PRE-CLASS ONLINE MODULES: "LOW COST" VERSION OF A FLIPPED CLASSROOM?

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MOTIVATION

Preparation before class can significantly improve the learning process by "priming" the mind of students before the enter the classroom. Online modules can enhance student learning as a a form of flipped classroom at relatively low cost to the instructor.
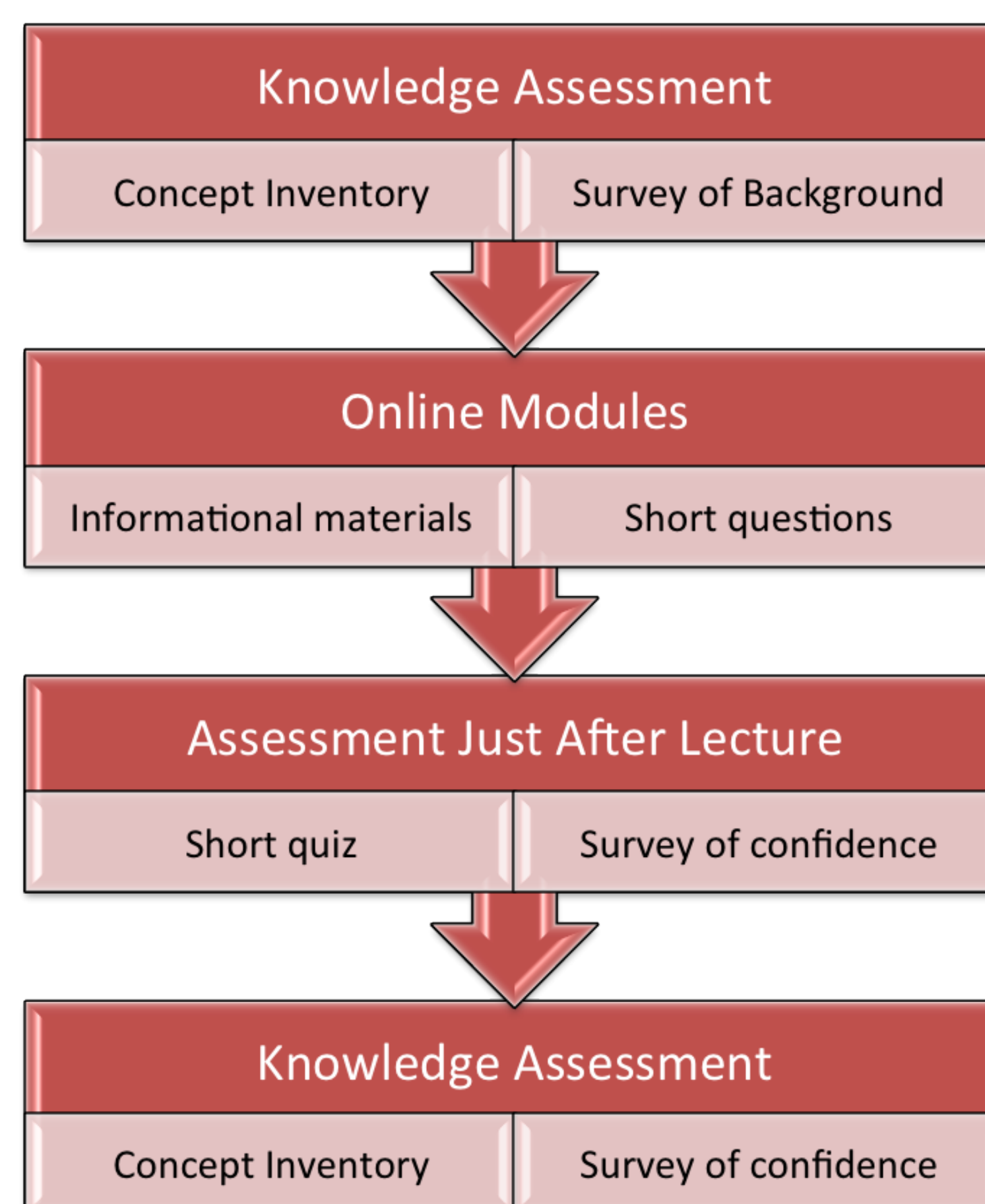
Research Questions

How do these online modules...

- Improve the learning process or speed at which material is learned?
- Improve retention of course material or depth of understanding?
- Influence students with varying technical background?

