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ABSTRACT

Partnering for Elementary Environmental Science, a professional development program developed to enhance teachers' skills and content knowledge in science education, pairs classroom teachers with resource professionals for one year of collaborative instruction. This paper reports part of the evaluation and research related to the program. Specifically it examines changes in teachers' attitudes and instructional behaviors, changes in students' attitudes toward and participation in science and schooling, and changes in the learning environment and community as a result of teachers' involvement in the program. Data was collected from participating teachers and resource professionals using questionnaires, inventories, and interviews. Results indicate that both teachers and resource professionals responded positively to environmental science and partnering and this partnership increased teachers' confidence in teaching environmental science. The effect of the program on teaching was that it became less traditional, more integrated and collaborative, had more hands-on components, had more process emphasis, and was more analytical and reflective. The program increased student enthusiasm and positive attitudes toward science and school. It was concluded that the program was effective in bringing about general change in science instruction and in accomplishing many of the goals of science education reform movements. Contains 11 references. (JRH)

Evaluating the Effects of Environmental Science Programs on Teachers, Students and Communities (Part II: Partnering for Elementary Environmental Science Program)

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ABSTRACT

Partnering for Elementary Environmental Science, a professional development program developed to enhance teachers' skills and content knowledge in science education, pairs classroom teachers with resource professionals for one year of collaborative instruction. This paper reports part of the evaluation and research related to the program. Specifically it examines changes in teachers' attitudes and instructional behaviors, changes in students' attitudes toward and participation in science and schooling, and changes in the learning environment and community as a result of teachers' involvement in the program.

Evaluating the Effects of Environmental Science Programs on Teachers, Students and Communities: Partnering for Elementary Environmental Science

Although collaborative projects between schools, businesses, agencies and universities have been advocated as a vehicle for professional development and education reform for the past decade, most of these efforts have lacked formal evaluation designs or mechanisms. This is especially true in the field of environmental education. As a result, the impact of these programs on instruction and student learning can only be surmised.

This symposium examines the specific problems and topics related to implementing and evaluating federally-funded environmental science programs into K-12 school settings. Specifically, the symposium will compare and contrast the programs, evaluation procedures, and impacts of the Ecological Citizenship Program in urban Chicago and the Partnering for Elementary Environmental Science program in rural Ohio. This paper discusses the content and impact of the rural-based program, Partnering for Elementary Environmental Science.

Background

Professional development for the 1990s utilizes three powerful ideas that are "altering the face of professional development in this decade" (Sparks, 1994, p. 2). The first is the notion of results-driven professional development which judges the success of the professional development program not by how many teachers and administrators participate or how satisfied they are with the program, but by whether the program alters instruction in ways that benefit students. Honig (1994) points out that a problem with education reform is that it is not typically organized around improving teachers' knowledge of content or enhancing their ability to collaborate to improve instruction.

The second guiding notion is systems thinking, which recognizes the complex, interdependent interrelationships among various parts of the educational system. This suggests that collective, not individual, efforts which involve a critical mass of staff committed to improving student performance and making necessary instructional changes are needed to initiate systemic reform in science education. Further, it suggests that parents and members of the community must not only support education efforts, but be actively involved in them.

A third notion driving professional development programs is constructivism. Constructivist professional development involves multiple forms of job embedded learning. It depends on successful networking among education professionals that focuses attention on instruction and learning, provides nurturing to schools, and brings schools together to broaden perspectives and offer needed collegial support. In short, it suggests that teachers and educators must work collaboratively toward improved

instruction.

A promising mechanism for carrying these powerful ideas into professional development for the '90s is collaborative relationships or partnerships. In the early 1980s, the federal government began to recognize the need to integrate school and business entities. By 1989, the Department of Education estimated that over 140,000 school-business partnerships existed nationwide (Rigden, 1991). Initially, most businesses avoided getting involved in decisions which impacted curricula and educational systems. The partnerships, mostly confined to urban and suburban areas, took on a variety of forms ranging from providing equipment or financial support to the school with no direct involvement with teachers or students, to "popping in and doing a few 'gee whiz' things" (Sills, Barron & Heath, 1993). It is uncertain, however, that these partnerships resulted in fundamental changes in instruction or student learning. Miron and Wimpelberg (1989), for example, found that only eight of the 450 local school-business partnerships they investigated led to instructional change. According to Cobb and Quaglia (1994), many partnerships achieve worthwhile objectives, but many also fail in their attempts to improve student learning.

More recently, partnership efforts have focused on what Sills et. al. (1993) call the "next generation of partnerships." These reform-based partnerships intend to go beyond compiling good projects to impacting instruction, student learning, and teacher empowerment. Successful reform-based partnerships tend to: 1) be innovative and pioneering; 2) involve hands-on, classroom-focused, and age-appropriate activities; 3) grow out of long-term collaborative relationships; 4) assess both student learning and the partnership process; 5) bring partners together often -- a few times a month, or weekly; and 6) involve multi-level support. Cobb and Quaglia (1994) identify seven choices which must be made as schools and businesses engage in collaborative relationships. They advocate choices that move the partnership into the "relationship domain," characterized by a dynamic focus on relationships among people rather than on structure, a focus on individual rather than organizational needs, self-examination, and multiple power bases and benefits. That is, having a content expert in the classroom does not automatically result in enhanced instruction and learning. This occurs "when teachers and scientists develop good working relationships, when they move forward together on an experiential curriculum, and when scientists become a normal presence in the school" (Sills et. al., 1993, p. 69).

Yet the ability of collaborative efforts to enhance education is yet to be demonstrated. Few researchers have studied the dynamics of these efforts or explored how they can be improved. Cobb and Quaglia (1994) point out the need for research on the micro-level interactions within partnerships in order to ensure successful school reform. Further, the opportunity to enter into partnerships with businesses is largely absent from rural schools and many urban centers, where professional development and education reform are often sorely needed.

