A BRIEF REPORT ON AVAILABLE MULTIMEDIA MATERIALS IN THE USA

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Abstract
Over the past few years many groups and individuals in the USA have created new and useful curricular materials for use in the teaching of physics. We will briefly summarize the most promising pedagogical ideas and resources that are currently available. This paper will focus on several recent developments in textbooks and multimedia-based curricular materials and will also describe the new distribution mechanisms available at digital libraries.

New Research-Based Textbooks
One trend in publishing is the inclusion of physics education research (PER) methods in traditional textbooks. In addition, textbook companies are also publicizing PER techniques in stand-alone books, such the books in Prentice Hall's *Series in Educational Innovation* [1-4]. This trend is important as it shows that the results of the PER community are being taken seriously by textbook companies and the greater physics community. There are several textbooks that are informed by PER to some extent; we will focus on three.

Physics: A Contemporary Perspective (forthcoming in 2004 as *Physics for Scientists and Engineers: A Strategic Approach*) by Randall Knight is a new calculus-based physics textbook based on 20 years of physics education research. It seeks to aid instructors in creating an active learning environment in the classroom [5]. In addition to the text, Knight's instructor's guidebook *Five Easy Lessons* [6], is a resource for how instructors can bring the ideas of PER into the classroom.

Figure 1: The cover of *Matter and Interactions* Volumes 1 and 2.

Matter and Interactions [7] by Ruth Chabay and Bruce Sherwood is a two-volume text for the calculus-based introductory physics course. It is a novel textbook in that it emphasizes the atomic nature of matter, macro-micro connections, and, most importantly, the modeling of physical systems (as you can see from the cover of each volume shown in Figure 1). The text starts all analyses from a small set of fundamental principles, thereby discouraging the memorization of formulas. The computer modeling environment used in *Matter and Interactions* is the programming language environment VPython [8]. VPython is a three-dimensional programming environment based on the Python language that is suitable for modeling physical systems. The approach of *Matter and Interactions* includes having introductory physics students program computer models in VPython.

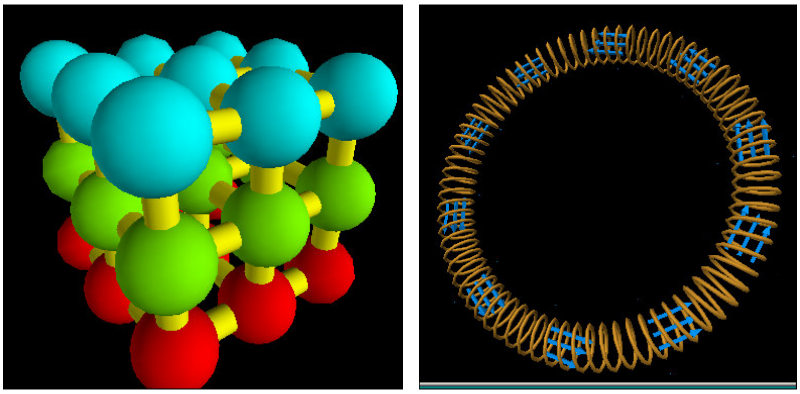

Figure 2: Two examples of VPython programming. On the left a three-dimensional lattice of atoms and on the right a calculation of the magnetic field from the law of Biot-Savart.

The *Physics Suite* is a complete package of resources for teaching with research-based methods in introductory physics courses. The centerpiece of the *Suite* is the textbook *Understanding Physics* [9] by Cummings, Laws, Redish, and Cooney. This book is based on Halliday, Resnick and Walker's *Fundamentals of Physics* [10], with additional research-based material included. In addition to the text are ILDs (Interactive Lecture Demonstrations [11]), Workshop Physics [12], Tutorials [13], computer tools (such as Video Point), Laboratories (Real Time Physics [14]), the Action Research Kit [15] and *Teaching Physics with the Physics Suite* [16] (the *Physics Suite* Instructor's Guide by Redish).

These and other PER-based and PER-informed textbooks show great promise to affect the teaching and learning of physics in the United States and elsewhere.

A New Model Course in Applied Quantum Physics

A New Model Course in Applied Quantum Physics [17] is a website with a collection of materials designed by Redish, Steinberg, and Wittmann. These materials are a set of resources for instructors of introductory quantum mechanics and modern physics. Their website contains an overview of the project, multimedia materials for the classroom, a teacher's guide, suggested uses for the materials, and PER-based materials that describe how students learn quantum mechanics.

The suite of multimedia materials available on the site includes the Photoelectric Tutor [18], Visual Quantum Mechanics [19] (Spectroscopy Lab Suite, Quantum Tunneling, and Energy Band Creator), MBL (Microcomputer-Based Laboratory) materials [20], the M.U.P.P.E.T utilities [21], as well as some Physlet-based exercises.

