RESEACH PROJECT-BASED LEARNING THROUGH *COMPUTATIONAL METHODS OF PHYSICS* COURSE

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Abstract

The poster presents results and insights from the Computational Physics course taught from 2002–2008 at the University of Delaware. The course is organized around six Research Projects covering different subfields of numerical methods while introducing a topic from physics that is typically not covered in a standard undergraduate curriculum. After the two week period assigned for the project, students write reports in the format of the Physical Review journal article or create a poster for the session which also includes peer reviewing. By implementing concepts of scientific teaching through RPBL method, students can be brought to research frontiers where their response has been particularly enthusiastic when given a chance to reproduce results from recent papers (as observed in projects dealing with topics in chaos, complexity, and spintronics) and make discoveries on their own.

Introduction

Without doubt, doctoral science programs exemplify one of the most successful educational enterprises. Envisaging an ideal course that would embody the salient features of their methods hints at the following guidelines. Such course would have to:

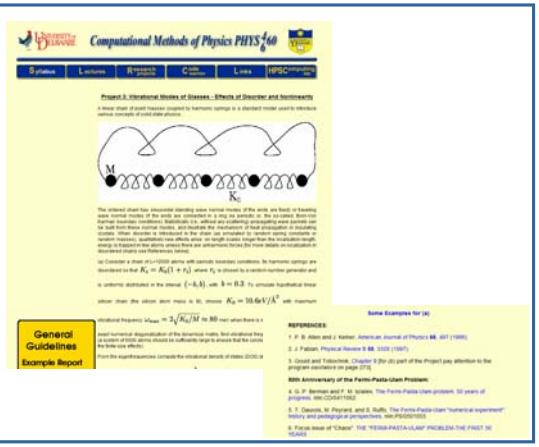
•be project oriented;
•instill collaborative efforts and team work;
•Include modern topics that are highly relevant for real-world basic and applied research problems;
•develop in stages, while stimulating active learning, intellectual curiosity, and fostering maturity;
•use research and pedagogical papers, Internet and other cutting-edge technological tools, rather than, or in addition to, a traditional single bound textbook;
•use of interactive simulations to facilitate conceptual understanding.

Recent reexamination [Science **304**, 521 (2004)] of teaching methods in science courses advocates to find ways to engage "students as scientists" in the classroom where they can develop hypothesis, design and conduct laboratory or computational experiments, collect and interpret data, and report on their results.

Course WEB

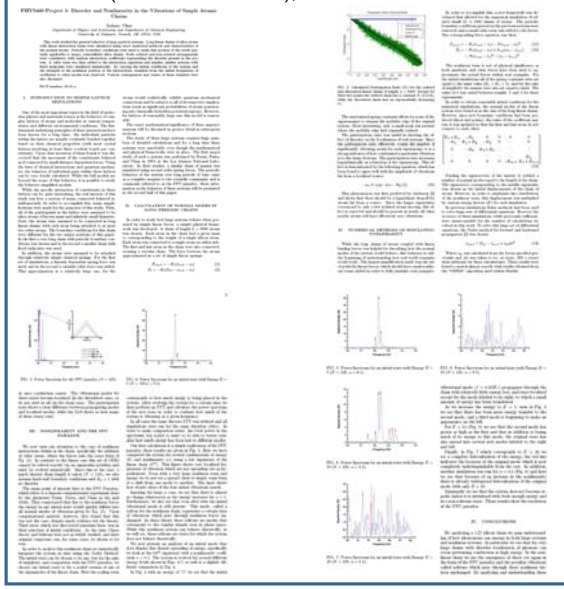
http://www.physics.udel.edu/~bnikolic/teaching/teaching.html

Six (2 weeks) Projects

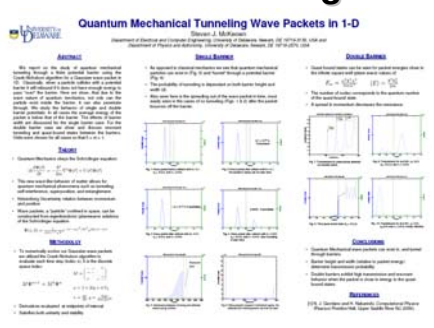


Student Reports and Results

Students prepare their reports in the form of a Physical Review article with proper formatting (two column style), citations, PACS codes,..., facilitated by using RevTeX. An introduction to Linux and LaTeX is provided at the beginning of the semester. The final form of the report is converted into a PDF file and sent, together with the codes written in Matlab (or Fortran 90 or C), to the instructor via email.



Course Poster Session and Peer Reviewing



Since Spring 2004, a novel methods of assessment has been incorporated into the course where **research teams** composed of one graduate and one undergraduate student present their results in the form of a **poster** and participate in the **peer reviewing** process of these posters conducted by all students in the class.

Conclusions

•Computational Physics courses provide an ideal setting for the implementation of scientific teaching and active learning concepts.
•Research Project-Based Learning, implemented through Computational Physics course, makes it possible for students to experience some of the topics from the research frontiers, as well as sophisticated technology used by computational physics research groups (such as multiprocessing platforms, parallel and multithreaded codes, networking, data visualization, …).
•Future: interdisciplinary projects; introduction of new forms of collaboration; expansion toward planned interdisciplinary computational science majors at the University of Delaware.