Professional Development Program

Partnering for Elementary Environmental Science, a collaborative program involving The Ohio State University-Mansfield, the Ohio Department of Natural Resources, and the Science and Mathematics Network of Central Ohio, attempts to enhance science teaching by linking teachers with natural resource professionals in reform-based partnerships in predominantly rural schools. During an intensive four-day summer institute, teachers and resource professionals are assigned to partnership teams and provided with instruction regarding the fundamentals of reform-based partnering. Partners work together throughout the institute, which models and provides training in inquiry-based environmental science instruction and supporting pedagogy including process skills, management of students and materials, authentic assessment, and questioning strategies. Throughout the summer, partnership teams work collaboratively to develop a year-long action plan outlining the content and strategies for integrating activity-based environmental science instruction into the existing curriculum. Throughout the academic year, teachers and resource professionals implement the action plan and work together in the classroom, assuming a variety of roles and responsibilities. Partnership teams are in contact with the project directors for encouragement and mentoring. Site visits enable project directors to observe and evaluate the progress of participants toward the program goals. Participants in the program meet for day-long seminars in the Autumn and Spring to share their progress, evaluate their effectiveness as a partnership team, examine the impact of their action plan on instruction and student learning, and to continue planning.

Program Evaluation

Evaluation of the Partnering program was directed toward: a) changes in teachers' and resource professionals' perceptions about science instruction and partnering; b) the impact of the partnership program on the instructional process; c) changes in students' participation in and attitudes toward science, school, and science-related careers; and d) changes in the learning environment and community.

Sample. This study examined the impact of participation in a partnership program among teachers and natural resource professionals in 11 predominantly rural counties in a Midwestern state. The elementary teachers represented kindergarten through grade six and special education classrooms, usually involved with inclusion. Resource professionals represented divisions of forestry, geological survey, natural areas and preserves, parks and recreation, real estate and land management, reclamation, recycling and litter prevention, soil and water, public information and education, water, and wildlife from the state Department of Natural Resources, as well as the state university's cooperative extension service, county soil and water conservation districts, and the U.S. Army Corps of Engineers.

Participants included teachers and natural resource professionals working collaboratively in partnership teams formed over the first two years of the program. During the first year, 23 partnerships were formed in five counties among 44 elementary teachers, 1 curriculum specialist, and 27 resource professionals, involving 23 schools. While the effectiveness and structure of the Institute

were evaluated during the first year, measures to evaluate the impact of the program on teacher attitudes and instruction were merely piloted. The instruments and procedures were subsequently polished and restructured for use during the second Summer Institute. Thus the quantitative results reported below reflect responses of participants during the second year of the program. During the second year, 39 teachers, 1 principal, and 24 resource professionals formed 18 partnerships in six counties, involving 20 schools. Qualitative data, including interviews and teacher and team self-reports, reflect responses from participants in both cohorts of the program.

Procedure. The measures and interviews given to the teachers, resource professionals, and school principals across two years are detailed below.

1) Curriculum Use Inventory. As part of the application process and after one year of participation in the program, data was gathered regarding teachers' familiarity with and use of eleven nationally known environmental science curricula, such as Project WILD, Project AIMS, and Sharing Nature with Children. Teachers were asked to complete a chart indicating if they were familiar with and had used each of the curricula.

2) Summer Institute Questionnaire (Pre, Post, and Delayed forms) were administered to all participants. All three forms of the questionnaire contained identical scaled, closed, and open-ended items designed to capture participants' perceptions toward environmental science instruction and partnering. The Post form contained additional questions examining the effectiveness and impact of the Institute. The Delayed form was given to the second cohort after individuals had participated in the program for one year. The sample (**N = 63**) consisted of those individuals who completed all three forms of the questionnaire. Data was analyzed using SAS (Statistical Analysis System). Analysis of Variance (One-Between, One-Within ANOVA) was used for scaled items. Simple descriptive statistics were used for closed items, and responses to open-ended items were analyzed using content analysis.

3) A focus group technique was employed to develop a more in-depth review of the effectiveness and impact of the Institute. Members of the focus group consisted of six Institute participants: four teachers and two environmental resource professionals. Members were selected by the Institute instructors. Criteria for selection included: a) representatives from teacher and resource professional groups, and b) demonstrated articulation of thought-provoking, critical views and opinions in either large or small group settings. The focus group interview occurred on the final day of the Institute, and lasted for approximately one hour. The interview was audio-recorded subsequent to obtaining permission from all participants. Assurances of anonymity and confidentiality were provided by the evaluators. The recording was transcribed verbatim; analysis was performed via content and cluster analysis techniques.

4) Reflection questions or writing prompts were given to all participants four times during the second Institute. During the first years' Institute and throughout the year of involvement with the program, all participants were provided with and instructed to keep journals about the Institute and

subsequent implementation and partnering activities. Journals were reviewed three times during the year and feedback was provided to writers. This approach was not popular with program participants and was largely ineffective in securing detailed information about teachers' attitudes and instructional changes. As a result, open-ended reflection questions were developed and used to obtain more specific data during the second Institute. Participants were given 20-30 minutes to respond to each question, and were encouraged to write a one to two page response. One reflective question, for example, was used to gather baseline information of participants' teaching or presentation style prior to attending the Institute. It asked participants to describe their teaching or presentation style in detail: "Think back over the past year to the times you taught or made presentations to students. In as much detail as possible, describe your presentation/teaching approach or style. What methods do you most frequently use? How long are your science lessons/presentations? How do students generally respond? If you are a teacher, how much time per week do you spend doing science? Paint us a picture of yourself as a teacher/presenter."

