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ABSTRACT

The Partners in Elementary Science (PIES) program of the National Science Foundation (NSF) is a model Teacher Enhancement project. Its goal was to develop and test a program to help elementary teachers strengthen their science teaching by addressing areas of need, specifically teachers' confidence in teaching inquiry science and helping teachers overcome forces inhibiting the teaching of science. The NSF/PIES project was sponsored by the Five College/Public School Partnership--a school/college collaborative initiated in 1984 to share resources and strengthen communication between the 43 school systems in the 4 western Massachusetts counties and members of the higher education consortium, Five Colleges, Inc. (Amherst, Hampshire, Mount Holyoke, and Smith Colleges, and the University of Massachusetts at Amherst). The Administrator's report presents the various aspects of the program in chronological order: (1) staffing; (2) participants; (3) spring pre-institute workshops; (4) institute; (5) academic year follow-up; and (6) continuation. Each section includes a brief description followed by suggestions to other administrators starting similar projects. The Evaluator's report is divided into two sections. The first is a summary report which looks at NSF/PIES as a successful staff development project and analyzes the reasons for its success. The second is a series of presentations and discussions for each major data source used in the process. Appended are all of the questionnaire and interview protocols, the criteria used by the people who made the classroom observations for the project, and a full chronology of project events. (KR)

PARTNERS IN ELEMENTARY SCIENCE

FINAL REPORT TO THE NATIONAL SCIENCE FOUNDATION

August 30, 1990

Grant Number: TEI-8650170

PART I: ADMINISTRATOR'S FINAL REPORT

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PART II: EVALUATOR'S FINAL REPORT

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FINAL REPORT PART I: ADMINISTRATOR'S REPORT

NSF/PARTNERS IN ELEMENTARY SCIENCE: CASE STUDY IN STRENGTHENING SCIENCE TEACHING IN THE ELEMENTARY SCHOOLS

Submitted by: Mary Alice B. Wilson, Coordinator
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Submitted to: The National Science Foundation

August 30, 1990

Grant Number: TEI-8650170

NSF/PARTNERS IN ELEMENTARY SCIENCE: CASE STUDY IN STRENGTHENING SCIENCE TEACHING IN THE ELEMENTARY SCHOOLS

ADMINISTRATOR'S FINAL REPORT

NSF/Partners in Elementary Science (NSF/PIES) was funded in 1987 by the National Science Foundation as a model Teacher Enhancement Project. Its goal was to develop and test a program to help elementary teachers strengthen their science teaching by addressing two areas of need:

to strengthen elementary teachers' confidence in teaching inquiry science in the classroom (what we came to call "Hands-on, Minds-on Science");

to help teachers overcome forces inhibiting the teaching of science (classroom management problems, lack of resources, pressure to focus on other subjects, lack of administrative support).

The project officially ended in June 1989 when the second cycle of NSF/PIES Fellows completed their program. However, our commitment to the participants has continued this past year and will continue for many years to come. We can now say with confidence that NSF/PIES has developed an approach to teacher enhancement which should be considered by others interested in improving elementary science education.

Organization of the Report: As with all complex programs, there were many components of NSF/PIES. This report will present the various aspects of the program in chronological order.

Staffing: both the selection of staff and planning by them;

Participants: recruiting and selecting 50 elementary teachers/year from our area schools (November-March of each year);

Spring pre-institute workshops: 2 Saturdays in March and April to introduce concepts and individuals;

Institute: 3-week, non-residential summer program in July (Facilities, Science Strands, Writing, Student Program);

Academic year follow-up (Resource Teacher, Workshops, Workshops for Principals, Evaluation);

Continuation (Science/Resource Workshops, Leadership Training).

Each section will include a brief description, including changes between the first cycle (1987-1988) and the second cycle (1988-1989) of the program, followed by suggestions to other administrators starting similar projects. References will be made to the evaluator's report which appears as Part II of this Final Report. Every effort has been made to not duplicate the information and recommendations found in that report. NSF/PIES staff have also prepared publications on this project a list appears at the end of this report.

Background: The NSF/PIES (Partners in Elementary Science) Project was sponsored by the Five College/Public School Partnership - a school/college collaborative initiated in 1984 to share resources and strengthen communication between the 43 school systems in the four western Massachusetts counties and members of the higher education consortium, Five Colleges, Inc. (Amherst, Hampshire, Mount Holyoke, and Smith Colleges, and the University of Massachusetts at Amherst). One of the first planning committees formed within the Partnership was made up of science teachers from the elementary, secondary and college level. Within six months, that original committee had split into committees of high school and college faculty in physics, biology, and chemistry. The elementary teachers, who felt left out in the re-organization, began searching for school and college science faculty who would understand their unique needs. The NSF/PIES proposal developed from these meetings. There is no doubt that the strength of the initial design and the quality of the staff was assured by the careful planning done by the proposal-writing committee.

STAFFING

The original proposal to the National Science Foundation included a teaching staff of three school faculty, two college faculty (serving as co-directors), and two staff members from the Hitchcock Center for the Environment. The staff also included an evaluator, and a project administrator (Coordinator of the Five College/Public School Partnership and author of this report.) While there was some change in personnel among the school faculty as other responsibilities and professional opportunities arose, the mixture of school, college, and environmental center teaching staff remained. Each teaching staff member also brought a strong background in science, a philosophic commitment to the hands-on, minds-on approach to teaching science, superb teaching skills, and a willingness to take the time to plan together. A list of the NSF/PIES staff members appears at the end of this report.

The evaluator's final report lists the shared philosophic goals of the staff as one of the strengths of the project. While careful selection of staff obviously contributed to such a common philosophy, it was equally important to balance the staff to reflect the diversity within our community. In the long run, the willingness of the staff to take time to discuss issues thoroughly and to confront differing styles and assumptions was surely as important as initial selection.

Administrative Suggestions: Staff of any project must simultaneously:

reflect the diversity of the partners (school/college/ science center, primary/intermediate, urban/suburban/rural);

encourage challenging, intellectually simulating discussion which forces the staff to be as reflective of the program as participants will be asked to be in their own classroom;

include administrative support so that staff who have other academic year responsibilities will not get bogged down in mailings and deadlines;

include enough planning time so that staff can talk through alternative ways to provide support for participants;

develop a climate of mutual support that makes participation in the project personally rewarding and models the sharing of resources and ideas so vital to strengthening our elementary science programs.

PARTICIPANTS

In the first cycle of the project (1987-1988), most of the 52 elementary teachers were recruited from the five school systems which had participated in preparing the proposal - 24 teachers came from two of those systems (a total of 16 systems were represented). In the second cycle (1988-1989), teachers from all 43 systems were invited to participate. We had 40 teachers from 20 systems participating. (Teacher cutbacks during the spring discouraged some of those accepted from actually attending). Since the institute was not residential, most of our participants came from school systems within a hour's drive of Hampshire College. Berkshire County schools, which make up 10 of our school districts and are all more than an hour's drive away, had only 3 participants from 2 systems.

Each year participants were nearly equally divided between primary and intermediate grades. Each year included teachers from self-contained classrooms, from grade-level teams, and from special services including special education teachers, gifted and talented coordinators, bi-lingual, and ESL teachers. There were many more women than men (ratio each year of 9:1) - accurately reflecting the staffing of our elementary schools. Each participant received a $680 stipend and could receive 3 graduate credits through the University of Massachusetts.

Administrative Suggestions: It is tempting to recruit participants from only a few school systems - publicity is easier and participants can rely on each other for support in the future. Our experience in this project, and in all Partnership programs, has been that there is a delicate balance between encouraging colleagues to participate together, on the one hand, and having a program dominated by pre-established cliques, on the other. Any program trying to promote the sharing of ideas and resources must confront this issue either by actively recruiting from the widest possible range of schools or by encouraging the formation of cross-district teams within the program itself. Recruiting for established programs is much easier: all of our second-year participants reported having been encouraged to apply by first-year participants (at school, in the community, through friends, at professional meetings.) A list of the NSF/PIES participants appears at the end of this report.

