ATE Major Project Report

Project Name:
Honors Conceptual Physics Curriculum Redevelopment

Principal Investigators:
Anthony Genova, Physics Teacher
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Institutional Affiliation:
Windward School

Our ATE Project was to develop a full curriculum module for the freshman-level (9th grade) Honors Conceptual Physics course using a coordinated set of physlet simulations, ranking tasks, TIPER's, assessments and hands-on laboratory exercises. The primary goal was to create a more interactive classroom using a technology enhanced Studio Physics model to stimulate student involvement in the learning process. Windward School adapted a Physics First curriculum and is now adapting a university-level Studio model (*e.g.* Scale-up, North Caroline State,; TEAL, MIT) for use at the secondary level by teaching conceptual physics in a technology-enhanced active learning environment. The active learning environment is facilitated by classroom design and the grouping of students using assessments to identify differing skill levels. Students are then placed in triplets that include students that performed at high, medium and low levels on the assessments. We have designed the curriculum with significant reiteration by having problem solving activities integrated into lectures, peer learning, physlets and laboratory exercises. Students are engaged using a more interactive curriculum model and our Studio Physics First classroom, which allows us to more effectively deliver technology enhanced lessons to facilitate student learning.

The project began with a search for simulations to support chapter content. We identified chapter assessments to determine the initial level of the student's understanding of concepts and to access prior knowledge, as well as to address misconceptions. Problems, homework and practice sets were identified that are aligned with our simulations and laboratory experiments that support the physlets were developed. An experimental web site was designed to hold this chapter-based content.

During curriculum development, we found assessment design to be a particularly difficult aspect of the project. It was a challenge to find or write good assessments for ninth graders who typically possess relatively low level skill sets. We had to accommodate students' difficulty in shifting from concrete to abstract materials. We had more success with Ranking Tasks (RT) and TIPERs, although most tasks provided at the ASIP workshop needed to be rewritten for ninth graders. Much of this content was delivered directly in the classroom using personal response systems (PRS), so place holders have been added to the web site to identify their use. (Note: The PRS system was not required,

however it did help streamline the integration of additional assessments, TIPERs and RTs.)

During the course of the project, Anthony converted all of his curriculum notes into PowerPoint presentations to facilitate the delivery of lectures in the technology enhanced classroom. The PowerPoint decks also allow us to easily embed gifs and videos, along with TIPERS, RTs and example problems. Anthony found the flow of class time was improved and the lectures lead naturally into physlets and labs. Jim Bologna and Dr. Thomas Haglund (Science Department Chair) frequently observed classes to provide feedback. Anthony found the transition to an electronic format challenging, however he is gaining confidence with experience and support for learning the technology from Jim.

There are a significant number of pre-made simulations for use with our Electricity and Magnetism module in the materials provided at the ASIP workshop, as well as numerous sources on the web. Our search for simulations focused on those to match our labs and problem solving activities, and although we found most of the simulations easily adaptable to the 9th grade Conceptual Physics course, we did have to write our own guided exercises. Hands-on laboratories were used to re-enforce lectures, simulations and problem solving activities. The interactive curriculum allowed for the reiteration of principles using different learning modalities and provided an array of solid conceptual examples for the students to draw upon.

Our web page is available at:
http://physics.windwardschool.org/physics/index.html
Username: physics
Password: conceptual

The web page is organized by chapter and includes all four chapters used in the Electricity and Magnetism module. The web site has been reorganized two times mid-project and will be revamped again prior to the start of the 2007-2008 school year to better match the current pattern of curriculum delivery. Each chapter has a pre-assessment link that is activated after the students take the assessment, which allows them to review the materials throughout the chapter. The main chapter page links to a glossary page and to primary topic pages with PowerPoint notes and links to supporting simulations, animations, videos, problem sets, TIPERs and RTs , all of which intended for student review.

Future Project extensions:
Windward School considers our ATE Project a success and is actively working on developing the complete Conceptual Physics curriculum using this model. We plan on integrating more RTs and TIPERs in the classroom sets, simulation-based homework assignments and problem solving activities. The use of the PRS system will be expanded due to the students favorable response to the risk free nature of the devices and we will be able to collect data from each assessment. Assessments will be used to guide curriculum, and evaluations will measure our success.

The technologically enhanced simulation-based active learning model will be extended to all of Windward's Physics classes, including the non-honors 9th grade Conceptual Physics classes, 12th grade Physics and Advanced Placement Physics classes. The curricula of the senior classes will include more advanced physlets and open-ended laboratory experimentation. The resource web pages will be reworked to accommodate the simulations, questions, and practice problems for all levels. Windward School's long-range plans are to provide outreach which will facilitate the adoption of a Studio Physics First program at other schools. The web site will be made available to all interested schools/teachers for ideas, practice and use of materials.