5) Individual and team interim evaluations were completed by all participants and all partnership teams in November at the mini-conference. Both evaluations consisted of open-ended items designed to gather specific information on the implementation of the action plan and to parallel the reflective questions presented during the Summer Institute. Specifically, questions aimed to ascertain the perceived benefits and challenges of the program for the teachers, resource persons, and the school and community; what excited participants the most and least about partnering; and anecdotal accounts of class or students' involvement with the program. One item on the individual interim report paralleled the teaching style question from the Summer Institute: "List and describe some ways that your professional life is different because of partnering. For example, in what ways is your teaching/presentation style different? What changes have you made in the classroom? Do you think differently about planning, presenting to groups, or learning? Please be as specific as possible." Data from interim reports was transcribed by question and content analyzed.

6) Individual and team final evaluation reports contain scaled, closed, and open-ended items designed to capture participants' perceptions toward environmental science instruction and partnering identical to the items on the pre- and post-Institute questionnaire. Some open-ended questions paralleled questions to the interim reports about the specific benefits and challenges of the partnership and action plan. Team evaluations also asked the team to discuss extending their partnering activities into a second year and, if they desired to continue, to begin planning for the continuation. Data was analyzed using SAS, using Analysis of Variance for scaled items to see longitudinal changes in attitudes toward environmental science instruction and partnering. Responses to open-ended questions were analyzed using content analysis.

7) Telephone interviews with building principals were conducted after partnership teams had been active for one and two years in the program. Interview questions sought to determine if the

principal was aware of the teachers' involvement with the program; if the partnership was active; the sorts of activities the partnerships were engaged in; the perceived benefits of the partnering program for the teacher, students, school, and community; and challenges of which the principal was aware. Descriptive statistics and content analysis were used, where appropriate, after interview data was transcribed.

8) Telephone interviews with team leaders were conducted after two years of potential involvement in the program to ascertain the level of activity of the partnership (very active and dynamic, active and on schedule, limited activity, or disbanded); changes in the participants of the partnership; perceptions of why the partnership endured or disbanded; and impacts of the partnering program on teaching style, curriculum, students, and the way the teachers thought about teaching and learning. Descriptive statistics and content analysis were used, when appropriate, after interview data was analyzed.

Results and Discussion

Results will be presented as responses the four foci driving the evaluation and research efforts for the Partnering in Elementary Environmental Science effort to date.

a) Were there changes in participants' perceptions about science instruction and partnering?

On all three forms of the Summer Institute Questionnaire, pretest, posttest, and delayed forms, participants were asked to: a) consider one-word descriptors for environmental science and partnering; and b) indicate the degree to which they agreed with the term as an appropriate descriptor. Responses ranged from 5 (strongly agree) to 1 (strongly disagree). Tables 1 and 2 show means and standard deviations for these questions.

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Tables 1 and 2

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Analysis of variance (ANOVA) was performed on responses to determine differences between the responses of teachers and resource professionals and changes in their responses across pretest, posttest, and delayed forms of the instrument. Table 3 shows an F-value for each of three sources by variable for descriptors of environmental science. Table 4 shows an F-value for each of three sources by variable for descriptors of partnering. The three sources are: 1) main effects between groups (teachers and resource professionals) (A); 2) main effects of pretest, posttest, and delayed scores (B); and 3) the interaction of group and pre-post-delayed (AB). Significant differences ($p<.05$) in F-values are noted with a single asterisk.

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Tables 3 and 4

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A number of significant differences were observed in the perceptions of participants concerning

environmental science and partnering. Results are reported below for; 1) overall differences between teachers and resource professionals; and 2) changes between pre/post/delayed measures.

Overall differences between teachers' and resource professionals' perceptions. Although no statistically significant differences between teachers' and resource professional's perceptions of environmental science were shown following the posttest measure, overall significant differences were noted between groups when the delayed measure was included. Specifically, teachers perceived environmental science to be more "active" and "exciting" than did resource professionals.

With regard to partnering, teachers and resource professionals demonstrated perceived differences from pretest to posttest in three areas: teachers generally perceived partnering to be more "meaningful," more "helpful," and more "exciting." These differences were sustained throughout the year, as indicated by the delayed instrument.

Changes between pre/post/delayed measures. Significant changes were noted between pretest and posttest scores on the questionnaire for two environmental science descriptors. participants rated environmental science as more "exciting" and "interesting" at the end of the Institute than at the beginning. In addition, changes were observed in participants' perceptions of four other qualities following the Institute, as measured by pretest and delayed questionnaires. Specifically, teachers and resource professionals perceived environmental science as less "unfamiliar," teachers perceived environmental science as more "active' and resource professionals were shown to perceive environmental science to be "less intimidating" and "less difficult."

Examination of the data indicated that significant differences were also observed between pretest and posttest questionnaires for several of the partnering descriptors. Participants rated partnering as more "meaningful," more "exciting," and less "unfamiliar" (ie., more familiar) and less "intimidating." However, they also found partnering to be less "meaningful," less "helpful," and less "exciting" at the end of the Institute than they did prior to the Institute. After one year of involvement in the program, based on the delayed questionnaire, no significant differences were observed in the participants' perception of partnering as "meaningful" or "helpful." This suggests that participants perceptions of the meaningfulness and helpfulness of partnering actually increased during their year of participation in the program. Participants' perceptions of partnering as less "unfamiliar," "intimidating," and "exciting" were sustained across their year of involvement.

Interaction of teachers/resource professionals and pre/post/delayed variables. Interaction effects were observed in the teachers' and resource professionals' responses to the partnering descriptor, "unfamiliar." In response to this descriptor of partnering, teachers changed dramatically in their perception of partnering from a view of partnering as unfamiliar to less unfamiliar (more familiar - pretest M = 2.91, delayed mean M = 4.59) and similarly to less intimidating (pretest M = 3.82, delayed mean M = 4.74). In contrast, resource professionals showed only modest movement toward a view of partnering as more familiar (pretest M = 3.58, delayed mean M = 3.95) and less intimidating

(pretest M = 4.21, delayed mean M = 4.10) although they began the Institute with a more "familiar" and less "intimidating" view of partnering.