SPRING PRE-INSTITUTE WORKSHOPS

All participants were asked to come to two Saturday workshops (one in March, one in April). There were four goals for these two days:

to allow the staff to meet the participants so that through conversation and an extensive questionnaire we could be sure that the summer institute program would be appropriate;

to introduce participants to the staff, the buildings, and the program (four 3-hour activities introduced the components of the summer institute);

to give the participants simple activities to try with their students during the spring so that they would not arrive at the institute saying "My kids couldn't do/wouldn't like this...";

to build a sense of community and reduce the anxiety that makes the first days at an institute so tiring.

NSF/PIES was, in fact, the first Partnership institute which included a pre-institute program. Based on its success, we now include it whenever possible in our programs - and always regret not including it when it seems too difficult to arrange. From an administrative view, the pre-institute events also help establish deadlines for the staff, thereby avoiding a late-June panic.

Administrative Suggestions: Projects which draw participants from great distances usually cannot offer pre-institute workshops. However, such events contribute immeasurably to the confidence that both staff and participants bring to the summer program. Since the events of those days will, for better or worse, set the tone for the program, having activities that reflect at every level (topics, methodology, pacing, food, space) the philosophy, goals, and content of the program is essential.

SUMMER INSTITUTE

FACILITIES

The NSF/PIES summer institute was held at Hampshire College, home campus Co-director Merle Bruno. The college provided us with:

an appropriate space (work tables, good light, air conditioning, large and small teaching areas, space for a Resource Center);

healthy, enjoyable lunches for staff and participants together in the Dining Commons;

easy parking;

swimming and gym facilities;

a sense of being valued - an attractive campus, a picnic at the President's house, and a thoughtful staff.

It was especially important for us to emphasize the effective use of space because our public schools, perhaps more secondary than elementary, tend to ignore the messages given by teaching spaces. The second year of the project, the staff was offered an interesting classroom (the art building), but felt so strongly about the need for an attractive setting, that they spent the fourth of July weekend painting the walls! Work tables were covered with interesting fabrics, bouquets of wild flowers greeted participants every day.

Each year, the Resource Center was the hub of the physical space and of activity (where the coffee was). Participants concerned about the poor quality and high cost of science materials were able to browse through excellent, inexpensive materials - to share, borrow, and discuss them with, Peg MacDaniel, the knowledgeable librarian from the Hitchcock Center.

Administrative Suggestions: Inappropriate space (too fancy, ugly, hot, unsafe, dirty) sends a clear message to participants (of any age) that they are not valued. It is also the worst possible model of a teaching environment appropriate for the elementary classroom.

Encouraging participants to examine and discuss curricular materials - especially those appropriate for their meager school budgets - is clearly desirable. Going the next step to establish a functioning Resource Center (or to borrow space in one that already exists) is ideal - both as a hospitable area for participants and as a model of supportive educational environments.

SCIENCE COURSES (STRANDS)

During the first year, the staff offered 2-hour, week-long "strands" (short courses with emphasis on experiential learning) in the physical and natural sciences (Electricity, The Sky, Life, Bubbles). Other class time was taken up with science mini-course and lectures/panels on inquiry science, the process approach to teaching writing, peer observation, curricular resources, and working with administrators. The second year, the lectures/panels were revised: science mini-courses, inquiry science and writing (now limited to journal writing), and curricular resources were taught within the strands. Peer observation was eliminated. The changes enriched each science strand (the instructors could now discuss both the science and the methodology) and provided time for more strands (four one-week strands were offered). In response to the differing needs of the participants: those who wanted more science topics (usually primary teachers) and those who wanted more depth (usually intermediate teachers), the four strands were offered at both a beginning and advanced level. Participants could take four introductory strands, three introductory and one advanced, or two introductory-advanced strands on: Critters in the Classroom, Forces and Structures, Outdoor Science at Your School Site, Water. Time was left during the final week to offer mini-workshops by participants on their areas of special skill (kites, kaleidoscopes, nature trails, growing plants).

Administrative Suggestions: Teachers, whether staff at an institute or in a classroom, always want to "cover all the essential material" and it is never possible. It is certainly not possible to provide elementary teachers with the equivalent of an undergraduate degree in science in three weeks! It is, therefore, essential that the topics chosen reflect an approach to understanding basic scientific principals and misconceptions, to using resources, to using the inquiry approach to teaching science, and to inviting students' questions that can be applied to new subjects areas. The topics will vary with the teaching circumstances of the participants, the expertise of the staff, and the classroom materials available. Collectively the topics chosen should include differing classroom management problems (of materials, students, and evaluation strategies).

WRITING

Using writing in the science classroom as an evaluative tool, for both the teacher and the student, evolved over the two years. We had initially hoped that most of the participants would already be familiar with the process approach to the teaching of writing. When it became clear that very few of our participants were using the writing process - and that it was not possible to introduce it properly in the time available to us, we confined our expectation to having participants learn ways to use science journals (essentially offering a case study in the process approach to the teaching of writing).

The first year, we had the additional problem of saying that science and writing should be integrated, but not having science staff who could, themselves, teach about writing. Having writing consultants, who were not full-time staff members, reinforced the separateness of writing. The second year the writing consultants worked with the staff, instead of the participants, to help them develop a more integrated science/writing program. In subsequent projects (especially the NSF/SpaceMet space science project for middle school teachers), we have been more successful in integrating writing into every aspect of the project.

Given these problems we were not surprised that very few teachers reported using science journals during the academic year after the institute. We have been pleased that our long-range evaluation indicates that these same teachers, now confident about teaching science, have turned their attention to strengthening the role of writing in the science classroom. (However, the Partnership and many of the school systems offer programs in using the process approach to teaching writing. While NSF/PIES has surely contributed to the increased use of writing in science, it is not the sole cause.)

Administrative Suggestions: Interdisciplinary teaching is surely intrinsically desirable at every level, kindergarten through college. Furthermore, as the time pressures on elementary teachers increase, every effort to have an activity serve more than one skill area/discipline helps both teachers and students. Writing is an especially rich resource for science teachers - both to help them (and the student) understand how the student is thinking about a problem, and to provide a focus for required writing activities. In retrospect, including more mathematics - especially in light of the new NCTM Standards - would also have been desirable. A cautionary note: if the institute staff do not use writing as a teaching/evaluation tool in the project, the participants will not use it in their own classrooms.

STUDENT PROGRAM

One of the problems with the inquiry approach to teaching science is that teachers are often reluctant to try such messy, open-ended, challenging activities with their students, "the children will just make a mess... they can't do anything that complex... they will get out of control." Recognizing that the only argument against such fears is working with children, we arranged for teams of participants to work with students for 7 two-hour sessions. We were fortunate to be invited to work with the Massachusetts Migrant Education Program whose students were in two summer school programs approximately a half hour from Hampshire College. The program provided the extra advantage of introducing many of our teachers to their first experience in bi-lingual classrooms.

It is difficult to determine how successful this component of the program was. It clearly achieved two goals: no teacher left the summer saying that students can't do/won't like/aren't able to manage this approach to science. In addition, both the Massachusetts Migrant Education Program and our staff and participants learned about new resources that they might otherwise never have discovered. However, the travel time to the sites, the complexity of working with new students and with another group of teachers limited the value for some of the participants. The very fact that this is the only component of the program which we have not tried to replicate within the Partnership indicates our ambivalence.

Administrative Suggestions: It is important to determine whether working with children during a summer institute will enhance the learning experience for teachers. Based on our experience in this program and a small follow-up project with eight NSF/PIES graduates (Watson and Konicek, 1990), we have concluded that only if the participants have an opportunity to work in depth with a few students, to follow their thinking processes for a period of time, does such a component seem to be of value.

