A Program to Enhance K–12 Science Education in Ten Rural New York School Districts

Abstract

The Rural Partnership for Science Education, designed by educators and scientists in 1991 with funding from the National Institutes of Health, works in two rural New York State counties with students and their teachers from kindergarten through grade 12 to improve pre-college science education. The Partnership is an alliance among ten rural New York school districts and several New York State institutions (e.g., a regional academic medical center, the New York Academy of Sciences; and others) and has activities that involve around 4,800 students and 240 teachers each year.

The authors describe the program's activities, e.g., summer workshops for teachers, science exploration camps for elementary and middle school students, enrichment activities for high school students. A certified science education specialist directs classroom demonstrations throughout the academic year to support teachers efforts to integrate hands-on activities into the science curriculum. A variety of evaluations over the years provides strong evidence of the program's effectiveness in promoting students' and teachers' interest in science. The long-term goal of the Partnership is to inspire more rural students to work hard, learn science, and enter the medical professions.


Rural students face many barriers to pursuing medical education. During the 1980s, the number of medical students from rural areas decreased by 11%, while the total number of medical students remained fairly static. Along with geographic isolation and sparse population, rural communities lack fiscal resources, and rural students often lack access to science enrichment opportunities available to students in suburban and urban settings. Rural students are poorer and attend poorer schools.

These problems are compounded by the fact that elementary teachers in general often have less training, less experience, and few professional development opportunities in science and thus are intimidated by science topics. Because many college students who choose elementary education as their major field of study seek to minimize course work in math and science, teaching science is a chore to many elementary teachers. Not surprisingly, their students soon view science as a boring subject to be avoided. Students who come from this educational background are less likely to study science throughout their pre-college years, and many are lost to the medical education pipeline.

These issues are critical because many rural communities have too few health care practitioners to provide medical services. Science education must be enhanced so that more rural students will remain in the medical education pipeline and return to rural communities as physicians to practice.

Program Description

The Rural Partnership for Science Education works with rural students and their teachers from kindergarten through grade 12 to improve pre-college science education in rural
New York State. The Partnership is an alliance among ten rural New York school districts (in Otsego and Southern Herkimer Counties) and several New York State institutions: the Research Institute of Bassett Healthcare (a regional academic medical center affiliated with Columbia University College of Physicians and Surgeons) in Cooperstown; Hartwick College in Oneonta; the State University of New York College at Oneonta and that institution's biological field station; the Science Discovery Center in Oneonta; the Corning Science Products Division in Oneonta; the Clark Scholarship Foundation in Cooperstown; and the New York Academy of Sciences in New York City. At present (1998), the Partnership carries out activities in ten schools and works with 4,800 students and 240 teachers. The program, designed by educators and scientists, was established in 1991 with funding from the National Institutes of Health, and has continued with the support of member schools and institutions. Its long-term goal is to help address the need for health care professionals in rural communities. While the Partnership may eventually expand to serve additional schools, it will continue its focus on rural schools in New York State. The focus of this article is on the elementary and middle-school components of the Partnership's work.

The Partnership program consists of activities designed to interest teachers and students in science and to motivate them to improve the teaching and learning of science. During the summer, teachers attend one-week professional development workshops on a variety of topics, including elementary science inquiry. The workshops focus on the integration of hands-on science activities into the science curriculum, consistent with state and national standards.6–8 Teachers complete an application to attend these workshops and are selected by an advisory panel of their peers. Approximately 70 teachers participate in workshops each summer. In the earlier years of the partnership, teachers received a stipend for participation; however, in recent years no stipend has been provided.

Also during the summer, students from grades three through eight participate in a series of week-long science exploration camps, where they conduct experiments, learn scientific method, and study general topics in biology, chemistry, physics, and environmental sciences. Students complete an application to attend the science explorer's camp and are selected by an advisory panel of educators and scientists based on the information provided on the application and teachers' recommendations. About 65 students attend each summer. In the initial years of the Partnership, students attended the camp without payment; currently, students pay a fee to attend, and scholarships are available for deserving eligible students.

During the academic year, a regional science fair is held to encourage students to undertake a research-based project. To support integration of hands-on science activities into the science curriculum, directed classroom demonstrations and activities are presented throughout the academic year at participating schools by a certified science education specialist. These classroom science experiments are open to all teachers, not just workshop participants. In presenting these activities with the students, the science education specialist also models classroom innovations in science teaching with the teachers; thus, both teachers and students learn from the specialist's visits to the classroom.

The Partnership provides science education enrichment activities through the high school years. High school counselors in Partnership schools are informed and involved regarding program activities, and work with students in pursuing opportunities beyond the eighth-grade level. At Bassett's Research Institute, high school students participate in a summer research laboratory training program and in two academic-year health sciences programs developed in partnership with the regional occupational center.

**Program Evaluation**

Both formative and summative evaluation activities, as described below (focused mainly on teachers' and students' attitudes toward science), have yielded extensive data on the effects of Partnership activities.