Participants' level of confidence in teaching environmental science. Participants were also asked to rate their level of confidence with regard to teaching environmental science. Tables 5 and 6 show the results. With the exception of "managing materials," for each of the dimensions of teaching environmental science on the pre/post/delayed questionnaires, significant differences were indicated by the participants' responses. Table 6 indicates that teachers expressed greater confidence in "using a variety of approaches, " "teaching process skills." "adapting what you are teaching to a specific age," "managing students," "asking effective questions," and "measuring student learning using methods other than traditional tests and worksheets." Resource professionals expressed greater confidence in their "level of knowledge about environmental science."

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Tables 5 and 6

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The data analysis presented in Table 6 indicates a significant change ($p < .05$) in participants' level of confidence from pretest to posttest (ie., during the Institute) in each of the dimensions of teaching environmental science. Specifically, participants indicated that they were more confident teaching environmental science following the Institute than they were prior to the Institute. Moreover, the data suggests that these changes were sustained throughout the year of participation in the partnering program. Interaction effects were also significant for a)"adapting what you are teaching to a specific age group," and b) "your own level of knowledge about environmental science." Further analysis revealed that the interaction effects could be attributed to the more dramatic increase in teachers' level of confidence when compared to the increase shown by resource professionals. Concerning their "level of knowledge about environmental science," although teachers began significantly lower than resource professionals, on the posttest questionnaire they showed no significant difference from the resource professionals.

Regarding partnering, participants were asked to indicate their level of confidence by selecting the statement that most accurately reflected their feeling about partnering. Options for the item were: 1) Very Confident, 2) Let's just say, "confident" and leave it at that, 3) Somewhat confident, or 4) I'd prefer to "wait and see." As shown in Table 7, only the teachers indicated a significant change ($p < .05$) in their level of confidence toward partnering from pre- to posttest. Though the mean for both groups improved from pre to post, the teachers' level of confidence showed significant change (ie., improvement). The mean response for both groups at the end of the Institute was "very confident."

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Table 7

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b) What is the impact of the partnering program on the instructional process?

To begin to determine changes in classroom instruction as a result of the partnership effort, the following open-ended responses were content analyzed: 1) teacher descriptions of their instructional approach when teaching science from the Institute reflection question; 2) teacher responses to the individual interim report question asking how their instruction had changed, 3) team responses to the interim and final evaluation questions soliciting anecdotal stories about how the project had benefited students, 4) interviews with building principals after about the benefits of the program for teachers one and two years of participation in the program, and 5) pre-institute and end of year curriculum inventories.

Approximately three-quarters of teachers shared that their instructional approach had changed, sometimes radically. Most of these teachers described their approach as "less traditional", and noted that they were using more "hands-on approaches", and "cooperative groups and teaming." They described their instruction as less teacher-centered and textbook dominated and, although they avoided the "inquiry" label, many described inquiry learning taking place in their classrooms as students investigate, reason through questions that evolve during the lesson, and draw conclusions. One teacher shared:

> "I have always been most traditional in my teaching, but after this summer and with the team approach we used I'm finding I can use teams within my class and I can live with talking because excitement is being shown and learning is taking place. No, it's not pencil and paper -- but it's really not fun and games -- it's learning from peers in many ways even if it is noisy it is a learning atmosphere.The class investigates -- not just reads, outlines, etc. There are many answers and it is fun to see these reasonings for conclusions."

Interviews with building principals reinforced teacher self-reports of changes in their instructional approaches. Principals noted more use of hands-on projects and lessons and use of cooperative learning and teaching.

One theme related to instructional changes that was repeated in teacher responses was changes in how they plan and think about the goals of the lesson and the desired learning outcomes. Teachers reported integrating across subject areas more frequently and with greater ease and depth, and this report was reiterated by principal observations. Many teachers described themselves as more organized and structured and more confident. Two teachers commented:

> "I plan now with vision as to how I can bring other members of this team's *(ie, the partners')* expertise to my class and don't worry so much that I have to cover X number of pages."

> "Because of the hands-on activities and the resource people in my classroom, I approached the whole year differently. I have

become a lot more confident in the areas of integration of the curriculum. hands-on activities, cooperative learning and less 'paper test taking,' lecture teaching, and holding narrow goals."

A second change noted in teachers' instructional approaches, though less frequently identified. was an awareness and use of a wider variety of resources. Not surprisingly, this included a variety of the curricula and science materials with which they were acquainted during the Institute. Table 8 summarizes the data about teachers' familiarity with and use of leading environmental science curricula reported during the application process and after one years' involvement with the program. Table 8 shows consistent dramatic increases in the number of curriculum programs which teacher have heard of, showing increased awareness of potential environmental science resources. Further, in comparing teachers' use of the curricula prior to the Institute and during their first year of involvement with the partnering program, teachers' reported use of the programs increases from 4% to 51%. This suggests that one specific way in which teachers' instructional approaches changed was with increased use of recognized environmental science curriculum materials during their first year of involvement with the program.

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Table 8

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Moreso, however, teachers identified a new awareness and use of human resources. Many cited looking beyond the resource people collaborating with them to others in the community. One teacher explained:

"Another way I have changed is that I am more open to people who want to come into the classroom. I used to throw away everything in my mailbox because everyone wanted a piece of my teaching time. I now see that there are valuable people out there excited about helping teachers."

Principals highlighted this benefit of the program for participating teachers. Most principal comments focused on the benefits to teachers of having a resource person with whom to work. Resource persons were valued for their content expertise, but moreso for the impact that their relationship with teachers had on teachers' professional lives. Three of the principals stated that working with the resource person helped the teachers become more comfortable with teaching and practice "new ways of teaching." In short, these principals felt that as a result of working in a partnership team, the teachers were strengthened. Some principals also cited that teachers benefited by having another professional with whom to collaborate. One principal also noted that the affiliation with a resource professional helped a new teacher acclimate to the rural environment.

