

PHYS 4620 Prospectus

Intro and Motivation

This project is focused on developing a set of heuristics for incorporating computer simulations into existing assignments in physics classes. While prior work has been done to create new curricula around computer simulations, very little work has been done on understanding how to implement a simulation into existing curricula. By researching prior studies on using computer simulations in physics classes, and through several case studies of modifying assignments and implementing them in different classes at CU Boulder, a list of heuristics will emerge that take into account the factors that must be considered when using computer simulations in physics courses.

Overview of Studies

This project has involved five different case studies in which assignments were modified to incorporate using a PhET simulation. These include modifying: a quantum tunneling tutorial for introductory modern physics courses, a homework problem about quadratic drag in Classical Mechanics I, a lasers homework in Physics of Everyday Life 2, a Snell's Law pre-lab in Physics of Everyday Life 2, and a resonance homework problem in Classical Mechanics I.

In each case, there are three general areas of analysis that emerge: analyzing the design process that the designer (me) went through, especially paying attention to the constraints presented during the design process and the reasons for designing the assignment in its particular way/ format; analyzing the students' reactions to this modified assignment, found by assigning surveys about the assignment, as well as looking at results from post-assignment conceptual assessments; and lastly analyzing the instructors' reactions to the assignments, including how they see the effectiveness of the assignment and what they believed to be helpful and effective or not.

Current Progress and Future Work

While data are still being collected and will primarily be analyzed over the summer, several ideas have emerged from this project so far. First, a set of 10 heuristics for modifying assignments has been created. This list will be refined and possibly expanded based on research of prior studies, as well as through an analysis of the studies conducted over the course of this semester. Second, a list of environmental considerations that give general guidelines for which heuristics should be implemented in a given situation has also been created, based on observations of student usage of these assignments, as well as constraints that I have faced in the design process itself. More work will be done to refine these lists, and further studies in the fall will help in doing so.

Timeline

April 2011 – Will present the quantum tunneling tutorial to a subset of students in PHYS 2130 (modern physics for engineers). One group will use a tutorial with a simulation and one without the simulation. Data analysis will be in the form of analyzing student responses on the tutorial itself (which will be collected), as well as comparing student scores on a post-assessment quiz. In addition, the resonance problem for PHYS 2210 will be handed out and a post-assignment survey will be given to the students.

May – August of 2011 – Will begin to analyze the data collected from all 5 studies done this semester, as well as continue to research prior studies on using computer simulations. The primary goal is to refine the list of heuristics to a near-final copy, and also hone in on the environmental considerations that must be accounted for when implementing these assignments. By the end of the summer, a clear vision of what aspects of this project need further study and modification will be clear, and a list of projects/ studies to be carried out in the fall semester will be written down and prepared. A rough draft of the honors thesis itself will be complete by the time school starts.

September – October 2011 – Will continue to conduct final studies that will clear any uncertain aspects of the project thus far. These studies will presumably have been chosen in the summer, but possibly will be invented in the months listed. In addition to finishing any of these studies, a final copy of the thesis will be written up and submitted on time. After completing the thesis, will prepare to defend and finish up anything else that is needed to complete the graduation with honors requirements.

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