Revitalizing an undergraduate physics program: A case study from the University of Arkansas

This work supported in part by NSF Grants DUE-9455732 and PHY-0108787

Gay and John Stewart
In better-serving all students, a department also benefits. University of Arkansas, Fayetteville has seen a drastic change in number of majors, the number of students active in research and the number of graduates pursuing graduate work while also increasing the number of majors who decide to teach.
University Physics II (UPII) is the calculus-based introductory electricity and magnetism course at the University of Arkansas.

{PER hire to start this…}
Analysis of Differences by Instructor:

- Implementation Problems:
  - Instructor attitude toward materials
  - Integration of in-class activities in with reading, homework and lecture
  - Instructor comfort with unstructured environment
Fortunately the major problems arose in the first semester. For the second semester we revised the materials to strengthen integration:
• have specific educational goals in mind as writing activities
• tie activities into lecture by having them derive stuff in lab
• tie activities into homework by having students make measurements in class
• write our own homework problems on trouble areas
• write our own homework problems for measurements
• In the second semester there was no significant difference in grades between instructors, although the teaching styles still varied. The one noted difference was that in the class were the instructor still lectured, the students left the class with a much less enthusiastic review, although that section had the highest test average, overall.
• Now, write all our own problems…
Calculus-based class format:

- Students required to read material and do qualitative homework before class, daily quizzes make sure.
- Large number of experiments, activities and demonstrations
- Lecture kept to a minimum, closely tied to activities. Lecture/lab twice a week
- Interactive discussion strongly encouraged
- Written homework to pull it all together
Of course, UPII wasn't the only change we made!

- The new class opened up a dialog with the engineering faculty.
- New BS Program-Multiple Tracks for Multiple Career Paths
- Change of Prerequisites
- Exceptional mentoring and advising
- Chosen for PhysTEC
  - {Second PER hire}
Once you get them

• Upper division courses get better…a lot of excited, well-prepared students
• They get involved in research…many of our undergrads are published
• The whole place just “feels” better
• Other faculty get involved!
• Track record of graduates-best recruiting
Some supporting bits

- For broader ideas, you can read the paper, citation later....
Teaching Assistants

• TA’s come in with strong attitudes on teaching: “Physics is supposed to be hard.”
• With adequate TA preparation, the setting becomes an opportunity for good student interaction: “I don’t know if I can still teach it that way!”
• Higher attendance at office hours and student approval ratings carried over to teaching a traditional lab.
Teaching Apprenticeships

• Some undergraduates wanted good preparation before going off to graduate school

• Even engineering counts it as a technical elective—“you really know it, on a whole different level, when you can teach it”

• Great experience for future teachers, mentored in a reformed course. College of Education counts it as a student teaching experience.

• Place to improve preparation of students who transfer…
The University of Arkansas Success Story

Number of Graduates

- Physics Majors
- Physics Teachers

Dramatic increase in majors enabled a large increase in physics teachers

PhysTEC start

PhysTEC end; program gains continue post-funding

Year


Results?
Summary: From course modification to recruitment

- Activities, homework and lecture or discussion must be integrated. You should have real learning goals in mind. Remember, we got factor of 4 with one class!
- The person “in front of the class” should be excited about physics and happy they chose it as a career.
- The person “in front of the class” needs to get to know the students. If they have potential, let them know that even if they aren’t majors, they are welcome to come talk to you.
- If the new major adviser is someone different, make the transition a personal introduction.
Once we had some students wanting to major in physics, and once we figured out how to advise them, it was time to think of some other things we needed to do to help them be successful:

1. Give them their own space, but visit.
2. Get them involved (outreach as well as research).
3. When an upper level class isn’t going well, even with faculty mentoring, provide resources, encourage study groups. (still de-recruits, but…)
4. Encourage them to apply for state and national awards, find out how to help them be successful in these applications, and celebrate their successes.
Don’t spin your wheels

Collect data

• Who are your majors
• Contact info
• Outcomes!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
  – Employers
  – Success stories
• Measure if your efforts are successful
  – HSPD
Environment: Do people get along? Do students feel comfortable in the department?

Presence: when students walk in to your building, does physics have a presence

Student Space

Outcomes: we want more physics majors because we want more successful individuals

Assessment: measure stuff! Student exit surveys, interest in intro classes, don’t be afraid to ask, the answers can help you (ask anonymously, you never know what you will find out).
Further Information