Several teachers commented on a third theme related to instructional change: that they were

using different methods of assessing student learning and involvement in science. One teacher cited having students do more "reflection" following science activities so that she had a better idea of how they felt about the activity and what they really learned. Teachers commented about moving away from "pencil and paper" methods of assessment toward journals, discussions, projects. and process-oriented questioning.

Notably, few teachers commented on instruction being impacted by increased science content knowledge, although one teacher commented that one of the ways she had changed was that she was more aware of environmental issues and attempted to bring them into the classroom whenever possible. One principal, however, did comment that the program has broadened teacher knowledge of the environment, as follows.

> Teachers broadened their knowledge of the environment and how people and the environment interact. An example was learning about bees. They went on a field trip and several students got stung by bees. They learned a lot about how to treat a hornet's nest!

c) Were there changes in student participation in and attitudes toward science, school, and science-related careers as a result of participation in the partnering program?

Although student learning was not directly assessed in this study, teachers reported increases in students' enthusiasm, more positive attitudes toward science and school in general, improved behavior, and enhanced social skills, especially leadership and collaboration, as a result of the new instructional approaches. Herein, teachers often shared success stories about individual students.

> "We have a student who has severe social problems with other students--mainly within the classroom setting. However, when given the chance to be involved with our environmental science activities, he not only was not a problem, but actually could articulate the conclusions and observations that were part of the desired outcome."

> "The other third grade teacher has a little guy who has a terribly difficult time working in small groups. We warned the resource person ahead of time to 'be prepared!' Well, you guessed it--this little guy got caught up in the conservation project and he was great! The little guy worked and cooperated beautifully in his group! He still struggles with group work, but this was a major breakthrough!"

An unexpected and noteworthy comment made by teachers from two teams showed that their involvement with the partnership helped break down gender stereotypes related to science-related careers. One teacher explained:

> "One female student stated, when she found out that our

(female) resource person was an engineer, that "being an engineer is a male profession." Positive results (of the program) are breaking stereotypical constraints, opening up career paths for students."

Interviews with the building principals reinforced the benefits for students which the teachers cited. According to one principal, the partnering program and related resources "opened up a new area to the students." Principals most frequently cited the active involvement in learning and the "variety of experiences beyond the book learning method" as benefits for students in classrooms participating in the program. Principals noted that lessons in those classrooms extended across the curriculum and enabled students to connect what they were learning with real world applications. One principal noted that "even some discipline problems have improved because kids are active and busy." Student response to the resource professional in the classroom was rated by all but one principal as "overwhelmingly positive." They observed that students were more attentive to the resource partners because "they felt that what they were doing was important" and that student interest was heightened from observing resource professionals as career role models. Principals also frequently mentioned that students benefited from cooperative group work especially when it involved special needs students, and from assuming leadership roles in partnership-related projects. Further, they observed that students had increased awareness of the environment and the role they play as individuals within that environment and its conservation.

d) Were there changes in the learning environment and community as a result of participation in the partnering program?

Teacher and principal responses suggest that not only instruction, but many aspects of the classroom climate and school environment have been impacted by the partnerships. For one thing, many teachers shared that "the excitement traveled throughout our entire school building." Fewer principals, about one half, noted the spread of the program throughout the building. Numerous reports were presented of teachers from other classrooms, teacher aides, custodians, and building administrators becoming actively involved with the partnering projects.

In addition, teachers reported parents and neighbors of the school becoming involved in the partnering projects and activities. A few principals cited specific examples of parents involved as helpers with the partnership program in a variety of capacities. Parents helped in classrooms, served as group leaders and coordinators during field trips, worked with teachers and parents to build land labs and establish prairies, and planted trees. Parents who were involved with the program even indirectly were reportedly "impressed with what we've done."

While principals recalled little direct feedback from parents regarding the program, many teachers reported positive comments they received from parents about the new approach to teaching science. One teacher shared:

"Parents have commented about the interest their students have developed in the environment and their ability to play around with science to find out an answer. They are

hooked! Science is fun and nothing to be afraid of!"

An additional change in the school learning environment associated with participation in the program was teacher professional development. Although the information was not directly solicited from teachers or principals during this stage of the evaluation, a theme of developing teacher professionalism emerged. Some partnership teams identified, wrote, and secured grants to obtain science curricula and materials, establish land labs, or expand the partnering project throughout their school district. Some partnership teams reported on their activities at state-level meetings of professional societies, such as the Science Education Council of Ohio (SECO), the state NSTA-affiliate, and the Environmental Education Council of Ohio (EECO). Nearly one fourth of teachers received additional training in partnering and teacher leadership skills and subsequently served as coaches and mentors for expanded partnership networks in their counties. A few principals noted that participating teachers and resource professionals helped with state-required curriculum revisions. Several teachers assumed leadership in their buildings to bring inservice training and workshops, such as Project WILD, to their buildings. One principal described the efforts of a partnering teacher who shared what she had learned in the program with the building staff. The principal commented that "the partnership enabled our teacher to become a resource person herself."

General Discussion and Conclusions

The discussion and conclusions will be delimited to two categories, a) what we have learned about evaluation, and b) what we have learned about the program and participants as a result of the evaluation of the Partnering for Elementary Environmental Science program.

a) What we've learned about evaluation. Regarding specific strategies for evaluating an environmental science program of this scope, three primary lessons are apparent. First, the need for continuity in the measures or instruments is vital if enduring effects of the program are to be accurately assessed. While it was important to pilot questions and instruments during the first year of the program and subsequent revisions certainly strengthened the questionnaires, important data was lost from an entire cohort of program participants. A similar event occurred with the second cohort, when questions which now seem important were omitted from the delayed form of the questionnaire. As a result, important program effects may be overlooked or omitted.

