Blended Introductory Physics Course for Science Programs: Instructor's Experience of NCAT Redesign

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Physics1@Ryerson

- Calculus-based introductory physics course for science programs (offered since 2005)
- Mechanics (3/4) + Electrostatics (1/4)
- Includes students in life sciences, physical sciences and mathematics
- 500+
- 3 “lecture” hours per week
- 2 lab hours every other week
- 2 tutorial hours every other week
- This course is typically taught in two or three parallel lecture sections
- All lecture sections share the same syllabus, common mandatory labs and tutorials, and a common grading scheme for all evaluations.

Challenges

- On average, about 30% of students do not have grade 12 physics experience
- The course had low retention and low successful completion rates
- Students' preparedness for the upper year courses (knowledge retention)

Motivation for Course Redesign

- Requires extensive human resources, as well as the space and equipment requirements and constraints
- To deal with continuous increase in introductory science class sizes for science, pre-medical and engineering programs
- To improve the retention and completion rates
- To improve the quality of student learning and preparedness for upper year courses
- The course had been a work in progress, with small incremental improvements

What is NCAT?

- **National Council for Academic Transformation (NCAT)** http://www.thencat.org/) is an independent, non-profit US-based organization that "provides leadership in using information technology to redesign learning environments to produce better learning outcomes for students at a reduced cost to the institution".
- The NCAT staff includes faculty members, administrators and researchers with extensive experience in higher education.

The National Center for Academic Transformation

Experts in improving learning and reducing cost in higher education.

NCAT Course Redesign Key Elements

NCAT identifies eight main elements of successful course redesign:

- establishing greater course consistency through the whole course redesign
- requiring active learning
- increasing interaction among students
- providing regular assessment and prompt (ideally, automated) feedback
- providing students with one-on-one individualized, on-demand assistance from qualified personnel
- allowing differentiated learning and sufficient time on task
- thoroughly monitoring student progress and intervening when necessary
- measuring learning, completion, and cost

Ryerson Courses Redesign

- In 2014 Ryerson University applied for and received funding from the government of Ontario to carry out a pilot course redesign project
- Funded through a Productivity and Innovation Fund (PIF) grant
- Two goals were simultaneously pursued in this project:

1) improving student learning outcomes

2) improving the institution's capacity to deliver enhanced educational experience efficiently (i.e., productivity improvement)

Ryerson Courses Redesign

- Fourteen courses across different faculties were selected for the pilot on course redesign
- Represented science, engineering, business and community service courses
- The courses redesign followed the NCAT guidelines
- The large-enrollment introductory physics course for science program majors was among the fourteen courses selected for the pilot

The Supplemental Model

- The changes in our course can be characterized best as the supplemental model of NCAT

  The Supplemental Model

- retains the basic structure of the traditional course

  and

  a) supplements lectures and textbooks with technology-based, out-of-class activities

  and/or

  b) changes what goes on in the class by creating an active learning environment within a large lecture hall setting“.

- In our case, both features a) and b) were present

Course Before the Redesign

- Lectures with Peer Instruction supported by clickers
- Mandatory home homework offered through “Mastering Physics” platform
- Labs
- Tutorials

Course Modifications

- The main change was expanding the online component
- Retained in-class large lecture setting
- Enforced pre-lecture preparation by checking the completion of assigned pre-lecture tasks

Course Online Component

- Online component allows students to progress through the materials at their own pace
- We use online self-tutoring/homework/assignment system (Mastering Physics from Pearson Education) http://www.pearsonmylabandmastering.com/northamerica/masteringphysics/ to assign short pre-lecture reading quizzes as well as tutorials and post-lecture extensive homework problem solving assignments

Relatively New Features in Mastering Physics

- Short videos with built-in self-evaluation questions
- Adaptive features for homework assignments (differentiated follow-up assignments that can be added based on the needs of the individual students)
- The access to Learning Catalytics is added through MP

Reinforcing Pre-Lecture Preparations

- Assign pre-lecture textbook reading and/or video watching and
- Monitor the compliance: expand pre-lecture assignments to monitor the students compliance with pre-lecture reading and/or watching videos requirement

Post-Lectures Homework Problem Solving

- Adaptive (differentiated) follow-up assignments based on the needs of the individual students

The Results: Learning Environment

- **Improved compliancy with pre-lecture studies**
- **Improved ongoing automated but highly individualized feedback**
- Improved consistency between different class sections
- Improved accessibility to overcome work and scheduling constraints
- With the increase of the online component of the course, the role of the Teaching Assistants shifted from administering and grading toward more tutoring and mentoring roles

The Results: Learning Outcomes

- The students achieved better mastery of core physics concepts included in the course syllabus
- Further improvement in retention and successful completion rate which was achieved without increasing the cost of course delivery

Challenges

- The students do not complete the suggested tasks unless the activities are graded
- Academic integrity issues for the unsupervised online activities

Future Plans

- Use the systems that allows to ask questions not limited to the multiple choice format
- Explore systems that facilitate collaborations between the students
- Explore open resources

Thank you!

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