

# Flipping an Introductory Physics course - a first experience

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This poster will provide a detailed description of the use of the flipped classroom instructional model in an Introductory Physics course for Life Science majors at Western New England University in the Fall semester 2013. Challenges encountered with regards to student behavior and attitudes will be discussed, as well as some thoughts about future improvements.

# Physics of the Life Sciences at WNE

- Two semesters: Phys 123/124, three lecture hours + three hour lab per week
- Prerequisite: One semester of Calculus
- Students taking sequence (no first year students):
  - Pre-pharmacy (about half of the students, only take Phys 123)
  - Biology
  - Forensic Chemistry
  - Forensic Biology
  - Health Science
  - Pre-PA

# Topics covered in Phys 123/124

- Phys 123:
  - Mechanics (point masses, some rigid body rotation)
  - Elasticity
  - Oscillations
  - Fluids
  - Thermal physics
- Phys 124:
  - Electricity & Magnetism
  - Mechanical waves
  - Geometric Optics & Wave Optics
  - A few modern physics topics
- Labs:
  - for both: standard introductory physics experiments with home-grown lab manual; requires written lab report completed during lab time

# General Challenges with Phys 123/124

- Student attitudes:
  - Service course
  - Students often don't see relevance to their major
  - Students have already taken one year of science courses (BIO/CHEM) and expect that the developed study skills (e.g. memorization) will get them through Physics
- Mathematical challenges
  - General lack of math skills
  - Some (juniors/seniors) took calculus course several semesters earlier
  - Can only assume Differential Calculus background, so “Calculus light” Physics
  - Choice of appropriate book -> currently using Algebra-based book with calculus supplements
- Preparedness
  - Some students had Physics in High School, some did not
  - Students don't do reading assignments
  - Students don't know how to read physics textbook

# Motivation – Why flip?

- Increase student preparation for class
- Online lectures to support reading assignments
- Spend more class time on actively engaging students
- Compensate for lack of problem sessions (no graduate students -> no TA's) by spending more time on problems in class without sacrificing content coverage
- Increase emphasis on conceptual understanding
- Provide students with more study materials

# Elements of the Flipped Classroom

- Pre-lectures
- Reading assignments
- Practice quizzes with answers
- In-class quizzes
- Class time
- Online homework assignments
- Exams (3 midterm + 1 final)
- Laboratory (standard physics lab)

# Pre-lectures and Reading Assignments

- Have to be completed before coming to class
- Pre-lectures:
  - Voice-over PowerPoint presentations (created by me)
  - 20–30 minutes long
  - Presentation of the material, including derivations of equations
  - Some examples, worked and discussed in detail
  - Slides also posted in PDF format for students to take notes on
- Reading Assignments:
  - sections of chapters of textbook directly related to topic of pre-lecture

# In-class Quizzes and Practice Quizzes

- In-class quizzes:
  - Six questions, multiple choice
  - Check conceptual understanding of material covered in pre-lecture
  - Students that have finished quiz start working on worksheet/problems of the day
  - Results are discussed right after everybody is finished
- Practice quizzes:
  - About 10 questions, multiple choice with answers
  - Similar in style to in-class quizzes and covering the same topics, but not the same questions
  - Introduced a few weeks into semester based on student feedback

# Class time

- Start with answering questions about pre-lecture and practice quiz
- In-class quiz
- Discussion of quiz
- Sometimes: Lecture demonstration and discussion
- Problem solving in groups and/or on board
- Rarely: Standard lecture or mini-lecture (only if no pre-lecture was assigned)

# Homework Assignments

- Online homework using Wiley Plus
- About 15 problems per week
  - A couple of conceptual problems
  - Three tries
  - Homework split into two parts: one due Wed. , one Fri.

# Results

- Student evaluations indicated that the students did not like the flipped classroom model:
  - “felt like I was teaching myself”
  - “can learn much better from standard lecture”
- Exam averages seem to be better than in years past, but no statistical analysis has been attempted
  - One reason: exams have larger emphasis on conceptual understanding (about 1/3 of exam)
    - > difficult to compare to previous years

# Challenges

- Enormous amount of work first time around (previously used chalk and blackboard, no PPT)
- Negative attitudes of students (especially Pre-Pharm) towards flipped classroom model
  - Flipped courses had never been taught at WNE especially in the Sciences
  - Students had preconceived notions of what a science course should look like (e.g. standard lecture, memorization)
  - Some students did not watch the pre-lectures or only some of them
  - **Usual problems encountered when learning physics were now blamed on flipped classroom model**

# Challenges (cont.)

- Student in-class behavior:
  - Reluctance to actively engage
  - Instead of focusing on problems, some students used group work time for chatting or drifting off
    - Students did not see the value of solving problems with instructor present to help and give guidance (expressed on course evaluations)
- Potential future challenge:
  - In Fall 2013, I taught all four sections of Phys 123; next time I will teach only two

# Ideas for the Future

- Find better ways to get students to buy into the flipped classroom model
  - Small incentives for watching pre-lectures?
  - Work on improving in-class student behavior
- Inclusion of more life science related examples to emphasize relevance to student's majors
- Re-work the lab experiments to make them more relevant