ACADEMIC YEAR FOLLOW-UP

RESOURCE TEACHER

The NSF/PIES project was fortunate to have a half-time Hitchcock Center staff member available to work with our summer institute participants during the academic year. In her 2 1/2 day/week she served as:

cheerleader - visiting and encouraging teachers in their science activities;

hauler of resources - bringing NSF/PIES books and kits from the Hitchcock Center to the participants to try with their students a d share with their colleagues;

master teacher - sometimes teaching classes, but more often teaming with a participant on a new science unit;

liaison between participants and staff - lling staff what was actually happening in the classrooms.

A successful resource teacher must have the confidence of the participants. Our resource teacher found her job much easier the second year, when she had been a fully participating staff member during the summer - and was therefore known and respected by the participants, than the first year when a new baby kept her from actively participating during the summer.

Administrative Suggestions: There is no doubt that having a skilled staff member available during the academic year will greatly enrich any project in which teachers are asked to make changes in their classroom. This person must be a member of the teaching staff, i.e. must share the project history with the staff and participants. It is important to note that this job is totally unrelated to the administrative support of the project - and probably should not be combined with it, since administrative details can swamp good intentions to visit school sites.

WORKSHOPS

Each year, participants were invited to 2 release-day workshops and 4 afternoon events. These events were planned by a voluntary committees of participants. The second-year participants invited first-year participants to join them. The purpose of these events was to:

re-kindle the enthusiasm of the summer;

provide an opportunity for participants to bring their principals to a reception/lecture-demonstration about the project and the te.ching of science;

provide an opportunity for participants to lead workshops on successful science activities they had developed;

introduce participants to new resources, including training by GEMS (Lawrence Hall of Science, Berkeley) staff;

build toward an on-going elementary science partnership including both participants from the two years, other elementary teachers, and additional resource people from museums, schools, and colleges.

During the academic year following the program participants received a small stipend ($160) for participating in the after-school activities. Participants had been granted three release-days by their school systems (with substitute teachers paid by the schools). As part of our goal to introduce them to new resources and to develop leadership skills, they were asked to use two of the days at our workshops and the third at a professional meeting they would otherwise not have attended. Although we used a number of sites during the two years to introduce participants to new resources, we were never able to make effective use of the Resource Center at the Hitchcock Center for the Environment as a meeting space because of its limited capacity (25 in the largest meeting room).

Administrative Suggestions: Regular follow-up activities for summer institutes are essential, both to renew the spirits of all the participants and to reward those who have tried new classroom projects. In retrospect, however, asking the participants to design, carry out, and report on a classroom project would have strengthened the program. We now include that component in all Partnership institutes. In fact, we now include, whenever possible, a one-week second summer institute to provide a sense of closure to projects and to help participants start more sophisticated projects. The leadership training projects which were tested in NSF/PIES (and which will be described in the next section) have led us to a much more sophisticated understanding of the long-term commitment any teacher enhancement project must make to its participants.

WORKSHOPS FOR PRINCIPALS

The teachers who helped write the NSF/PIES proposal believed that one of the major problems in improving science teaching was lack of administrative support. The recently published NSTA 4-volume series, Promoting Science Among Elementary School Principals, confirmed their belief that such support is both essential and complex. During the project we tried the following approaches to improving administrative support in our participants' schools:

- workshops for all participants in "Managing Up" so that teachers could help administrators be supportive;

- workshop/reception for participants and their principals to introduce the principals to the types of activities and the philosophy of inquiry science;

- workshops specifically for principals (this series was plagued by ice and snow storms and was very poorly attended);

- regular personal communication between the travelling NSF/PIES resource teacher and the building principals;

- regular personal communication between the project administrator and the superintendents about the project and the specific activities of teachers;

discussion with participants during academic year meetings about problems and solutions to administrative support issues (an oral history of foolish behaviors and successful strategies).

Although we were disappointed that more principals did not attend our afternoon seminar series (and that those who did come needed it the least), we realized that their behavior was hardly surprising. Such a series is, by definition, threatening ("You are invited because you are not doing a good job."). Other more informal, and less threatening, approaches were more successful. While we cannot claim to have influenced the actual behavior of principals, we do know that the participants stopped viewing their administrators as the reason for the problems in science teaching.

Administrative Suggestions: It is clearly vital to keep building administrators, supervisors, and others in positions of authority informed about successful teaching methods and how they can support them more effectively. Finding the proper vehicle (workshops offered within their own professional organization, personal conversation, opportunities to observe within their own and other school systems, for example) is a challenge. It is equally important to give teachers the confidence to ask for support and the skill (non-threatening, win/win strategies) to secure it.

EVALUATION

A complete copy of the final evaluation appears as Part II of this report. The evaluation strategies we used included:

simple questionnaires distributed and collected at the end of each component (Spring Saturdays, each Friday during the summer, each release-day or after-school workshop). Questions were: How will you use what you learned? In retrospect how could the day/week have been better? What should we consider in our future planning? The answers were used by the staff for immediate planning;

personal interviews (based on the Concerns Based Adoption Model, see Part II for explanation and references) of all participants at the beginning, middle and the end of the year and classroom observations during the spring of the year. The results were used to adjust the second-year program and to plan other Partnership programs;

some additional data sources including questionnaires to parents and interviews with staff. The results were used by the evaluator to enrich his understanding of the project.

There were a number of advantages, and one problem, with our system. The advantages, which greatly outweighed the problem, included:

for staff: easy access to quick, simple planning information; periodic access to sophisticated information on the effects of the institute in the classrooms; personal access to the evaluator who participated in planning meetings and helped us understand the implications of the data;

for participants: our rapid response to participants suggestions demonstrated our respect for their ideas; the interview-observation process reinforced the statements of the teaching staff that using the inquiry approach to teaching science was difficult, that it would take time to feel confident, but that the confidence would eventually come.

The problem was that we collected too much data and, therefore, were always behind processing it. This is exactly the same problem (trying to do too much) which we encountered in both the science and writing components and one which we believe we have solved (at least for the evaluation component) in our present National Science Foundation space project for middle school science teachers (NSF/SpaceMet) by limiting the amount of data and setting more frequent deadlines for reports.

Administrative Suggestions: Both the quick-and-dirty evaluations of events and the long-term evaluation of the impact of the project are necessary, i.e., both formative and summative evaluation. In the perfect world there would be a variety of sources, appropriately analyzed, and provided to the staff in a timely fashion. In the real world, it is vital to have some data, even if it is less than perfect, regularly.

The Concerns Based Adoption Model is especially appropriate for projects which expect real change in classroom teaching. It is possible to use this evaluation technique at a number of different levels of sophistication (written questionnaires only, personal interviews, and/or classroom observations) depending on the needs of a project.

It is vital that the evaluation be planned before the project begins (even if improvements are made later) and that the evaluator serve as a full member of the planning staff throughout the project.

CONTINUATION

SCIENCE/RESOURCE WORKSHOPS

In the spring of the second year, NSF/PIES began offering a series of workshops for both the participants and other elementary school faculty interested in strengthening their teaching of science. Using staff and participants as presenters, we began a series of self-supporting workshops which we hope will continue for many years to come. This past year, we expanded the presenters to include other school, college, and museum personnel. Since all presenters at all academic-year Partnership events donate their time, we were able to charge a $20 fee for release-day workshops to cover the cost of food and materials and to offer The after-school workshops free of charge. This year's events will include training in the chemistry kits developed at Mount Holyoke College, a release-day workshop devoted to techniques for using plants in the classroom, at least one workshop on professional opportunities such as EarthWatch, and training for elementary teachers in using our electronic bulletin board.

Administrative Suggestions: If science programs are to improve, teachers need on-going support in locating new resources. Even teachers who have participated in programs such as NSF/PIES, have neither the time, nor the self-confidence, to call school or college faculty they do not know personally to ask for assistance. On-going workshop series provide a low-risk environment for encouraging teachers to use new resources. The commitment to the participants, and their school systems, must extend well beyond the final date of the grant.