**Elementary Student Interest Survey.** The Partnership program's evaluator and a teacher advisory team developed a survey to assess students' interest and achievement in the lower elementary grades. This instrument, the Elementary Student Interest Survey (ESIS) has undergone item generation, field testing, analysis, content validation, item revision, and reliability studies. The ESIS, which contains both science- and non-science-related items, was administered in grades one and two during 1993–1996, averaging responses from over 1,000 students each year. Results showed that the students of teachers who had attended Partnership workshops rated science more favorably than did the students of non-attendees. Initial analyses, comparing scores for 1992 attendees against those for non-attendees, yielded a significant difference in science scores (p = .01) in favor of the students of workshop participants, with no significant difference in total and non-science scores. Analyses in subsequent years consistently showed this same pattern of results. Also, science interest increased from grade one to grade two in Partnership schools, while interest in non-science topics decreased. These results suggest that the Partnership had a positive effect on attitudes toward science.

**Children's Academic Intrinsic Motivation Inventory.** The Children's Academic Intrinsic Motivation Inventory (CAIMI), a commercially-published instrument, is designed to measure “academic intrinsic motivation,” yielding scores
in each of five areas: general studies, science, reading, math, and social studies. Partnership schools administered the CAIMI in grade seven from 1992 to 1996, to an average of 250 students each year. Results were consistent over the five-year period of administration: the highest mean scores each year were in science. A t-test procedure comparing 1992 with 1996 scores showed significant ($p < .05$) increases in science and general motivation, but significant decreases in reading and math scores. Furthermore, among schools that administered the CAIMI all five years, the difference in scores between science and the next highest area increased each year. In 1995 and 1996 combined, the CAIMI science mean for the female students exceeded the mean for the male students, suggesting that the Partnership was more effective at engendering positive attitudes toward science in the seventh-grade girls.

Nine non-Partnership rural schools from the same upstate New York region as our partner schools administered the CAIMI to their seventh-grade students in the spring of 1996. This allowed results for non-Partnership schools to be compared with those for Partnership schools ($n = 503$ students). The mean scores for the students in the non-Partnership schools were higher than those for the students in the Partnership schools in all areas except science. All differences between Partnership and non-Partnership means were significant statistically at the .05 level, providing strong evidence of program effectiveness in promoting students' interest and motivation in science. However, the students in the Partnership schools were less interested/motivated in learning generally and were less interested in learning math, reading, and social studies specifically than were the students in the non-Partnership schools.

Lesson surveys. The program coordinator visits classrooms of the ten Partnership schools for experiments, demonstrations, and presentation of science lessons on specific topics. He visits each classroom about twice a year. Although he presents a wide range of materials, he repeats some "lessons" (e.g., magnets, germs, electricity) throughout the year. By 1996–1997, five instruments measuring content learning of K–8 students, each using a "yes/no" format, had been developed and administered. Before the lesson was presented, an instrument designed to measure the students' knowledge about the subject of the lesson was administered, resulting in pretest scores. After the coordinator presented the lesson, the same instrument was used to assess the students' knowledge of the subject, resulting in the post-test scores. The results for all five content lesson surveys are comparable, each showing a substantial pre-to-post-test gain: pretest averages of 54–66% correct and post-test averages of 76–93% correct. Pre–post differences on each instrument were significant statistically at the $p = .01$ level.

Coordinator feedback forms. Since 1992–1993, surveys have been sent to teachers whose classrooms were visited by the program coordinator. The teachers rated the coordinator in seven performance categories (expertise, communication skills, content relevance, content applicability, student enthusiasm, student involvement, maintaining interest) on a 1–5 Likert scale. These ratings have consistently been high (exceeding 4.5), and have improved over the years. In 1996–97, the ratings ranged from 4.87 to 4.98. Teachers' remarks have been overwhelmingly positive.

Other measures. Other measures have included written surveys of teachers, questionnaires and interviews directed toward workshop participants, interviews with counselors, surveys of science fair attendees, and interviews of science camp participants. Both quantitative and qualitative data from these measures provide further evidence of the program's positive effects. Most of these evaluation instruments will not be administered in the future. The grant funds allowing this level of activity are no longer available.

THE PARTNERSHIP PROGRAM'S LONG-TERM EFFECT ON THE PIPELINE

All too often, grant-funded programs end when the grant ends. The Partnership staff worked diligently throughout the years of grant funding to prevent the demise of its successful programs. Even though the Partnership is not currently funded by grants, its programs have been institutionalized and expanded with the support of member schools, scientists, and educators. The classroom visits by the science education specialist are supported through a cooperative service contract with the schools and administered by the local Board of Cooperative Educational Services of the New York State Education Department. The summer workshops for teachers and the camp for students continue on a fee-for-service basis through local organizations. In addition to the summer research laboratory experience, the programs for high school students have been expanded to include two programs during the academic year: health occupations exploration and health care technology.

The seven years of the Partnership program's activities, and the evaluations of these activities, indicate that this program and others help to inspire rural students to work hard and to learn science. Elementary school students who participate in the Partnership program have opportunities and motivation to pursue their interests in science through their high school years because the Partnership program provides high school enrichment activities. It is too early to tell whether the increased interest and achievement in science by Partnership students have helped more of these students to enter the medical professions, but the Partnership program will keep track of its students and eventually be able to compare their careers with those of non-Partnership students.
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REFERENCES


