INTRODUCTORY PHYSICS STUDIO LEARNING ENVIRONMENT AT NWU

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Classroom Response Technology

Introductory Survey. Student responders are used to survey the students at the beginning of class using questions drawn from the day’s lesson. The introductory survey is used as a way of introducing the lesson topics and the learning goals for the lesson.

Post Test. The same questions are administered at the end of the class meeting. Students are asked to collaborate during the re-vote. We view this as an implementation of peer instruction,1 except better, since students can use the entire lesson to reflect upon the questions of interest (it is essentially peer instruction inside-out).

Scoring. Students receive 1 point for answering anything (attendance), 2 points for answering everything (participation), and 3 points for answering everything and scoring 100% on the post test (performance).

Experimental Equipment

High-tech Equipment. NWU is fortunate to have twelve stations consisting of a Vernier LabQuest 2 interface plus sensors, including motion and force sensors. NWU also has low friction carts and tracks, complete optics kits, electronic prototyping units, etc. The equipment is used in an “integrated lecture/lab” format for students to explore physical principles and learn experimental techniques.

Low Cost/Improvised Equipment. Sometimes very simple, eye-catching apparatus can serve our instructional purposes as well as purchased equipment. Such pieces of equipment (such as the pop-can electroscope shown) help our students appreciate that the principles of physics can be fun and easily investigated, with a little creativity and imagination.3

About the Learning Studio

There are twenty-four seat learning studios within NWU’s Olin Hall of Science. Most physics courses (even upper level) are taught in these studios.

Computer Exercises. Because much use is made of simulations and calculation applications, the studio is equipped with twelve Windows PCs. Students work on simulation and calculation exercises in pairs.

Experimental Exercises. To carry out experimental exercises, the studio is set up with six experimental equipment stations. A team of four students is formed to work at each station.

In-class Activity Guide

Student activities are guided through the daily lessons using four to eight-page hand-outs. Students record their predictions, observations, and reflections. They also work out example problems. The activity guide has been customized for the NWU courses, but draws much inspiration from the Workshop Physics Curriculum.2 Each day, four papers are chosen at random for scoring. The reproduction costs of the activity guide are covered by a small course fee.

Computer Simulation and Technical Calculation

Computer Simulation. It is often more convenient and visually informative to use simulations to explore physical phenomena. Because each computer is shared by just two students, it is easier for students to engage in the activity. Simulation applications include:

- PhET Interactive Simulations, by the PhET Group at the University of Colorado at Boulder.
- EM Field 6, by David Trowbridge and Bruce Sherwood.

Technical Calculation. One of the learning goals of our course is for students to become fluent in a few industry-standard calculation platforms. It is felt that a computer savvy person is a stronger, more successful person. Calculation applications include:

- Microsoft Excel, by Microsoft Corporation. NWU owns a site license for the Microsoft Office Suite, and it is installed on all Olin PCs. Excel is used to plot and fit data sets, to carry out repetitive calculations, and even to iteratively solve Laplace’s equation in 2D (for which it really serves as a simulator).
- Mathcad Prime, by Parametric Technology Corporation. Students use Mathcad to symbolically solve equations and calculate expressions. Mathcad is units-aware and can detect dimensional inconsistency. NWU owns a 50-copy site license.

Out-of-class Engagement

MasteringPhysics. MasteringPhysics is an online homework and tutorial delivery system produced by Pearson Education. It is bundled with the course textbook (Young’s College Physics 9/E, and Young and Freedman’s University Physics 13/E). Two end-of-chapter exercises are assigned before class time as a way for students to prepare for class. Two more challenging exercises per lesson are assigned as “exit” homework. Types of questions include numerical, symbolic, and even graphing. The system provides real time indication of response accuracy, allowing students to know immediately if they are being successful.

Handed-in Homework. Students submit a traditional written-out solution to a problem four times per semester, which is graded by the instructor for accuracy, style, and clarity. Handed-in homework allows students to express their creativity and exercise their written communication skills.

REFERENCES