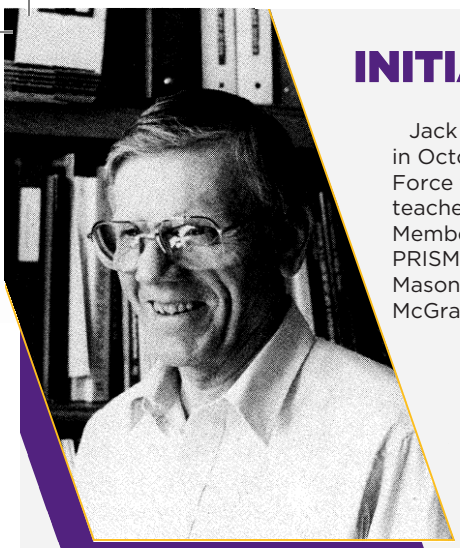
PRISMS Project to PRISMS PLUS

A history of the Physics Resources and Instructional Strategies for Motivating Students (PRISMS) Project

UNI University of Northern Iowa



Roy Unruh

INITIATION OF A PROJECT

Jack Gerlovich, state science consultant, contacted Roy Unruh in October, 1981 and asked him to help form a Physics Task Force to address the issue of assisting marginally prepared teachers of physics to improve the quality of instruction. Members of this task force were Tim Cooney (co-director of the PRISMS Project), Rollie Freel, Marshalltown; Ken Schaefer, Mason City; Bob Wilson, Belmond; Ken Hartman, Ames; Dan McGrail, Carlisle; and Vince Lunetta, University of Iowa.

An awareness session was organized by George Magrane, science consultant with Southern Prairie Educational Association, for March 2, 1982 with teachers of physics and their school superintendents to meet with Jack Gerlovich, Roy Unruh, Tim Cooney, Dan McGrail, and Vince Lunetta. The purpose of this meeting was to assess how best to improve the quality of physics teaching, especially in schools where physics was taught by teachers with a marginal background in physics. An approach was presented for teaching the concept of conservation of energy that involved a learning cycle consisting of exploration, concept development, and application activities with inexpensive, easily obtained equipment.

The PRISMS materials were developed utilizing the learning cycle as described and advocated in the Science Teaching and the Development of Reasoning-Physics (1981) workshop materials developed at the Lawrence Hall of Science, Berkeley, California under the direction of Robert Karplus. Just as scientists start with making informal observations, so also PRISMS contains exploration activities in which students are given the opportunity to make their own observations and find their own patterns. The concept development activity is used to test students' tentative understandings of the concept and to guide them toward an acceptable scientific explanation or interpretation of a physical phenomenon.

It is said that science starts with an experiment and ends with an experiment. After a theory has been formulated, scientists then conduct an additional experiment to see whether the theory can be verified in another phenomena. In a similar manner, the test for student understanding is for them to be able to apply the newly learned concept to another phenomenon. The application activity provides an opportunity for the students to generalize the concept.

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PILOT PROGRAM

Teachers indicated they did not have time available during the summer to take university level physics classes to supplement their backgrounds in physics. They were, however, very receptive to the activities presented, especially since they could be taught with readily available materials. In October, 1982, a pilot program began in Southern Prairie Area Education Agency (AEA) with six schools from the Empire Conference.

The six participating schools were provided with a telephone line into the classroom where physics was taught and a telephone with amplifier to free the teachers' hands so that they could conduct laboratory activities being narrated to them by Tim Cooney and Roy Unruh from the University of Northern Iowa. These telephone conference calls continued through the teaching of the entire unit on conservation of energy. The reaction of the teachers was very positive.

Photo source: University of Northern Iowa. Department of Physics., *"CrossSections, Volume 6"* (1994). *CrossSections. pg 1.*

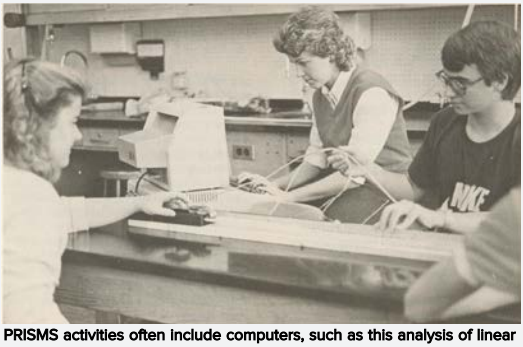
PROGRAM EXPANDED

Through efforts of the Governor's Science Advisory Council, the Iowa Academy of Science, and the Iowa Department of Public Instruction (DPI) a report was prepared which detailed the problems and potential solutions to the issues of securing and retaining qualified science teachers in Iowa. The report entitled "The Crisis in Science Education in Iowa: The Problem and Recommendations" was delivered to Governor Ray's Office and to the DPI in November 1982.