LEADERSHIP TRAINING

During the first academic year, it became obvious that participants needed more support than we had initially planned to provide. It was not that they were not doing as well as we had anticipated; they were doing better. They were being successful in their classroom and were now ready to help others. Since we had not included a one-week second summer institute (as we do now), we explored five alternatives during the next two years.

> Curriculum development teams in which 10 NSF/PIES graduates completed projects they had worked on during the school year so that they could be shared with others. (This project was frankly not very successful. Without a staff member of organize the teams, the work completed was personally satisfying, but not as useful to others as it could have been. With proper leadership this could have been a more valuable experience for the participants and their colleagues.)
>
> Follow-up workshop/seminar focusing on scientific reasoning lead by Co-director Richard Konicek. This was an extremely valuable experience for the 8 participants who, working with children, were challenged to become teacher-researchers observing the student's thinking processes (Watson and Konicek, 1990).
>
> Support for participants who wanted to give presentations to other teachers. We sponsored a number of workshops in which participants could give presentations, sent participants to regional meetings to make presentations, and helped them prepared presentations, posters, and papers through individual assistance and a seminar series "Letting Others Know."
>
> Selection of individual participants as staff in the second year of NSF/PIES and in our middle school science project, NSF/SpaceMet. Nomination of participants to special opportunities (Massachusetts Lucretia Crocker Scholar; NSF/Operation Physics team member).
>
> Invitations to participants to serve as participants in, and planning members of, other Partnership projects.

At last count 81 of our original 92 NSF/PIES participants still have teaching positions (3 have retired because of age or ill health, 2 are teaching outside the state, 6 have lost their teaching positions because of state budget cutbacks). Of those 81 still in our schools, 49 are actively involved in Partnership activities (26 in leadership roles); we know of at least 10 others are actively involved in other professional activities outside the Partnership; at least 30 have continued to use the resources of the Hitchcock Center. Both the Hitchcock Center and the Partnership regularly receive inquiries about future programs in elementary science. We are very pleased with these results.

Administrative Suggestions: We are very fortunate that the Five College/Public School Partnership as an organization will continue for many years beyond the NSF/PIES grant. It is, therefore, possible for us to offer on-going support to participants in both science education and in leadership training. Somehow, all teacher enhancement projects must acknowledge and accept this responsibility. In the long run it is this on-going support which will surely make the difference between having just a happy memory and having strong science programs in our schools.

Publications:

Watson, Bruce and Richard Konicek, "Teaching for Conceptual Change: Confronting Children's Experience," Phi Delta Kappan, May 1990, pp.680-685.

Laffond, Wanita Sioui, "Who Me, Teach Science?" submitted to Teacher magazine.

Merle Bruno, Richard Konicek, and Thomas Wolf are completing articles for submission.

NSF/Partnership in Elementary Science Staff

Co-directors

Merle Bruno, Natural Science, Hampshire College
Richard Konicek, School of Education, University of Massachusetts

Science faculty

Mary Gugino, Holyoke Elementary Schools (second year)
Wanita Sioui Laffond, Buckland-Shelburne Elementary School (second year)
Peg McDaniel, Librarian, Hitchcock Center for the Environment (both years)
Susan Mitchell, Amherst Elementary School Science Coordinator (first year)
Karen Pedersen, Resource Teacher, Hitchcock Center for the Environment (both academic years, second summer)
George Smith, Science Department Chair and Woodrow Wilson Master Teacher, South Hadley High School (first year)
Terez Waldoch, Wildwood School, Amherst (both years)

Workshops for Teachers ("Managing Up") and Principals on Administrative Support

Gwen Van Dorp, Associate Superintendent, Mohawk Trail Regional Schools

Consultants on Process Writing

Marna Bunce, Amherst Public Schools
Marilyn Gass, Psychology/Education Department, Mount Holyoke College
Charles Moran, Writing Project, University of Massachusetts

Evaluator

Thomas Wolf, Associate Superintendent, South Hadley Public Schools

Project Administrator

Mary Alice B. Wilson, Coordinator, Five College/Public School Partnership

1987 and 1988 NSF/PIES Fellows

Agawam: Ann Bradford, Barbara Daubitz
Amherst: Richard Berman, Barbara Rynerson, Louise Stark, Debbie Teece, Lisa Yaffee
Ashfield: Poppy Doyle, Katherine First, Budge Litchfield, Debbie Robidoux
Belchertown: Deborah Jacobson, Sherry Sajdak, Cindy White
Bernardston: Diana Campbell
Buckland-Shelburne: Wanita Sioui Laffond
East Longmeadow: Louisa-May Bouchard, Diedra Paczkowski
Goshen: Rita Horn
Granby: Maureen Bail, Louise Cox, Betsy Dickinson, Claudette Finck, Patricia O'Neill, Margaret O'Sullivan, Shirley Pion, Betty Rice, Dretta Weaver
Great Barrington: Coreen NeJame
Greenfield: Denise Petrin
Hampden: Gisela Leven
Holyoke: Marguerito Buskey, Thomas Cadigan, Cecelia Cauley, Julianne Deni, Patricia Eagan, Maryellen Fisher, Sylvia Galvan, Carole Gamache, Teresa Greenwood, Mary Gugino, Mary Kay Haller, Mary Haradon, Joanne Lamoreaux, Christine Leary, Catherine Long, Judy McGinty, Jody McNally, Gwen Morrissey, Debra Sicilia, David Zuccalo
Leverett: David Hammond
Longmeadow: Grace Hayden, Kristina Gagne, Paula Lewis, Nina Skolsky, Ina Tober
Ludlow: Betsy Koscher, Lenore Paul
Northampton: Phyllis Bouthilette, Joanne Parsons
Northfield: Laura DiBari
Old Deerfield: Mark Foley, Donna Patterson, Irene Woodard
Pittsfield: Kerry Campbell Ross, David Cooper
Shutesbury: Elinor Saltz
South Hadley: Ruby Costa, Bonnie Crowe, Bob Fitzgerald, Jane Golob, Tom Kennedy, Barbara LaCorte, Sandra Manijak, Deborah O'Brien, Peggy Murphy-Richardson, Margaret Riddle, Marilyn Simpson, Nancy Sinclair, Janet Smith, Eugene Turcotte
Southwick: Nancy English, Joyce Zippe
Springfield: Gail Healey, Judith Schwabe, Linda Wilson
Williamsburg: Kathleen Chlanda, Pamela Lamond, Patricia Lessie, Diana Rutherford

PART II: EVALUATOR'S FINAL REPORT

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INTRODUCTION

"Encouraging the class to construct paper airplanes in the classroom was not the kind of science experiment I would have expected to be invested in. Yet these were the experiences in which the class became the most actively involved and for which we received the most positive feedback... my learning was a direct result of the risks I took in assuming the role of facilitator as opposed to instructor. I also learned that ownership is important in science process... ownership of ideas, conclusions, and projects seems to stimulate investment and interest."

"I am encouraged to say that I have a new insight into how I can teach science in a way meaningful to my students...Using the assigned text book series selected by our curriculum committee, I have for six years been unsure about what my students were learning. The past three weeks I have a better idea about what has worked and what I would like to change. I see the tremendous value of teaching science through inquiry. This method along with a valid writing program involves the students in their learning far more than textbooks."

"PIES motivated me to seek out courses designed especially for teachers concentrating on how students learn. Cooperative learning groups are blossoming in my classroom in math and science... I feel I have become a "professional" in teaching. At the same time I'm still learning."

