Plymouth State

15 in 15

Re-engaging Students in Intro STEM Classes

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Physics 1
Fall 2022

- What I thought would work:
  - Modeling Instruction framework
    - Constructivist labs
    - Lots of whiteboarding
    - Group problem solving
    - Very little lecture
  - Intro Physics for the Life Sciences curriculum
    - Restructured topics
    - Focus on life science applications

What Happened?

University Physics 1

- Modeling Instruction worked great!
- Lots of active engagement from students in the class
- These were meteorology and chemistry majors

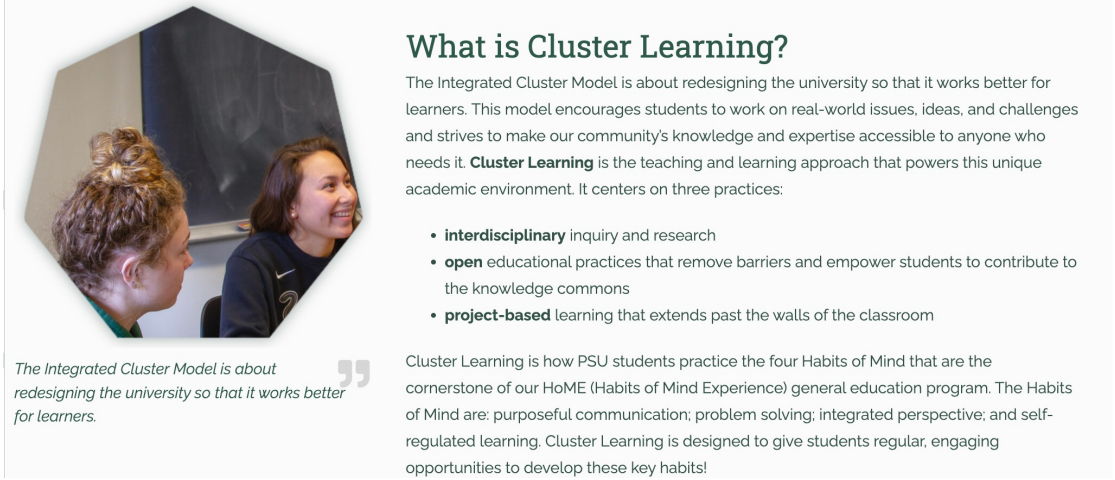
Physics 1

- Crash and Burn
- Lab structure (Modeling) didn't work well
- Very little student engagement in whiteboarding and group problem solving
- Students didn't do well on assessments

Now What?

- I felt confused.
  - This framework and approach usually worked well.
- I felt disheartened.
- I knew COVID played a role in this.
- I knew I had to do something.

What about those clusters?



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What is Cluster Learning?

The Integrated Cluster Model is about redesigning the university so that it works better for learners. This model encourages students to work on real-world issues, ideas, and challenges and strives to make our community's knowledge and expertise accessible to anyone who needs it. **Cluster Learning** is the teaching and learning approach that powers this unique academic environment. It centers on three practices:

- **interdisciplinary** inquiry and research
- **open** educational practices that remove barriers and empower students to contribute to the knowledge commons
- **project-based** learning that extends past the walls of the classroom

Cluster Learning is how PSU students practice the four Habits of Mind that are the cornerstone of our HoME (Habits of Mind Experience) general education program. The Habits of Mind are: purposeful communication; problem solving; integrated perspective; and self-regulated learning. Cluster Learning is designed to give students regular, engaging opportunities to develop these key habits!

- I was on the Gen Ed committee (now HoME).
- I had submitted a new INCAP proposal.
- I was excited about a big project-based experience.

OPEN CoLab

PLYMOUTH STATE UNIVERSITY

Who ya gonna call?

Physics 2
Spring 2023

- ”Dipped my toes” with a ½-semester project
  - First half – physics as usual
  - Second half – the project
- Physics 2 specs
  - 8 students enrolled
  - All were pre-PT (physical therapy)
- First half
  - Same lack of engagement as Physics 1
  - Even worse, because 8 students meant VERY quiet

Did it work??

YES!
YES!
YES!

The Students…

- Came to life!
- Were curious.
- Worked hard.
- Worked well together.
- Were open to feedback.
- Were engaged in the process of co-creation.
- Were grateful.

Rave Reviews

What else would you like your instructor to know about your learning experience?

Student Responses
I loved this professor, I think he is by far one of the best professors I have had at plymouth state. He is very personable, he comes up with ways to get students attention from the minute you walk into class until the clock ticks and class time is over. He does a very good job of relating the concepts we are learning to each and every students major/future career so that all students understand in a better way. He is not one to just lecture, he is always engaging students and making sure we understand concepts before he moves to the next one. He comes up with questions that pertain to anatomy/exercise science and the physics behind them which I really enjoyed because all of us students are pre PT students so it is easier for us to understand concepts when questions are related to our field of study.
I liked how the course was laid out with the project at the end of the semester, i thought it was a good way to engage everyone. I do wish we did more hands on labs.
I enjoyed the half and half semesters. It kept me engaged in this class.
I found the class to be enjoyable even though Physics isn't what I would typically think of as enjoyable. I took a lot from this class and I am glad that I was in this time with this professor.
I had a lot of fun in this class. I have never enjoyed a class like chemistry or physics, but I thought it was really cool to do something that we were all are interested in.
I think overall, I really liked the set up of half lecture and half project term because not only does the project focus on the physics principles but really helped us to interpret with meaning in comparison to our own field of study.
We all enjoyed the project!