The State Legislature provided direct support in the amount of $40,000 to expand the support to 45 schools, three from each AEA for the 1983-84 academic year. The AEA science consultants were asked to make the selection of these teachers based on commitments to implement the teaching strategies of the materials, a desire to strengthen physics enrollments, and acquire necessary computers.

During the summer of 1983 the Physics Task Force developed activities for four units in physics, Force and Motion; Work and Energy; Waves and Optics; and Electricity, Magnetism, and Modern Physics. The University of Northern Iowa provided released time from teaching for Roy Unruh to direct the project for the fall semester. An anonymous donor provided $18,800 which, in part, was used to provide Roy Unruh released time for the project for the second semester.

During the 1983-84 and 1984-85 academic years workshops were conducted in Cedar Falls, Storm Lake, Red Oak, Des Moines, and Mount Pleasant which were attended by teachers and administrators from each of the AEAs in Iowa. Teachers and administrators were treated as students in working through representative activities in some of the learning cycles. Between workshops teachers were divided into groups to participate in teleconference calls to reflect on how they experienced the teaching of the learning cycles. Instructions and demonstrations of teaching techniques on future activities were also modeled and discussed during the teleconferences. Teachers were evaluated on the implementation of the learning cycle method by evaluating video tapes made of their teaching and personal visits by the PRISMS staff.



PRISMS activities often include computers, such as this analysis of linear motion using toy cars and race track. From left, Laura Walker, Tanya Elsbury and Andy Ormond, all students at UNI's Malcolm Price Laboratory School.

Grants from the U. S. Department of Education, for a total of $215,000 were awarded through the Iowa Academy of Science from 1984-86. These funds were used to complete the development of the PRISMS resource guide and to field test activities that applied the use of computers in some of the activities. This included such devices as photogates, thermistors, and light sensors.

125 ACTIVITY HIGHLIGHTS (as of 1985)

Teaching strategies designed to cultivate laboratory problem-solving skills

The use of laboratory interfacing with computers

The use of computer software as an instruction resource

The development of selected software integrated with course objectives

Photo and "Activity Highlights" source: University of Northern Iowa. Department of Physics., *"CrossSections, Volume 1"* (1985). *CrossSections. pg 1-2.*

PRISMS GAINS NATIONAL EXPOSURE

The U S Department of Education had created the National Diffusion Network (NDN) to promote exemplary programs in education. These programs and curriculum projects were identified from K-12 based on research studies and documented data. In the spring of 1983 the directors of the PRISMS Project were informed that they were encouraged to conduct such a research study.

A research study involving PRISMS classes and matched pairs of control schools was conducted during the 1885-86 academic year. Achievement gain in understanding physics concepts was measured using two forms of the New York Regency Physics Exam. Gain in reasoning/science problem solving skills was measured by using two forms of the Test of Integrated Process Skills (TIPS II). It measured science process skills such as hypothesizing, identifying variables, operationally defining, designing investigations, and graphing and interpreting data. Research showed that the PRISMS students had significantly greater gains in both understanding physics and development of reasoning skills.

Peter Hoekje, Tim Cooney, and Dan McGrail determine how much energy it takes to blow a horn.

The PRISMS Project received grants from NSF for Regional Teacher Enhancement in which 60 physics teachers from nine upper Mid-West states were invited to participate in a PRISMS implementation programs for the 1986-87 and 1987-88 academic years. Each summer 60 teachers would participate in a two-week workshop learning the methods and materials associated with PRISMS. Support activities during the academic year included monthly teleconference calls as well as on site visits to the teachers' classrooms while teaching their physics classes.

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In October of 1987 the PRISMS Project were informed that PRISMS was validated by the NDN as an exemplary curriculum.

NDN contains facilitators in each state whose responsibility it is to assist schools in their state to become acquainted with and adopt programs that have been deemed exemplary by research studies.

