

Constructing Physics Understanding in a Computer-Supported Learning Environment (CPU)

Publisher: The Learning Team

Developer: Center for Research in Mathematics and Science Education, San Diego State University

Grade levels: 9–12

Scientific domain: Physics

Web sites:

<http://learningteam.org/htmls/cpu.html>

<http://cpuproject.sdsu.edu>

Year profiled: 2002

The *Constructing Physics Understanding in a Computer-Supported Learning Environment (CPU)* project, developed in 1995, is a set of laboratory and computer-based materials, available on CD-ROM, designed to assist students in the learning of physics concepts. The project presents a learning environment that incorporates computer technology and follows an inquiry-based pedagogy throughout its set of curriculum units and associated simulation software.

SCOPE/CONTENT

The *CPU* program comprises seven stand-alone curriculum units on the topics of force and motion, current electricity, static electricity and magnetism, light and color, waves and sound, the nature of matter, and a generic skills unit called “Underpinnings.” Units are divided into learning cycles intended to help students develop ideas that can explain a phenomenon within the topic of the unit. These cycles represent the pedagogical approach of the program. Each is broken down into three phases: elicitation, development, and application. Cycles in the “Underpinnings” unit focus on a particular science-thinking or experimental skill.

FORMAT

CPU consists of the Curriculum Units CD-ROM and a companion set of simulation software CDs. A teacher’s guide for each unit details information about each activity within each cycle, including common student ideas, a list of materials, information about the simulators, and target ideas for each cycle. An introductory software package CD—the “CPU IntroPak”—is also available from the publisher.

Each unit in the *CPU* program is broken into cycles, each of which focuses on a subset of the content in the unit. Guided inquiry activities in each cycle are directed towards a set of Target Ideas. Students identify, develop, and keep track of their thinking in series of activities that involve experimental, hands-on activities and simulations; use of computer simulators to receive model-based feedback; and the recording of predictions, observations, ideas, and explanations. Each idea is developed through a planned sequence and is, ultimately, prompted by a set of questions in Idea Journals, which help students describe and record their evolving ideas as they work through the cycles. The pedagogical structure frequently has students discuss and present their ideas in informal and formal settings to support development of their understanding.

CPU units consist of numerous activities, and each activity includes one or more embedded links to computer simulations and/or microcomputer-based lab (MBL) measurements. Units require student groups of two to four at a computer, where opportunities are provided that are not available in the alternative pencil-and-paper versions. For those classrooms not equipped

with multiple computers, the units can be printed out and simulations displayed on a single demonstration computer with an LCD panel.

The *CPU* simulation software comprises a series of pedagogically designed physics computer programs designed for demonstrations or to complement and extend hands-on laboratory activities. The simulators and MBL activities provide students with discernible quantified phenomena as well as model-based evidence to help them develop new ideas.

ASSESSMENT INSTRUMENTS

The learning activities of the curriculum are designed to bring students' ideas into the open. Teachers have opportunities for formative assessment, and students themselves can evaluate the progress of their ideas as they build new knowledge by recording their evolving explanations in the activity documents or electronic Idea Journals. Also, each phase of the learning cycle presents students with challenges, questions, and multiple opportunities for testing, describing, analyzing, interpreting, and reaching conclusions. Students are stimulated to defend their new ideas by developing explanations of their findings as they work through the activities. Homework assignments and sample tests are provided.

PROFESSIONAL DEVELOPMENT SUPPORT

CPU developers trained a cadre of 24 teams to provide professional development to teachers. These teams, distributed widely across the United States, are available to help teachers and/or districts adopt the *CPU* materials for use in high school physics courses. *CPU* offers training to elementary and secondary teachers. For the secondary school physics and physical science teachers, Implementation Workshops focus on strategies for implementing the *CPU* pedagogy, materials, and software in their classrooms.

STAND-ALONE VS. SUPPLEMENTAL

CPU is designed as a set of stand-alone units associated with simulation software appropriate for secondary classrooms, teacher workshops, and some university courses. *CPU*'s developers claim that the program is closely aligned with the *National Science Education Standards* (NRC) and the *Benchmarks for Science Literacy* (AAAS).