levels on Piazza
   c. Misinterpretations of marking scheme (misperceptions of failure)
   d. Helpful: Introduced "Class Ambassadors"
      i. 3 student representatives met with me weekly starting about halfway through the semester
      ii. Discussed student concerns and possible changes to address them
2. Stress created by tests
   a. Technical difficulties with online quiz platform
   b. 2-stage and A/B formats did not relieve issues with closed-response tests
3. Failure of planned collaborative online activities
   a. Breakout rooms did not work for first week
   b. New collaborative platform crashed during first attempt to use it; was abandoned based on class vote
4. Results: Lower learning gains on CSEM and CLASS than previous years
   a. Consistent with lower perceptions of learning on SALG