NSF funded a National Leadership Development proposal to invite 60 teachers of physics from across the country to participate in a 2-week 1988 summer PRISMS workshop and become resource leaders in each state. These teachers would then be available to conduct awareness programs and to conduct PRISMS training for schools that wished to implement PRISMS into their curricula. After teaching PRISMS in 1988-89 they returned to the UNI campus to debrief their teaching experiences and develop plans for conducting PRISMS training workshops in their states with the help of NDN facilitators.

Dan McGrail and Jan Mader demonstrating the Power application activity in which lung capacity can be measured.

DISSEMINATION OF INFORMATION

Evaluations of the implementation program showed that teachers significantly increased the number of laboratory activities in their teaching and especially the use of exploratory activities prior to the introduction of a concept. Enrollments in physics classes increased significantly after implementation of PRISMS.

Programs that are part of the NDN must be revalidated every five years to show they are still current in meeting their claims. Another research study was created with PRISMS trained teachers and control teachers selected from across the country. The results were similar to the first study and PRISMS was revalidated.

During the years from 1986 – 1993 over 2,000 teachers participated in these workshops through the support of the US Department of Education by way of the NDN. In this same time period nearly 1200 schools adopted the PRISMS curriculum which affected approximately 64,000 students.

Three Stage Human Rocket demonstration, conducted by teachers during a summer workshop funded by NSF.

PRISMS Enhancement

Teachers in Taiwan are contemplating how to arrange their bodies to send the third stage of a human rocket the greatest distance in this three stage human rocket.

The PRISMS Project was funded by NSF from April, 1998 to September, 2002 for enhancing the project. The enhancements included adding activities to show connections of basic ideas in physics to other fields of study, such as: biophysics, astronomy, physics of sports, meteorology, acoustics, and alternative energy sources.

A conceptual enhancer activity was added to the concept development part of the learning cycle followed with additional explanations to enforce the concept. Conceptual practice activities were added to give students added opportunities to utilize the concept to problem situations. The application activities ended with thought questions in “Developing and Using Scientific Ideas.” A final part of the application was to “Extend the Activity” to situations outside of the laboratory to explain normal life situations in which the main concept was couched.

The teacher’s guide was also enhanced. The concepts in each learning cycle that relate to concepts in the National Science Education Standards (5-8 and 9-12) and Benchmarks for Science Literacy (6-8 and 9-12) were identified. The guide identified science process skills (observing, classifying, inferring, predicting, hypothesizing, or formulating models) that were most likely encountered in each activity. Reasoning indicators (proportional reasoning, combinatorial logic, hypothetical/deducting thinking, controlling variables, and reflective thinking) are also identified that students would encounter.

Teachers complete PRISMS PLUS Conservation of Energy exploration activity with Hot Wheels cars and track during a professional development program in which they developed curriculum in alignment with the Next Generation Science Standards.

At one time NSF published projects that it supported, but during this PRISMS funding period NSF encouraged curriculum projects to find publishers that were interested in publishing these funded projects. The directors of the PRISMS Project sought interested publishers and were contacted by Centre Pointe Learning. An agreement was made with Centre Pointe for publishing of the enhanced project, which was called PRISMS PLUS. Centre Pointe Learning was a small startup publisher and was not able to build up sufficient volume of projects to continue with the publishing of PRISMS PLUS. Total financial support for the PRISMS Project from grants was $2,212,400.

Teachers review resources like PRISMS PLUS to develop instructional units aligned with national standards during the Summer of 2014.

Larry Escalada joined the University of Northern Iowa Physics Department in 1997 and joined Tim Cooney and Roy Unruh as codirector of the PRISMS Project. He also contributed to additional learning cycles in the area of modern physics. He became the principle director after 2001 and continued with conducting PRISMS workshop at UNI. The PRISMS PLUS materials are currently available to be purchased through the UNI Physics Department in computer disc format.

PRISMS gained international exposure by way of presentations and workshops in several countries. Invited international presentations were International Conference on Physics Education, Puebla, Mexico; Mexican Academy of Natural Science Teachers National Conference, Vera Cruz, Mexico; VI Inter American Physics Education Conference, Cordoba, Argentina; and International Conference on Physics Education, Herzen Pedagogical University of Russia, St. Petersburg, Russia. PRISMS workshops were conducted in Pago Pago, American Samoa; Hebei Teachers University, Hebei Province, Peoples Republic of China; Autonomous National University of Mexico, Mexico City; Bell Ville, Argentina; and Taipei, Taiwan.

Roy Unruh is demonstrating to teachers in Taiwan how to set up an experiment to determine the force applied to the rafters of the roof of a building.