These quotations are from NSF PIES Fellows and reflect the strong feelings that participating teachers have for the project. While NSF PIES originally was funded as a two year project, it was extended into a third summer and still attracts Fellows to school year meetings held through the Five College Public School Partnership. Clearly, the project has been very successful in meeting its major goals. Teachers currently are using hands-on inquiry science in their classrooms. They have materials and resources that they didn't before. They feel more confident about teaching science. More important, they feel comfortable with the inquiry process and responnding to student questions for which they are not the source of all right answers. They have established informal networks of colleagues which are a source of intellectual stimulation and support. While most of the teachers speak of disseminating ideas and materials informally, a number of them have received grants and fellowships, some of have gone on to graduate study in elementary science education, others work as staff members for SPACEMET which is another NSF funded science program sponsored by the Five College Public School Partnership.

The remainder of this report is divided into two sections. The first is a summary report which looks at NSF PIES as a successful staff development project and analyzes the reasons for its success. The second is a series of presentations and discussions for each major data source used in the process. All of the questionnaires and interview protocols are included in the Appendix One. Appendix Two includes the criteria used by the people who made the classroom observations for the project. Appendix Three includes a full chronology of project events.

SECTION ONE

NSF PIES as a Successful Staff Development Program

There are some key indicators of the NSF PIES' Project success as a staff development program in elementary science. Two years after the NSF PIES Project funding has ended, the Five College Partnerhsip helps to design follow-up activities for the Fellows and other elementary teachers interested in science curriculum and the inquiry method. Both first and second year Fellows remain active in science education in the area in a variety of ways. Individual school districts have increased their support for elementary science and the inquiry method within the constraints of problematic state and local budgets. There are some good reasons for the program's success, none of them surprising. NSF PIES exhibits important characteristics of a successful program; and the rest of this section looks at these programmatic features.

A number of specific features of successful staff development programs which can be mentioned here and which are mentioned often by the NSF PIES Fellows are important strengths of the project.

First, the NSF PIES staff was experienced in both working with elementary teachers and inquiry science. Most had experience teaching science to elementary students. Staff responsible for process writing had the same important experience.

Second, there was plenty of relevant content. The content was practical, teachers could use it their classrooms, it fit their curricula and developmental needs of their students. Moreover, the content came with the theoretical and methodological underpinnings which would enable the teachers to incorporate it as part of their teaching style and not just as someone else's recipes.

Third, there was enough follow-up. Not only were there meetings throughout the school year, but a staff member was available for any teacher who wanted assistance on-site in his/her school. Teachers were given memberships to the Hitchcock Center and access to the Center's materials and consulting help when they came to look for resources. Moreover, follow-up was available in the Year Two summer for Year One Fellows in the form of curriculum development stipends and in Year Three summer for both sets of Fellows in the form of an additional course.

Fourth, there has been ample and varied time for collegial interaction. Planning groups met regularly during the summer to plan for the practice teaching in the Mass Migrant Education Program and support each other's learning. Follow-up meetings during the year gave Fellows both structured and unstructured time to share their experience. Meetings of interested Fellows to plan project activities also gave those people involved in the planning additional opportunity for sharing.

Finally, although it is not mentioned as often by Fellows, the project helped them by involving their administrators and showing them how to "manage up," enlist the support of building and district administration.

While the evaluator feels these specific characteristics are necessary for successful staff development programs, he sees a set of principles which need to serve as part of the framework in which any subject-oriented staff development program must set.

1. <u>There is a clear, shared vision of educational goals and philosophy</u>. Much of the effective schools research points to the need for people to understand and commit to a shared set of values and goals. Most of the NSF PIES staff came to the project with extensive experience in and commitment to hands-on inquiry science. Merle Bruno had been one of the early curriculum developers for ESS. Richard Konicek had been operating both undergraduate and graduate programs in science educations based upon a constructivist point of view. The staff at the Hitchcock Center had previous grants in teacher training from NSF which were focussed on the same kinds of curricula and methodology. Two of the staff members from the schools had previously run NSF teacher training projects in ESS materials for their peers. The planning for and implementation of the project was informed throughout by a similar point of view. Thus, the NSF PIES Fellows consistently received the same implicit and explicit message. In addition, while the Fellows differed in their experience with inquiry science and their teaching settings, they all came as elementary teachers having made the commitment to learning more science theory and classroom practice.

Differences in this shared vision produced some of the more problematic moments in the life of the project. Initial planning meetings brought together university and school people, writing and science people, and urban and small school district people. There were some strong differences between the writing and science people even though the planners assumed that process writing and inquiry science had their roots in common assumptions about learning and how students construct meaning. Moreover, data from the project seem to indicate that it was not possible to convey the depth of purpose and vision about both discipline areas. While some teachers report that they are integrating writing with science, the success of the project is better indicated by the number of teachers who are implementing inquiry science by itself.

It is interesting to note that there was some confusion on the part of the Year One Fellows as to what inquiry science was. Some understood it as providing students with active "hands-on" learning experiences. Others knew that hands-on activities were just a piece of a larger "minds-on" process which involved students in generating questions for study, developing experimental situations, and drawing conclusions from the data gathered from these experiments. When this confusion emerged from the data in Year One, there was agreement among Project staff that summer workshop and school year activities needed to be redesigned to directly address the confusion between "hands-on" and "minds-on" activities.

Differences between urban and smaller school districts surfaced both during the planning process and the first summer. Needs of teachers, system resources, flexibility of bureaucratic response were issues that highlighted the differences between urban and rural/suburban schools during the planning process. The different school system norms and needs proved to be problematic. Early in the first summer, a serious split developed between some urban and small system teachers around issues of multicultural education and dealing with diversity. Some small district teachers dismissed the distinctive needs of minority students. Project staff dealt with this insensitivity and the resultant anger for most Fellows; but, the residue adversely influenced a few Fellows' commitment to the project.

These issues raise interesting questions. Staff development programs must model and not just preach the kind of learning environment they hope to have teachers create for their students. Is it possible to maintain both a shared vision and the kind of heterogeneity that makes for a rich educational experience? If the research is seriously questioning both the effectiveness and equity of homogeneous grouping with students, how can educators design such programs for themselves?

The evaluator feels strongly that differences in experience and needs does not have to interfere with having a shared vision. In fact, the NSF PIES Project worked through the issues listed above; and, the program was very successful. What is required is a reaffirmation of the values and assumptions about learning and growth that brings people together.

2. <u>There is a theoretical model which mirrors the ways in which teachers will first encounter, begin to master, and share the ideas and activities with others.</u> The Concerns Based Adoption Model is good way of conceptualizing the way in which teachers first encounter and then adapt an innovation for their classrooms. A full explanation and citations for CBAM appear in Section Two. Briefly, CBAM holds that a teacher moves through a process of:

learning about an innovation;
planning to use it;
beginning use in which he/she is mostly concerned about how it works and management;
becoming comfortable with it and gradually adapting it to maximize its effect on students;
and, sharing his/her experiences and learnings with colleagues in developing new directions based upon the innovation.

An outline of the project's four years (three NSF funded and one locally funded) shows th.. model of learning and growth.

Year One - There was a major emphasis on hands-on science and becoming comfortable with what that looks like and feels like in the classroom. Follow-up work was focussed on collegial sharing and support and on curricular extensions.

Year Two - The project combineds hands-on and minds-on science into a more comprehensive picture of inquiry science for teachers. In addition, Year One Fellows worked during the second summer in beginning dissemination activities of writing curriculum for distribution to peers. Follow-up work was focussed on minds-on science, collegial sharing, and an increasing emphasis on different forms of dissemination.

Year Three - The summer work moved into a more complex process of analyzing how students construct scientific meaning, how they develop scientific misconceptions, and how classroom experiences might be designed to challenge these misconceptions and move students to a more accurate understanding of scientific principles. Dissemination included participation in regional and national conferences. Some of the Fellows moved into graduate programs, staff positions in other staff development programs, and science resource people for either state grants or istrict programs.

Year Four - Dissemination activities continued through graduate programs, individual Fellows' work, continuing workshops and meetings throughout the year, presentations at conferences, and articles.