PROJECT DESIGN

Introduce online modules via CTools and assess student understanding and confidence in material

Specific course details:

- Engineering 100, Winter 2014
- Emphasis on solar energy
- Introductory physics and circuits

ONLINE MODULES

Issue modules via Lesson Builder in CTools

As a car approaches an intersection driving the traffic signal turns yellow when it is 100 meters from the middle of the stop line. The car weighs 1000 kg, it can speed up at 5 m/s^2 and it can slow down at 10 m/s^2. The length of the yellow light is 4 seconds. What is the maximum force the engine can provide?

- 100 N
- 125 N
- 250 N
- 5 kN
- 10 kN

Answer!

Show Grading Pane   Show Poll

Module Topics

- Mechanical Energy
- Electricity
- Resistive Circuits
- Diodes
- EM Waves
- Solar Energy & Solar Cells
- Batteries

Modules consist of:

- Short videos (typically Youtube)
- Short problems and solutions
- Approximately 20-30 minute commitment before class

### Split class into two groups

- Blue group
- Maize group
- Selectively issue modules
- Compare assessment results

ASSESSMENT

Concept Inventory

20 questions on mechanical energy, resistive circuits, diodes, and energy

A steel ball is placed at position A on the curved, hard surface shown below. The surface is fixed to the table on which it sits so that it does not move. The ball is held at rest at position A and then is released. It rolls smoothly along the surface. Which choice below most nearly describes the greatest height attained by the ball on the other side of the curve?
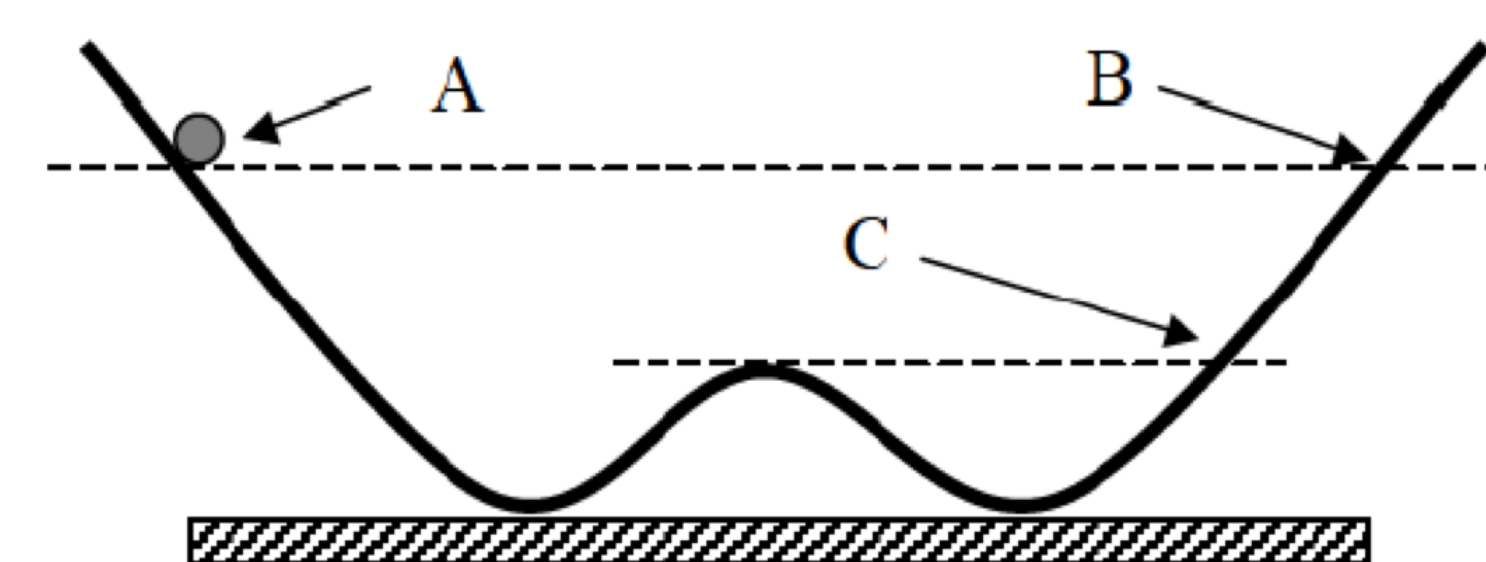
- a) It will not get over the hill in the middle.
- b) Significantly below position C
- c) Almost to position C
- d) Almost to position B
- e) Slightly higher than position B

- Force Concept Inventory, David Hestenes, Malcolm Wells, and Gregg Swackhamer, The Physics Teacher, Vol. 30, March 1992, 141-158
- Circuits Concept Inventory, Bob Helgeland and Dave Rancour, University of Massachusetts Dartmouth
- Physics of Semiconductors Concept Inventory, Emanuela Ene, Oklahoma State University
- Energy Concept Inventory, Gregg Swackhamer, Glenbrook North High School

Quizzes

Single question at end of class related to material just presented

Example: You would like to charge a battery with capacity of 2 Wh. Given a solar cell power conversion efficiency of 15% and incident solar power of 1000 W/m^2, what area of solar cell would be required to provide the required power to fully charge the battery in 10 hours?