The Statistical and Thermal Physics (STP) Project

The Statistical and Thermal Physics (STP) Project [22] is a growing collection of programs and curricular materials for the teaching and learning of Statistical and Thermal Physics. The STP Project is part of the Open Source Physics (OSP) Project [23] which provides a synergy of curriculum development, computational physics, computer science, and physics education for scientists and students wishing to write their own simulations. The core of this project is a collection of educational programs being distributed under the GNU Open Source license agreement. Under this model, anyone may improve existing features or add additional features to the applets as long as the new applet is also released as open source. Harvey Gould and Jan Tobochnik are currently developing curricular materials around these statistical and thermal physics programs such as the Monte Carlo calculation shown in Figure 3.

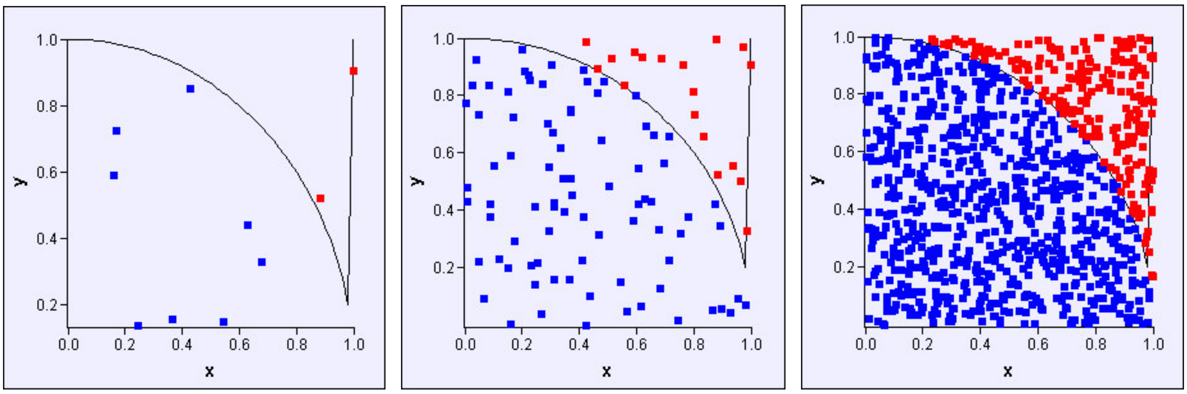

Figure 3: Monte Carlo calculation of the area under the curve sqrt(1-x*x) shown with 10, 100, 1000 shots. The hits are shown in blue and the misses in red. Estimated area: 0.8, 0.82, and 0.767, respectively.

Physlet® Physics and *Fislet Fisica*

The book *Physlets: Teaching Physics with Interactive Curricular Material* [1] was written for teachers with an interest in developing their own material. While hundreds of problems were written for the text and appeared on a CD, the problems were a resource for teachers who wanted to write their own Physlet-based curricular material. *Physlet® Physics*, and its Spanish counterpart *Fislet Fisica,* will consist of material that can be assigned without modification [24]. The aim of *Physlet® Physics*, therefore, is to provide physics teachers with a collection of ready-to-run, interactive, computer-based curricular material spanning the entire introductory physics curriculum. All that will be required is the *Physlet® Physics CD* and a browser that supports Java and JavaScript to Java communication. We expect that this collection of materials will be available from Prentice Hall by August 2003.

For more information about Physlets and future Physlet-based projects visit the Physlets website, http://webphysics.davidson.edu/applets/applets.html. This site provides technical information about Physlets, including an area for documentation and downloading the latest Physlet technology. One can sign up for the Physlet-L list server here as well.

Digital Libraries

MERLOT (**M**ultimedia **E**ducational **R**esource for **L**earning and **O**nline **T**eaching) [25] is a free online resource designed for faculty and students from twelve disciplines. MERLOT helps to enhance instruction by providing a collection of online multimedia learning materials and peer reviews. Anyone can become a member of MERLOT, post links to curricular material found on the web (you do not need to be the material's author to post material), and post comments and "assignments" (pedagogical materials) for curricular material already posted. MERLOT also provides users and authors with online peer-reviews. These peer reviews are managed by an editorial board in each discipline and any discipline can review any item on MERLOT. The process of peer review helps teachers and students find good material and helps authors by providing them with feedback and recognition for their work.

The iLumina project [26] is a Digital Libraries consortium in North Carolina that provides access to an electronic library of curricular material located on central servers to enable context-relevant searches. We have given permission for iLumina to tag and deliver the interactive problems in the *Physlets* book and this material can be found at the iLumina site under "collections".

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