It is also interesting to note that the program's increasingly complex programs and widening perspective roughly parallels Bloom's Taxonomy of Cognitive Objectives. Activities in Year One can be seen as focussing on understanding the concepts of inquiry science and beginning to apply them in the classroom. Year Two continues the process of application and begins to analyze the nature of inquiry science. The summer program in Year Three involves Fellows in analysis of how students construct scientific meaning and the synthesis of that knowledge that will enable them to design activities and programs based upon the students' construction of knowledge. Throughout the project, there is a growing emphasis on evaluation which can be seen in the increasingly complex dissemination and support activities.

The evaluator does not subscribe to the idea that the taxonomy is a rigidly chronological set of stages that all people must go through or that higher levels are necessarily better than lower ones. However, the successful CBAM research in the stages that teachers go through as they adapt innovations has been applied to thoughtful work on how to design successful staff development interventions based upon the stages. There are definite parallels between the two models in the increasing levels of complexity and widening sense of perpective. The NSF PIES design has both the increasing complexity and widening perspective; and, the evaluator believes that future NSF programs should consider a similar developmental model in developing long range plans.

3. <u>Teachers need to be treated as theoreticians as well as practitioners and an effective staff development program must be a model of the reflective process it encourages its participants to go through.</u> One often hears teachers talk about successful workshops as those which give them things to use in their classrooms. "Make and take" has been a phrase used to describe experiences which fill teachers' hands with things to do. The evaluator agrees that a consultant needs to: establish credibility by knowing what will work and what will not in the classroom; that teachers need to be able to use a wide variety of materials and activities; and they don't have the time to research or develop the full range of materials and activities that will add to their effectiveness in the classroom. However, unless teachers understand that they are constantly engaged in action research, that their choice and modification of materials is a reflection of their values and assumptions about learning constantly at work, and that becoming conscious of that

critical eye will deepen and enrich their teaching, the materials they prize will quickly lose their appeal and become old stuff to them and their students. However, if teachers can recognize the assumptions about learning important to them and understand how they can test their espoused theory against their theory in action, they will be in control of the materials they use and not vice versa.

The NSF PIES Project was an excellent example of a reflective model. It made several important adjustments from Year One to Year Two based upon the Fellows' feedback. It involved them in the evaluation and planning for all the follow-up activities and used them as presenters at a number of the follow-up meetings. NSF PIES staff actively recruited Fellows to design and deliver presentations at regional and national meetings. Year One and Year Two Fellows saw the ways in which the summer program developed as they pushed at the concepts of hands-on, inquiry science and constructivist theory. Finally, the project designed a great many activities which involved teachers in collegial relationships around the cycle of planning implementation, evaluation, and redesign or reaffirmation. Thus, the Fellows not only saw a reflective model at work but had the opportunity to participate in the model at every step of the program.

4. <u>An effective staff development program must have some of the characteristics of a temporary system, or be able to operate as if it were a part of loosely coupled system, while still maintaining efficient organization and communications mechanisms.</u> Teachers' lives are beset by bureaucracy, schedules, and other people'agendas (district curriculum and teachers' guides, community norms, etc.) Moreover, the rationale for staff development programs most often center on manipulating teachers in some way that will produce better students. Effective staff development programs use the characteristics of temporary or loosely coupled systems to treat teachers as people in their own right, as people who have individual goals for their own development as adult learners, who come together as a community of professionals around a body of theory and practice in which they are interested and have expertise.

The major features of a temporary or loosely coupled system are that it is outside the customary bureaucracy and bureaucratic control and hierarchical structure, that it is flexible and responsive to the needs of the participants, that the substance of the system lies outside the bureaucratic structure and is meaningful to the participants, and that the participants feel empowered as colleagues and decision-makers.

The evaluator feels the NSF PIES Project has been such a system.

First, it has been organized through the Five College Public School Partnership, an organization that is not tied into local or state bureaucracy. Moreover, each school system had to agree to support participating Fellows by releasing them three times during the school year in order to participate in follow-up activities. One of the features of the project is that leadership has come from both staff members and Fellows, with school teachers sometimes serving as staff members and working collaboratively with university or Hitchcock Center staff. The logistics and creature comforts for the summer workshops and follow-up sessions were well planned for and not characteristic of the usual staff development programs.

Second, the project was definitely responsive to Fellows' needs. Feedback was actively and often asked for, and program changes were made in direct response to Fellows' suggestions. Fellows were in on all the planning as soon as the project began to function during the first spring.

Finally, NSF PIES offered teachers substance that was important to them: a philosophy for teaching science, background science knowledge, and curriculum kits and activities that bring the philosophy and knowledge to life for students. Moreover, the philosophy, a vision of inquiry science, was never diluted with other agenda. In fact, it became stronger and more clearly articulated as the project grew in years two, three, and four. Most important, the Fellows were not treated as people to be remediated but as professionals with the experience and expertise to participate with colleagues in the ongoing development of the program.

It must be said here that the Five College Public School Partnership, w[illegible]le outside the customary bureaucracy, nonetheless was able to provide the necessary logistical and communications support for the project. There were few, if any logistical problems. Communication was timely and clear. It could have just as easily become a problem with the Fellows spread out across a number of member districts and schools. Thus, the project was able to maintain its character as a temporary system without sacrificing organization necessary to keep people informed and interested.

Data show that the NSF PIES Project achieved its major goals. The NSF PIES Project success can be attributed to the fact that teachers came away from the experience feeling they had gotten ideas and activities to use in their classrooms; that they have a better background in science and more confidence in teaching it; and that they better understand of the inquiry process and how to incorporate it in science and other subjects. The data contained in questionnaires, classroom observations and interviews validate these conclusions. However, the evaluator feels that it is the larger context of a staff development program which engaged teachers as adults and empowered them as professionals which will be responsible for the lasting impact of the project.

Empowerment or engagement are current buzzwords on the educational landscape. They imply a different kind of educational reform movement than the top down, mandated reforms that followed reports such as _A Nation at Risk_. In this scenario, the teacher is a reflective practitioner, a researcher who has a responsibility to build curriculum and test his/her ideas in the classroom. The teacher is a professional colleague with responsibility to the other teachers with whom he/she works. The teacher is an adult learner who can sensitively translate his/her experience as a learner into meaningful experiences for students.

The NSF PIES Project provided a staff development program consistent with this model of educational change.

SECTION TWO
DATA SOURCES

Level of Use (LoU) Interview

LoU Process

The LoU Interview was developed as part of the Concerns Based Adoption Model (Hall, Wallace, and Dossett, 1973). (Hall, Loucks, Rutherford, and Newlove, 1976), (Hall and Loucks, 1977) (Hall and Loucks, 1978). The central theory is that teachers go through a developmental process as they adopt any innovation. These stages are as follows (Loucks, 1977):

0. Non-Use - No action is being taken with respect to the innovation. The user (teacher) has no knowledge of it.

I. Orientation - The user (teacher) is seeking information about the innovation, how it works, what personal impact it will have, etc.

II. Preparation - The user (teacher) is preparing to use the innovation, has set a definite date.

III. Mechanical - The user (teacher) is implementing the innovation in a poorly coordinated manner, has management and logistical questions.

IVA. Routine - The user (teacher) is comfortable in using the innovation, is making few or no changes, and has an established pattern of use.

IVB. Refinement - The user (teacher) is making changes in his/her use to enhance student outcomes.

V. Integration - The user (teacher) is making deliberate efforts to collaborate with others in using the innovation.

VI. Renewal - The user (teacher) is seeking more effective alternatives to the established use of the innovation.

In the case of the NSF PIES Project, implementing hands-on inquiry science in the classroom was established as the innovation.