Survey of confidence:

- ☐ I do not feel confident even starting the problem.
- ☐ I have an idea of where to start but don't feel confident in implementing the concepts
- ☐ I am fairly confident, but I am having difficulty understanding _____
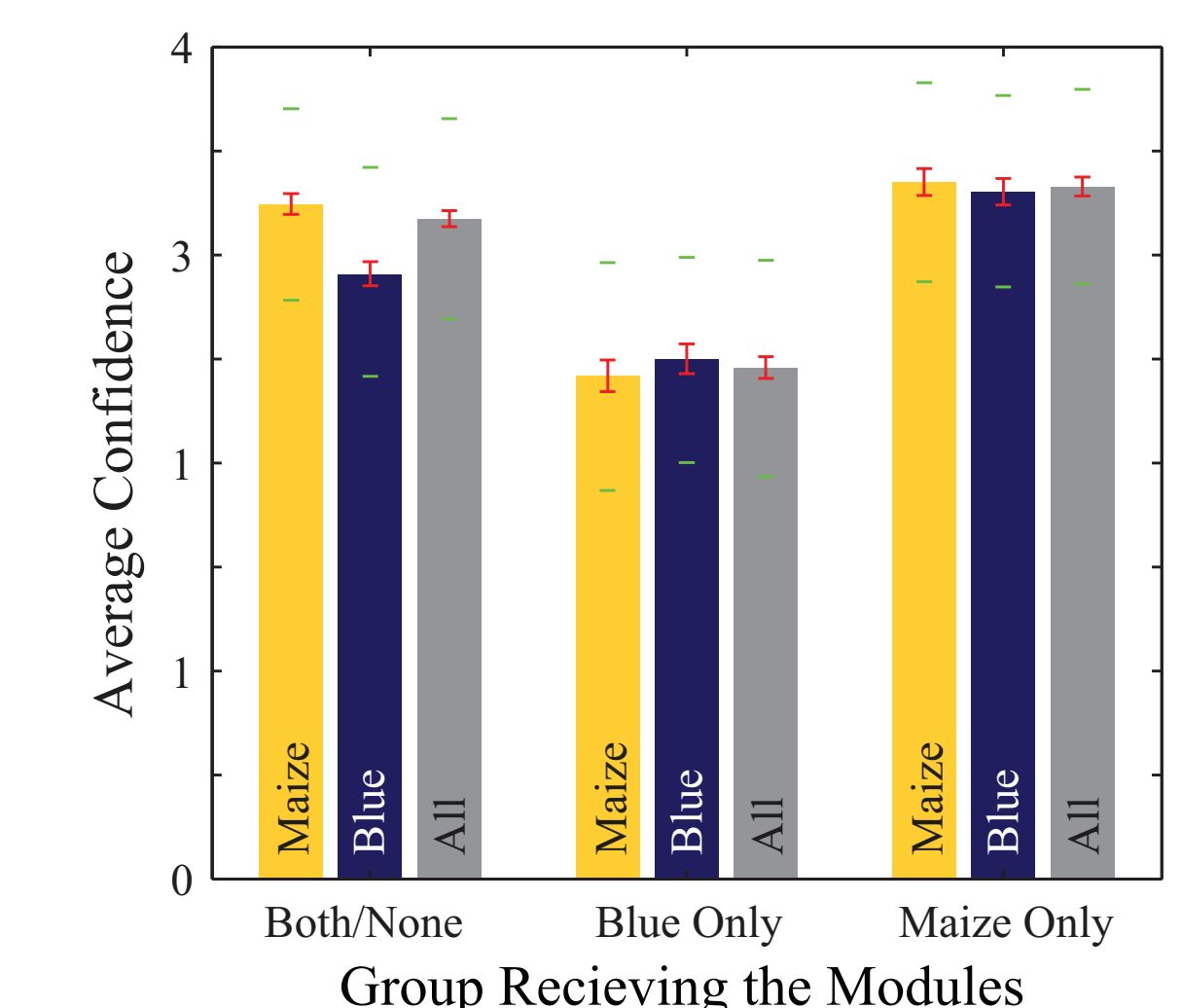- ☐ I am confident in the material