Second, we learned that while they are an accepted strategy for evaluating programs, focus groups provide information that is too general and perhaps too positive to be of real use in critically analyzing and refining a program. Perhaps a "group mentality" emerges in a focus group and, although the evaluators are declared to be neutral and responses held in confidentiality, a positive group think emerges. Perhaps the bonding that has gone on among the program participants and leaders casts focus group participants in a role of not wanting to hurt of offend their sponsors, who are now friends. As a result, a different strategy was used with the third cohort of participants in the Partnering

program. In order to receive specific, analytical feedback regarding the Institute program, participants were broken down into "buzz groups" of three or four people. Within that group, participants focused on two aspects of the program and, following discussion among themselves for 20 minutes, responded in writing to specific questions. The information obtained was much more helpful in evaluating the Institute program than was the focus group information.

Third, we learned that journaling simply does not work. Teachers were familiar with journaling and many required journals of their students, but many complained throughout the first Institute and following months about the requirement to regularly write in their journals. Resource persons, who were unfamiliar with journaling, found the task distasteful either ignored the requirement or recorded scant information too general for any possible use or analysis. The reflective prompts developed for the second Institute proved much more effective. The 20 minute writing response to specific questions yielded more detailed, useful information from both teachers and resource professionals. Reflective prompts were effective in gaining self-report of baseline data on qualities such as teaching style which would otherwise have required hours of classroom observation. The piloting of reflective prompts showed that it is essential that the questions be tailored to the job situation or context of each group of participants. That is, similar but separately worded prompts were needed for the teachers and resource professionals. Also, it was important to avoid education jargon, especially when writing prompts for the resource professionals.

b) What we learned about the program and participants. Each evaluation strategy informed us about the partnering program and its participants, and was helpful in further developing the program. From the curriculum inventory, for example, we found out during the application process that the teachers were much less familiar with leading science curricula than we had expected. This led to major revisions in the content of the Institute: the level of instruction was moved away from a strong inquiry-based approach to talking more about moving teaching along the instructional continuum toward activity-based approaches: and we modeled and identified activities from many of the leading curricula, briefly described those programs within the context of the Institute, and had the materials available for participants to review.

Interviews of the building principals and teachers/team leaders showed very different ideas about the impact of the program on the school and community. Teachers saw wider influence than did principals and were more aware of parent reactions to and perceptions of the program. Principals reportedly were most aware of the impact of the program on teacher development and instructional behavior. They were also more conscious of high-profile activities that gained publicity than of smaller changes more closely related to student attitudes and learning.

Overall, the Summer Institute Questionnaires and interim and final evaluations completed by individuals and teams suggest that the program is effective in accomplishing its goals. Teachers and resource professionals respond positively to environmental science and partnering. Initial misgivings

about partnering expressed by resource professionals following the Institute were not evident in the delayed questionnaire. That is. resource professionals' comfort with partnering increased during the year of participation in the program. Teachers changed more than did resource professionals in nearly every category, but especially in confidence in teaching environmental science. More important, teachers grew in ways that are considered "good" science: less traditional, more integrated, more hands-on, more collaborative. more process emphasis. more analytical and reflective. While teachers grew over the year in confidence and attitudes toward partnering and environmental science teaching, resource professionals maintained their levels on these variables throughout the year. Notably, there was no "wash" of the positive effects of the Institute, nor were negative experiences or attitudes acquired during the year of participation.

Although the effect of the partnership program on students was not directly measured, students did seem to benefit from participation with increased enthusiasm and more positive attitudes toward sciencing and schooling. They reportedly responded positively to having an additional adult involved in their education and serving as a role model in a science-related career.

With less confidence, we can suggest that participation in Partnering for Elementary Environmental Science has resulted in changes in the learning environment and community. Data suggests that, at least in some cases, parents are more involved in classroom activities. In many cases, teachers and/or principals report professional development in teachers in their buildings, not just in the teachers who were directly involved with the program. This is an aspect of the program which begs more focused research.

Conceiving of partnerships as a vehicle for teacher professional development and enhanced science instruction in rural schools appears to be supported by the evaluation of the Partnering for Elementary Environmental Science program. An examination of the evaluation strategies and procedures applied during the first two years of the program have led to a refined evaluation scheme to utilize on subsequent years of the program. Further, it suggests that the program is effective in bringing about general change in science instruction and in accomplishing many of the goals of science-education reform movements. What is needed, however, is a more detailed. micro-level analysis to fully understand the impacts of the program on teachers, students, and learning communities.

References

Cobb, C. & Quaglia, R. J. (1994). Moving beyond school-business partnerships and creating relationships. Paper presented at the annual meeting of the American Educational Research Association, New Orleans, LA.

Honig, B. (1994). How can Horace best be helped? Phi Delta Kappan, 75 (10), 790-796.

Loucks-Horsley, S. (1989). Developing and supporting teachers for elementary school science education. Washington, D. C. : The Network, Inc.

Miron, L. F. & Wimpelberg, R. K. (1989). School/business partnerships and the reform of education. Administrator's Notebook, XXXIII (9), 1-4).

Mullis, I. V. S. & Jenkins, L. B. (1988). The science report card. Princeton, NJ: Educational Testing Service.

National Science Teachers Association. (1986). Preschool and elementary level science education: NSTA position statement. Science and Children, 23 (2), 14-15.

Rigden, D. E. (1991). Business/school partnerships: A path to effective restructuring. New York: Council for Aid to Education.

Sills, B. A., Barron, P., & Heath, P. (1993). School reform through partnerships. report of the synergy conference: Industry's role in the reform of mathematics, science and technology education. Leesburg, VA. June 23-25, 1993. pp. 68-71.

Sparks, D. (March 16, 1994). A paradigm shift in staff development. Education Week, p. 42.

Weiss, I. R., Nelson, B. H., Boyd, S. E. & Hudson, S. B. (1989). Science and mathematics education briefing book. Washington, D. C.: National Science Teachers Association.