For each of the two years of the project, the evaluator attempted to interview the NSF PIES Fellows who were currently engaged in teaching science in their classrooms in the Fall and the Spring. He did not interview Special Education Chapter One, or remedial reading teachers who did not teach science regularly while. One teacher each year became ill and missed a great deal of school. One teacher in the second year of the program left teaching. For the remaining teachers, the evaluator sent them a letter which contained a series of dates, a form on which they could indicate three choices for interview times, a stamped addressed envelope for return, and the interview protocol. In addition, he followed this letter up with telephone calls to schedule those teachers who did not reply. For the most part, this process was very successful; and, most of the teachers were interviewed in the fall and spring.

All of the interviews were conducted by phone. In addition to the LoU questions (see Appendix A) the evaluator asked the NSF PIES Fellows the following questions:

-- Has your participation in the NSF PIES Project had any impact on you as teacher (individuals were asked to comment on thei answer)?

--What would you say are the major strengths of the NSF PIES Project?

--What would you say are the major weaknesses of the NSF PIES Project?

The evaluator looked at the data from these interviews in two ways. First, he placed the teachers at different Levels of Use according to the interview interpretation protocols. Second, he grouped the responses to the four questions above and the second LoU Question (What would you say are the strengths and weaknesses of hands-on, inquiry science) into general categories. The data from these four questions are an important source of Fellows' perceptions about the Program and its impact on them and their teaching.

LoU Data

Data show that teachers in both years grew in their comfort with and ability to adjust to hands-on, inquiry science. Table One presents the LoU data for the Year One Fellows; Table Two presents the LoU data for the Year Two Fellows.

Table One.
Year One NSF PIES Fellows LoU

Level of Use		Fall (n=38)	Spring (n=39)
0	Non-Use		2 (5%)
I	Informational		
II	Preparation	4 (11%)	2 (5%)
III	Mechanical	12 (32%)	1 (3%)
IVA	Routine	16 (42%)	27 (69%)
IVB	Adjustment	4 (11%)	6 (15%)
V	Collaboration	2 (5%)	1 (3%)
VI	Renewal		

Table Two.
Year Two NSF PIES Fellows LoU

Level of Use	Fall (n=36)	Spring (n=32)
0 Non-Use		
I Informational		
II Preparation		
III Mechanical	15 (42%)	4 (13%)
IVA Routine	18 (50%)	18 (56%)
IVB Adjustment	3 (8%)	8 (25%)
V Collaboration		2 (6%)
VI Renewal		

Discussion

In both years, the percentage of teachers who were concerned with management issues declined significantly. In Year One, the percentage of teachers who were able to establish a comfortable routine and in Year Two, the percentage of teachers who were able to make adjustments in their classroom to enhance student learning increased significantly. This growth on the part of the teachers is important. When teachers cannot develop beyond a primary concern with management of an innovation, their use will remain mechanical and may eventually disappear. More important, their focus cannot be on the students and what the students are or are not learning.

Other data in this interview substantiate the evaluator's feeling that the NSF PIES Project played a major role in the Fellows' growth in their use of hands-on inquiry science. However, there are two other factors which must be taken into account in looking at these data.

> First, not all teachers came to NSF PIES with the same background knowledge or training in science, with the same experience teaching or teaching science, with the same philosophy about teaching and learning, or from the same school system. Some teachers entered the program with a good deal of experience teaching science from this philsophical base. Others were to begin teaching science for the first time after their participation in the NSF PIES Summer Program.
>
> Second, unless a teacher's school district actively supports his/her participation in hands-on, inquiry science, the teacher will find it difficult to maintain his/her energy level and commitment. For the most part, the teachers did indicate a level of support when they responded to this question in the Spring. Year One Fellows made 31 positive comments, 3 indifferent comments, and 14 negative

comments. Year Two Fellows made 48 positive comments, 2 indifferent comments, and 7 negative comments. Most of the negative comments focussed on the lack of financial support. Budget shortages could lead to much larger student-teacher ratios, less time available for science in the school day, less money available for staff development, and fewer supplies. All of these factors would definitely impact the degree to which the classroom teacher could grow in his/her use of hands-on, inquiry science.

Additional Questions

Next, the evaluator looked at the answers to three questions as measures of teacher perceptions: (1) the strengths and weaknesses of hands-on inquiry science, (2) how the NSF PIES Project changed them or their attitudes toward teaching, and (3) the strengths and weaknesses of the Project itself. Tables Three, Four and Five present data about each of these attitudes in turn. Each table presents the totals, differences between the fall and spring interviews for each year, and differences between each year.

Strengths and Weaknesses of Hands-on Inquiry Science

Data

While this question is an integral part of the LoU Interview, the evaluator felt that the responses would be interesting to isolate. Table Three presents the results.

Discussion

It is an interesting feature of the responses that every grouping of the data for strengths show that over 90% of the responses are focussed on the impact that the content and approach has on students (students are motivated, students learn, students benefit, and non-verbal students succeed). These responses are a strong indication that the project has been successful in not only introducing teachers to hands-on, inquiry science but in getting them to understand and accept the set of assumptions which underlie process science as well.

One of the features of the data is the difference between the Fall and Spring responses for Year 2 Fellows. There is a lessening of responses (from 51% to 44%) for "students learn the inquiry process" and a growth of responses (from 10% to 21%) for "hands-on is good for students." The difference is not significant with the high aggregate percentage for both times of the year being more important.

Table Three
Strengths and Weaknesses of Hands-on Inquiry Science

Strengths	Total (n=385)	1st Year (n=177)	2nd Year (n=208)	1st Yr Fall (n=87)	1st Yr Spring (n=90)	2nd Yr Fall (n=119)	2nd Yr Spring (n=89)
Motivates students	101 (26%)	49 (28%)	52 (25%)	25 (29%)	24 (26%)	29 (24%)	23 (26%)
Students lrn inquiry proc	179 (46%)	79 (45%)	100 (48%)	36 (41%)	43 (47%)	61 (51%)	39 (44%)
Hands-on good for students	57 (15%)	26 (15%)	31 (15%)	14 (16%)	12 (13%)	12 (10%)	19 (21%
All students succeed	21 (5%)	10 (6%)	11 (5%)	4 (5%)	6 (7%)	7 (6%)	4 (4%
Integrates writing	11 (3%)	5 (3%)	6 (3%)	3 (3%)	2 (2%)	2 (2%)	4 (4%)
My comfort w sci grown	12 (3%)	6 (3%)	6 (3%)	[illegible] (3%)	3 (3%)	6 (5%)	0 ---
Other	4 (1%)	2 (1%)	2 (1%)	2 (2%)	0 ---	2 (2%)	0 ---

Weaknesses	Total (n=189)	1st Year (n=88)	2nd Year (n=101)	1st Yr Fall (n=45)	1st Yr Spring (n=53)	2nd Yr Fall (n=60)	2nd Yr Spring (n=41)
Time	63 (33%)	27 (31%)	36 (36%)	10 (22%)	17 (32%)	24 (40%)	12 (29%)
Management	45 (24%)	29 (33%)	16 (16%)	18 (40%)	11 (21%)	10 (17%)	6 (15%)
Materials, space	43 (23%)	18 (20%)	28 (28%)	6 (13%)	12 (23%)	15 (25%)	13 (32%)
Administrative support	7 (4%)	6 (7%)	1 (1%)	4 (9%)	2 (4%)	0 ---	1 (2%)
Evaluation of student lrn	17 (9%)	3 (3%)	14 (14%)	0 ---	3 (6%)	6 (10%)	8 (20%)
Student style background	6 (3%)	2 (2%)	4 (4%)	1 (2%)	1 (2%)	4 (7%)	0 ---
Other	4 (2%)	2 (2%)	2 (2%)	2 (4%)	[illegible] ---	1 (2%)	1 (2%)
None	17	11	6	4	7	2	4

It is important to note here that only three percent of the teachers mentioned that hands-on, inquiry science gave them a chance to integrate writing into science. The NSF PIES Project began with this integration as an important goal. During the first year, more workshop time was directly devoted to it than during the second. However, there is no corresponding difference in the teacher responses.