RESULTS

Quiz Performance
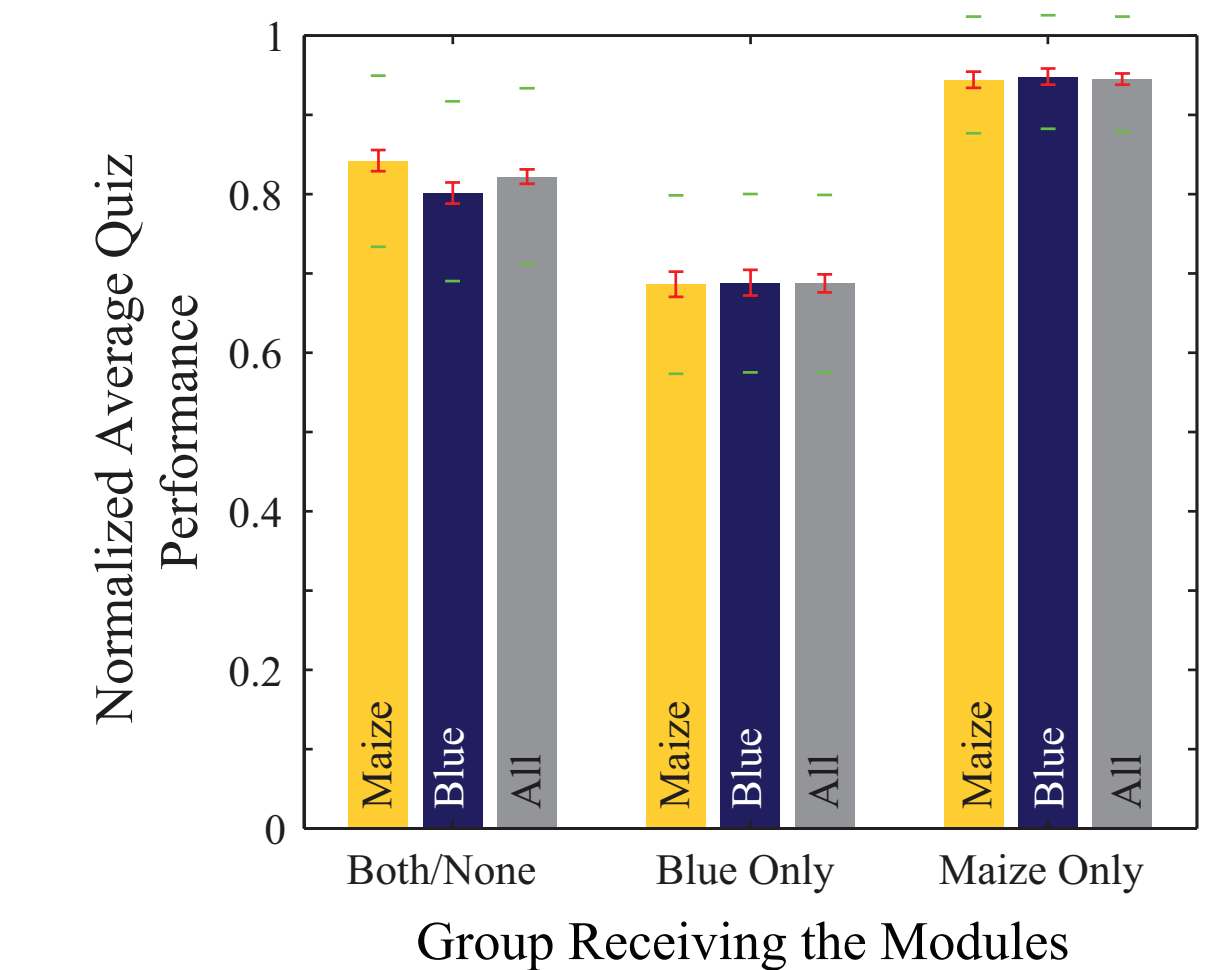
- No correlation observed between quiz performance and modules, though quiz performance is generally high for all students

Confidence in Material

- Slight increase in confidence reported for groups receiving modules, but not conclusive

CONCLUSIONS

While the initial data do not indicate pre-class modules significantly help students understand the material, better assessment tools may more effectively evaluate the impact of the modules. Additionally, feedback from surveys on the value of the online modules will be solicited to better understand student perspective on module worth, and additional data, including the exam scores and end of semester concept inventory, will be analyzed to evaluate whether the modules have a long-term impact on learning the material.

ACKNOWLEDGEMENTS