Blending Intro Physics Using MOOC Content

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Overview

Beginning in Fall 2013, Georgia Tech began offering a blended introductory mechanics class with a lab component. This class used previously-generated content from the introductory mechanics MOOC offered by Georgia Tech. Students watched lectures and performed laboratory exercises outside of the classroom on their own time. In-class time utilized active learning techniques, group problem-solving, and scientific communication. This poster summarizes our design process, course structure, and makes a comparison with a similar non-blended course. We find no difference between the two classes in FMCE gains or final exam scores.

Course Management

30 minutes a week online Piazza forum

90 minutes a week online homework

WebAssign ONLINE HOMEWORK AND GRADING

Blended Experience
In-class, Weekly

50 minutes active learning

150 minutes group problem solving

20 minutes practice with lab report & rubric

50 minutes free-response assessment

Individual Assessment
free-response, proctored

1 Common Final Exam **170** minutes

2 Midterm Exams **90** minutes each

8 Quizzes **50** minutes each

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BILL & MELINDA GATES foundation

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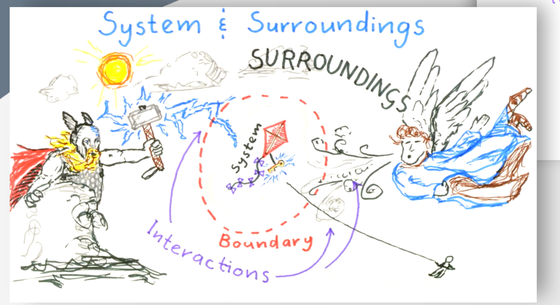
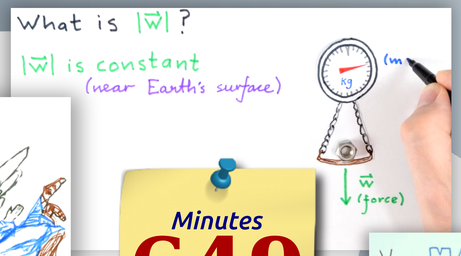
Evaluating Lab Reports

Criterion	Marginal						Advanced
Organization Structure	- No clear organization/logical structure - Lacked introduction and/or conclusions - Introduction fails to present problem - Introduction lacks a statement of result - Introduction lacks preview of major sections - Few or no transitions or signposts - Viewer is "lost"	Poor	Fair	Good	Very Good	Excellent	- Excellent organization/logical structure - Excellent intro and conclusion - Introduction clearly states problem - Excellent statement of result in introduction - Introduction contains excellent preview of major sections - Excellent use of transitions and signposts - Speaker helps audience follow structure
		Comments:					
Content Models	- Fails to identify models relevant to the physical system - Lacks discussion of main physics ideas - Lacks discussion of application of ideas - Lack of connections between fundamental physics principles and the model	Poor	Fair	Good	Very Good	Excellent	- Identifies models relevant to the physical system - Excellent discussion of main physics ideas - Excellent application of ideas to problem - Excellent connection between fundamental physics principles and the model
		Comments:					
Content Prediction Discussion	- Data used to initialize the model are not clearly identified - Fails to discuss how parameters are adjusted to fit data - Fails to discuss how data does or does not fit the model - Fails to discuss whether the computational model does or does not predict the motion of the object observed	Poor	Fair	Good	Very Good	Excellent	- Data used to initialize the model are clearly identified - Excellent discussion of how parameters are adjusted to fit data - Excellent discussion of how data does or does not fit the model - Excellent discussion of whether the computational model does or does not predict the motion of the object observed
		Comments:					
Content Overall	- Discussion contains major physics errors - Lack of discussion of "What if..." question - Lack of discussion of "What does it mean" question	Poor	Fair	Good	Very Good	Excellent	- Discussion contains no physics errors - Excellent discussion of "What if..." question - Excellent discussion of "What does it mean" question
		Comments:					
Production Delivery	- Poor lighting/low resolution; video hard to see - Poor audio, audio difficult to hear - Distracting vide (e.g., shaking) - Overall production quality is poor - Visuals fail to enhance message - Poor vocal qualities in narration	Poor	Fair	Good	Very Good	Excellent	- Excellent lighting/resolution - Excellent audio quality - No distracting video - Overall production quality is excellent - Visuals reinforce and support message - Excellent vocal qualities in narration
		Comments:					

Low cost (Labor, Tools)

Whiteboard Animation
with student created content





Minutes **649** of Video

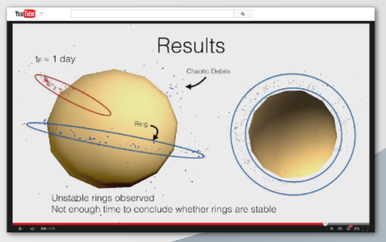
Better science than professional animators
Expresses student creativity, enthusiasm

coursera

Peer Evaluation
with WebAssign

Minutes **460** for each lab

Video Lab Report
with YouTube



Each student creates a **5** minute lab report anonymously uploaded to YouTube

Traditional Intro Physics

150 active learning lectures **180** online homework

Weekly minutes

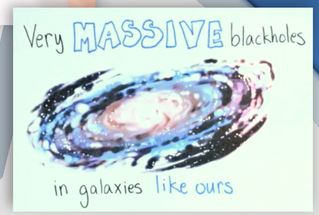
80 traditional lab activities

60 group problem solving

1 Common Final Exam **170** minutes

4 Midterm Exams **90** minutes each

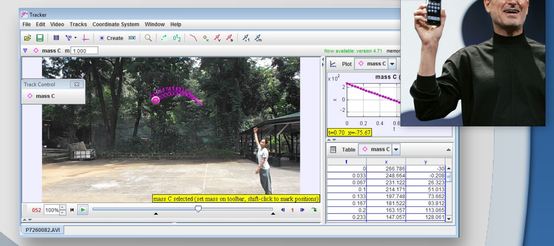
8 In-class quizzes **30** minutes each



Lab Topics
2-3 weeks each

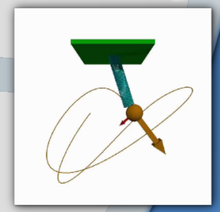
(1) Constant Velocity
(2) Free Fallin' (1D force & motion)
(3) Black Holes (2D force & motion)
(4) Rope Physics in Sports (Energy, Oscillations)
(5) Capstone: Choose Your Own Adventure

Data Acquisition
with Tracker



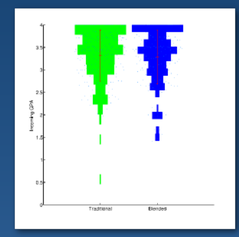
Computational Modeling
with VPython

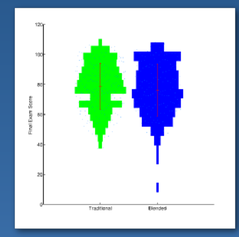
```
# Define Physics Parameters
ball.position = vector(-61,1,0) #ball position (x,y,z)
ball.mass = .145 #ball mass in kilograms
ball.velocity = vector(25,0,0) #ball velocity (vx,vy,vz)
ball.netForce = vector(35,0,0) #ball net force (Fx,Fy,Fz)

# Ball physics update
ball.velocity = ball.velocity + ball.netForce/ball.mass*time.deltaT
ball.pos = ball.pos + ball.velocity*time.deltaT
```

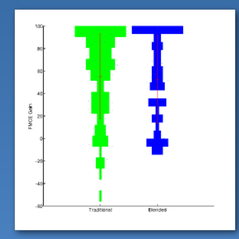


Traditional (green) Blended (blue)

No Statistical Difference







Final Exam by Cohort