Table 1

Environmental Science: Means and Standard Deviations by Groups for Pre/Post/Delay.

Variable	Group	Pre		Post		Delay	
		M	SD	M	SD	M	SD
Environmental Science							
Active	Teacher	4.71	0..46	4.82	0.39	4.94	0.24
	Resource	4.53	0.51	4.75	0.44	4.60	0.50
Unfamiliar	Teacher	3.29	1.29	4.09	1.03	4.21	1.05
	Resource	3.94	1.00	3.95	1.23	4.35	0.93
Intimidating	Teacher	3.61	1.34	4.22	0.87	4.24	1.06
	Resource	3.89	1.10	4.20	0.89	4.60	0.75
Exciting	Teacher	4.64	0.64	4.78	0.42	4.88	0.33
	Resource	4.36	0.76	4.63	0.76	4.55	0.51
Interesting	Teacher	4.74	0.45	4.88	0.33	----	----
	Resource	4.52	0.77	4.70	0.47	----	----
Difficult	Teacher	3.29	1.14	4.10	1.05	4.12	0.81
	Resource	3.37	1.11	3.60	0.99	4.30	0.73

Teachers (n = 34) Resource Professionals (n = 19)

Table 2

Partnering: Means and Standard Deviations for Pre (#1) and Post (#2)

Variable	Group	Pre		Post		Delay	
		M	SD	M	SD	M	SD
Partnering							
Meaningful	Teacher	4.67	0.64	4.88	0.33	4.79	0.73
	Resource	4.42	0.76	4.63	0.76	4.35	0.93
Unfamiliar	Teacher	2.91	1.42	4.09	1.27	4.63	0.91
	Resource	3.68	1.11	3.80	1.15	4.00	1.26
Complicated	Teacher	3.79	1.02	3.53	1.19	4.03	0.92
	Resource	3.58	0.84	3.26	1.14	3.30	1.38
Helpful	Teacher	4.68	0.47	4.94	0.24	4.79	0.74
	Resource	4.58	0.77	4.58	0.77	4.40	0.75
Confining	Teacher	4.26	0.75	4.28	0.99	4.64	0.65
	Resource	4.11	0.88	4.10	0.85	4.05	1.28
Intimidating	Teacher	3.82	1.19	4.34	1.10	4.73	0.45
	Resource	4.11	0.88	3.90	0.91	4.35	0.75
Exciting	Teacher	4.73	0.45	4.97	0.17	4.82	0.58
	Resource	4.11	0.88	4.63	0.76	4.45	0.76

Table 3

One-Between- One Within ANOVA by Environmental Science Variable and Pretest/Posttest/Delay Variable

Variable	Source	df	MS	F
Active	Groups (Teachers/Resource Professionals)	1	1.186	***6.64**
	Pre/Post/Delay Measures	2	.389	2.21
	Groups * Pre/Post/Delay	2	.121	0.69
	Error (SB/A)	87	.176	
Unfamiliar	Groups (Teachers/Resource Professionals)	1	.911	0.60
	Pre/Post/Delay Measures	2	7.895	***7.87**
	Groups * Pre/Post/Delay	2	1.843	1.84
	Error (SB/A)	87	1.003	
Intimidating	Groups (Teachers/Resource Professionals)	1	1.182	0.80
	Pre/Post/Delay Measures	2	6.308	***7.73**
	Groups * Pre/Post/Delay	2	.173	0.21
	Error (SB/A)	87	.816	
Exciting	Groups (Teachers/Resource Professionals)	1	2.829	***7.36**
	Pre/Post/Delay Measures	2	.868	***3.21**
	Groups * Pre/Post/Delay	2	.024	0.09
	Error (SB/A)	87	.270	
Interesting **	Groups (Teachers/Resource Professionals)	1	.721	2.19
	Pre/Post/ Measures	2	1.124	***7.75**
	Groups * Pre/Post/Delay	2	.013	0.09
	Error (SB/A)	87	.145	
Difficult	Groups (Teachers/Resource Professionals)	1	.303	0.29
	Pre/Post/Delay Measures	2	9.073	***10.38**
	Groups * Pre/Post/Delay	2	.648	0.74
	Error (SB/A)	87	.847	

Note. *p<.05. ** Pre/Post Measures only

Table 4

One-Between- One Within ANOVA by Partnering Variable and Pretest/Posttest/Delay Variable.

Variable	Source	df	MS	F
Meaningful	Groups (Teachers/Resource Professionals)	1	3.137	***6.33**
	Pre/Post/Delay Measures	2	.793	0.18
	Groups * Pre/Post/Delay	2	.303	0.52
	Error (SB/A)	87	.458	
Unfamiliar	Groups (Teachers/Resource Professionals)	1	.002	0.00
	Pre/Post/Delay Measures	2	11.814	***8.66**
	Groups * Pre/Post/Delay	2	6.578	***4.82**
	Error (SB/A)	87	1.364	
Complicated	Groups (Teachers/Resource Professionals)	1	5.994	***4.56**
	Pre/Post/Delay Measures	2	.734	0.68
	Groups * Pre/Post/Delay	2	2.128	1.98
	Error (SB/A)	87	1.073	
Helpful	Groups (Teachers/Resource Professionais)	1	2.266	***5.91**
	Pre/Post/Delay Measures	2	.270	0.69
	Groups * Pre/Post/Delay	2	.293	0.75
	Error (SB/A)	87	.390	
Confining	Groups (Teachers/Resource Professionals)	1	.2.380	2.48
	Pre/Post/ Measures	2	.448	0.67
	Groups * Pre/Post/Delay	2	.394	0.58
	Error (SB/A)	87	.674	
Intimidating	Groups (Teachers/Resource Professionals)	1	.310	0.23
	Pre/Post/Delay Measures	2	1.285	1.58
	Groups * Pre/Post/Delay	2	1.945	2.39
	Error (SB/A)	87	.815	
Exciting	Groups (Teachers/Resource Professionals)	1	8.045	***17.97**
	Pre/Post/Delay Measures	2	1.708	***6.09**
	Groups * Pre/Post/Delay	2	.746	2.66
	Error (SB/A)	87	.280	

Note. *p<.05.