Proposed Framework

Project Outline (Possible)

- *Week 1:* Connections: Working together to identify how physics connects and intersects with your field of study and career intentions. Presenting connections.
- *Week 2:* Project Shaping: Considering various themes and applications, exploring measurement and analysis tools that are used in the field or model physical scenarios, and investigating modes of delivering a public presentation. Presenting measurement techniques or field-based modalities, example data, possible stakeholders, and big picture questions
- *Week 3:* Project Proposal: Form teams, focus on a target theme and audience, determine an experimental approach and mode of presentation. Present project plans, gain feedback, consider next steps.
- *Weeks 4-6:* Work on Project, Project Check-Ins each week
- *Week 7:* Project Completion and Reflection
- *Week 8 (Final Exam):* Project Presentation

But Wait…

- Doesn’t this mean I’ll cover less content in my course?
  - Yes. Probably *a lot* less.

This is a significant departure from business as usual.


SOAP

Week-by-Week Itinerary

The following is a week-by-week summary of how the project proceeded.

- I trusted the “emergent” nature of the project.
- I planned each day only after the previous class had ended.
- I always gathered feedback and input from the students.

Week 1

1 - Exploratory Research

Questions:

- What are 4 or 5 connections between your field (physical therapy) and physics?
- Within those connections, what are the primary measurement tools and modalities and types/topics of experimental research?

  Give students 20-30 minutes to research (individual or small groups)

2 - Digging Deeper into Measurement Tools

The approach moving forward is to dig deeper into a variety of measurements tools:

1. Goniometer (Megan and Kobe)
2. Force plate (Tess and Christian)
3. Electrical (Bryan and Katie)
   - can include EKG, EMG, stim
   - Katie, you mentioned blood pressure, so you could explore that if you wanted
4. Motion analysis (Sophia and Courtney)
   - can utilize apps like Onform or Dartfish, also Capstone in the classroom

Week 2

3 - Learning about Measurement Tools

Start by presenting the Digging Deeper in Measurement Tools ppts.

- Goniometer (Megan and Kobe)
- Force plate (Tess and Christian)
- Blood pressure (Bryan and Katie)
- Motion analysis (Sophia and Courtn

4 - Testing Measurement Tools

Start with each student sharing ideas they thought about

a. Courtney - vertical jump for force, exercise and pre- post- blood pressure
b. Christian - squat with different types of weight, force for driving up
c. Bryan - different types of jump, squat jumps, with force plates or just-jump-mats
d. Katie - pre-post blood pressure, force plates too
e. Kobe - where force emerges from foot, use goniometer
f. Megan - motion analysis to see someone's gait, compare force in feet with walking and jumping
g. Sophia - curveballs, or something related to dance
h. Tess - force plates, but looking at rehab motions

Exploring some of the measurement tools

I pulled out the force plates, looked at motion analysis on Capstone, and considered the human arm model, but the angle sensor isn't helpful separate from the model. Could use an app to get angle vs time and angular rotation.

Week 3

5 - In the Lab

Meet in the HPC lab to start trying out measurements with various equipment
Checked out body-mass index machine, vertec (jump-height) – but group seems to be honing in on force plates.

6 - In the Lab

Meet in HPC classroom again
Testing out both of the force plates, how to sync data from each plate.
Brainstorming research questions, students were putting ideas on the whiteboard,
Honing in on doing different jumps, comparing left/right leg, what measurements to focus on

Week 4

7 - Proposal presentation

Overview of force plates as a tool
Focus on vertical jumps
- Purpose of those jumps, and types of jumps
- Depth drop into a jump

Measurement
- Comparing right and left leg force production
- Rate of force development

Example study 1
- Comparing male and female, "dominant" vs non-dominant leg

Example study 2
- Vertical tests, with flight time and height analysis, GRF

Research question
- Does a subject's dom leg produce more force?

Methodology

8 - Experiment Day #1

Students used the time to do jumps: two-legged jump, one-legged jump on each leg. Started to do depth jumps, but the drop box was taken away before they could finish.

Week 5

9 - Experiment Day #2

Students did the depth drop jump today, took videos and pictures.
Began uploading the data from all jumps to Excel to begin analysis.
We'll meet in Boyd classroom next class.

10 - Data Analysis Day #1

"Pop Quiz" on Force Plates
Data Analysis

Week 6

11 - Data Analysis Day #2

Gave students: "Ungrading" schema for grading the project and the rubric for the final project presentation.

12 - No Class

Students continue working on the project on their own.

Week 7

13 - Project Preparation

Questions I'll ask:
Who should I definitely invite to the final presentation?
What can I do to help support them further?

Students worked on presentation in class, only stayed 1 hour

14 - Reflection & Project Prep Day #2

Reflection: Give students a set of questions to reflect on about the project experience. Fill out on your own for the first 5 minutes. Then discuss in groups and have feedback from each table.

Project prep