Table 5

Levels of Confidence in Teaching Environmental Science: Means and Standard Deviations for Pre/Post/Delay.

Variable	Group	Pre		Post		Delay	
		M	SD	M	SD	M	SD
Using a variety of teaching approaches	Teacher	4.15	0.70	4.62	0.55	4.62	0.55
	Resource	3.37	1.12	3.72	0.67	4.05	0.86
Teaching process skills	Teacher	3.27	0.79	4.21	0.59	4.35	0.59
	Resource	2.89	1.13	3.28	0.58	3.42	0.89
Adapting what you are teaching to a specific age group	Teacher	4.00	0.65	4.59	0.56	4.67	0.48
	Resource	3.53	1.07	3.72	0.75	3.58	0.77
Managing students	Teacher	4.35	0.77	4.65	0.54	----	----
	Resource	3.61	0.78	3.78	0.65	----	----
Managing materials	Teacher	3.88	0.84	4.35	0.73	----	----
	Resource	3.78	0.73	4.00	0.59	----	----
Asking effective questions	Teacher	3.62	0.74	4.21	0.69	4.35	0.85
	Resource	3.39	0.70	3.56	0.62	3.89	0.81
Measuring student learning using methods other than traditional tests or worksheets	Teacher	3.50	0.90	4.29	0.72	4.32	0.81
	Resource	2.89	0.96	3.61	0.79	3.68	0.75
Your own level of knowledge about environmental science	Teacher	2.85	0.80	3.88	0.64	----	----
	Resource	3.78	0.65	4.22	0.65	----	----

Teachers (n=35) Resource Professionals (n=19)

Table 6

One-Between- One Within ANOVA by Environmental Science Variable and Pre (#1) -Post(#2)

Variable	Source	df	MS	F
Using a variety of approaches	Groups (Teachers/Resource Professionals)	1	19.961	***37.51**
	Pre/Post/Delay Measures	2	4.227	***8.30**
	Groups * Pre/Post/Delay	2	.169	0.33
	Error (SB(A)	61	.515	
Teaching Process Skills	Groups (Teachers/Resource Professionals)	1	20.90	***30.68**
	Pre/Post/Delay Measures	2	9.283	***18.91**
	Groups * Pre/Post/Delay	2	.850	1.73
	Error (SB(A)	89	.491	
Adapting what you are teaching to a specific age group	Groups (Teachers/Resource Professionals)	1	23.114	***34.98**
	Pre/Post/Delay Measures	2	1.956	***5.55**
	Groups * Pre/Post/Delay	2	1.205	***3.42**
	Error (SB(A)	89	.352	
Managing students**	Groups (Teachers/Resource Professionals)	1	*22.548	***30.18**
	Pre/Post/Delay Measures	2	2.1291	***9.02**
	Groups * Pre/Post/Delay	2	.000	0.00
	Error (SB(A)	89	.236	
Managing materials**	Groups (Teachers/Resource Professionals)	1	.579	0.71
	Pre/Post/Delay Measures	2	4.804	***15.90**
	Groups * Pre/Post/Delay	2	.546	1.81
	Error (SB(A)	89	.302	
Asking effective questions	Groups (Teachers/Resource Professionals)	1	.329	***9.93**
	Pre/Post/Delay Measures	2	.3.06	***9.76**
	Groups * Pre/Post/Delay	2	.608	1.94
	Error (SB(A)	89	.314	
Measuring student learning using methods other than traditional tests or worksheets	Groups (Teachers/Resource Professionals)	1	21.127	***30.68**
	Pre/Post/Delay Measures	2	3.756	***18.91**
	Groups * Pre/Post/Delay	2	1.18	1.73
	Error (SB(A)	89	.500	
Your own level of knowledge about environmental science**	Groups (Teachers/Resource Professionals)	1	9.9148	***12.71**
	Pre/Post/Delay Measures	2	18.0617	***73.27**
	Groups * Pre/Post/Delay	2	2.5535	***10.36**
	Error (SB(A)	89	.2465	

Note. *p < .05. **Reflects results of data collected for Pre/Post only

Table 7

Correlation Analysis for Level of Confidence in Partnering Pre (#13) and Post (#8)

Group	Pre		Post		Spearman Coefficient
	M	SD	M	SD	
Teachers	1.85	0.78	1.11	0.39	0.24*
Resource Professionals	2.22	1.04	1.36	0.58	0.44
Total Group	1.98	0.90	1.20	0.48	0.37

Note: * $p < .05$.

Table 8

Teacher Experience with Science and Environmental Education Curriculum Materials

Program	Never Heard of It (%)			Have Heard of but Never Used (%)			Have Used (%)	Have Used This Year (%)	
	Pre	1 Yr	Change	Pre	1 Yr	Change	Pre	1 Yr	Change
GEMS	77	11	-66	20	60	+40	3	23	+20
Earth Education (Acclimatization)	97	56	-41	3	38	+35	0	0	0
NatureScope	65	3	-62	18	26	+ 8	1	63	+46
OBIS	83	3	-80	17	67	+50	0	30	+30
OEAGLS (Sea Grant)	84	24	-60	14	62	+48	2	6	+ 4
PortaParKit	89	29	-60	11	62	+51	0	9	+ 9
AIMS	24	0	-24	38	6	-32	38	89	+51
Project Learning Tree	35	0	-35	47	29	-18	18	59	+41
Project WILD	13	0	-13	43	18	-25	44	68	+24
Sharing Nature with Children	74	25	-49	15	19	+ 4	11	53	+42
Super Saver Investigator	71	21	-50	17	26	+ 9	12	44	+32