While the teachers mention the impact on students as the strengths of hands-on, inquiry science, they note management issues as the weaknesses. Time to fit it in, classroom management, finding space and materials, and administrative support consistently represent over 80% of the responses. Three things are important.

First, the percentage of responses for time and materials/space are higher than those for classroom management. Moreover, they increase from the Fall to Spring for both years while the ones for management decrease (Year One) or stay the same (Year Two).

Second, the percentage of teachers who are concerned about evaluating student progress increases markedly in Year Two.

Third, the percentage of teachers who find no weakness in hands-on, inquiry science increases in both years-- from 9 to 13 percent in Year One and from 3 to 10 percent in Year Two.

Teacher perceptions of strengths would seem to place them at LoU Level IVA or IVB indicating that the project has been a success. Teacher perceptions of weaknesses would seem to place them at LoU Level III and indicate they are unable to escape worrying about management issues. This seeming contradiction can be looked in two ways.

First, management issues are inherent in hands-on, inquiry science. Regardless of the level of comfort a teacher has with the process or how much he/she believes in the benefits for students and the validity of the process as a way of knowing, it does take more time and require more space and materials than a text. In fact, the time and materials issues are generally more problematic with other important curricular approaches such as manipulative math and process writing. It is important to note that teacher concerns about classroom management decreased which indicates that they are feeling better about their ability to implement the process. Concerns about finding time in a schedule crowded with other curricular demands, having enough physical space, and getting proper materials are out of their control.

Second, the percentage of teachers in both years who found no weaknesses in the process increased from the Fall to the Spring indicating that a growing number of teachers were feeling better about their ability to implement hands-on, inquiry science in their classrooms.

The evaluator finds the difference in teachers' concerns about evaluating student learning between Year One and Year Two interesting. It is consistent with the LoU data which show that a greater percentage of Year Two teachers are at Level IVB than are Year One teachers. More important, the evaluator feels that the variation reflects a difference in emphasis of the staff in its design of Year Two activities. Data from Year One indicated that the teachers had focussed more on the hands-on aspects of science than the inquiry process. As a result, the NSF PIES staff focussed more on showing teachers how inquiry and reflection were necessary parts of the hands-on process and how to integrate "minds-on science" into their classrooms. This emphasis on reflective learning is evident in the difference in the data between the two groups of Fellows.

Impact on Me and My Teaching

Data

The evaluator did not ask this question directly to Year One Fellows in the Fall. However, enough of their responses to other questions could be characterized in this manner to cause him to ask the question directly in the Spring and to Year Two Fellows. The responses are presented in Table Four. The evaluator will discuss the Spring responses for both years as they are comparable.

Discussion

There were some differences between the two years. The most noticeable is that a much greater percentage of teachers in Year Two mentioned that they were using the inquiry process more in their teaching as a result of NSF PIES. More teachers (and a higher percentage) in Year Two also mentioned that they felt more comfortable with science than did Year One teachers. These differences are matched by the difference between the two years in the higher feeling of personal growth expressed by the Year One teachers. Very few teachers in either year talked about either integrating writing into their curriculum or teaching writing better as a result of the NSF PIES Program.

It is important for the evaluator to note two things about this data.

First, while differences do exist in the Year One and Year Two responses, "using the inquiry process," "personal growth in the classroom," and

Table Four.
Impact on Me and/or My Teaching

	Total (n=298)	1st Year (n=105)	2nd Year (n=193)	1st Yr Fall (n=32)	1st Yr Spring (n=73)	2nd Yr Fall (n=109)	2nd Yr Spring (n=84)
Using inquiry process more	112 (38%)	23 (22%)	89 (46%)	8 (25%)	15 (21%)	54 (50%)	35 (42%)
Teaching writing better	5 (2%)	1 (1%)	4 (2%)	0 ---	1 (1%)	4 (4%)	0 ---
Personal growth (eg. take more risks, enthusiasm)	66 (22%)	25 (24%)	41 (21%)	2 (6%)	23 (32%)	25 (23%)	16 (19%)
Comfortable with science	62 (21%)	25 (24%)	37 (19%)	11 (34%)	14 (19%)	17 (16%)	20 (24%)
Collegial network	27 (9%)	16 (15%)	11 (6%)	6 (19%)	10 (14%)	6 (6%)	5 (6%)
Access to good materials	20 (7%)	10 (10%)	10 (5%)	1 (3%)	9 (12%)	3 (3%)	7 (8%)
General positive	6 (2%)	5 (5%)	1 (1%)	4 (13%)	1 (1%)	0 ---	1 (1%)

"more comfort with science" may all be indications of the same thing; that the project has been successful in its major goal of increasing the use of hands-on inquiry science in elementary classrooms. It is also possible that the greater number (and higher percentage) of responses in Year Two which directly mention the inquiry process is a result of the NSF PIES Staff focussing on and articulating the "minds-on" (inquiry) part of the instructional methodology more in the year two activities.

Second, as with other data, few people mentioned their use of writing in the classroom as an impact. The small percentage of responses in this area is a result of the project's not having enough time or resources to accomplish two very ambitious goals of introducing both hands-on inquiry methodology and content and writing into the elementary science curriculum. In addition, the evaluator believes that asking teachers who weren't already comfortable with process writing to do both is contrary to what research tells us about how teachers adopt innovations.

Strengths and Weaknesses of the NSF PIES Project

Data

Table Five presents the data for this question.

Discussion

Teachers felt that the greatest strength of the project were the learnings (process skills, science content, and how to get classroom resources) that they experienced. Other responses with comparatively high percentages were the collegial experience and the chance to share with peers, the NSF PIES staff, and the increased confidence teachers felt in the classroom as a result of the NSF PIES experience. The most interesting difference between the two years is that there were many more responses by Year Two teachers than Year One (280 to 75). This discrepancy is reflected in the different number of responses in areas such as: the opportunity for collegial experience, the learnings that teachers experienced, the quality of the staff, the opportunity to practice their learnings during the summer, and the student outcomes as a result of hands-on inquiry science. In addition, a much greater percentage of teachers in Year One (37%) did not list any strengths of the project as compared to Year Two teachers (1%).

The most important feature of these responses is the fact that 96% of Year One teachers and 44% of Year Two teachers did not mention any weaknesses of the project. In

Table Five.
Strengths and Weaknesses of PIES

Strengths	Total (n=355)	1st Year (n=75)	2nd Year (n=280)	1st Yr Fall (n=37)	1st Yr Spring (n=38)	2nd Yr Fall (n=152)	2nd Yr Spring (n=128)
Collegial exper.	60 (17%)	16 (21%)	44 (16%)	6 (16%)	10 (26%)	24 (16%)	20 (16%)
Increased tch confidence	35 (10%)	20 (27%)	15 (5%)	9 (24%)	11 (29%)	8 (5%)	7 (5%)
Learnings (skills, content, resourc)	84 (24%)	13 (17%)	71 (25%)	6 (16%)	7 (18%)	41 (27%)	30 (23%)
Staff	35 (10%)	1 (1%)	33 (12%)	0 ---	1 (3%)	21 (14%)	12 (9%)
Summer program	11 (3%)	2 (3%)	9 (3%)	2 (5%)	0 ---	5 (3%)	4 (3%)
Chance to practice	27 (8%)	2 (3%)	25 (9%)	1 (3%)	1 (3%)	10 (7%)	15 (12%)
Follow-up	22 (6%)	3 (4%)	19 (7%)	3 (8%)	0 ---	9 (6%)	10 (8%)
Logistics organization	8 (2%)	0 ---	8 (3%)	0 ---	0 ---	3 (2%)	5 (4%)
Hitchcock Center	21 (6%)	8 (11%)	13 (5%)	3 (8%)	5 (13%)	6 (4%)	7 (5%)
Student outcomes	19 (5%)	0 ---	19 (7%)	0 ---	0 ---	15 (10%)	4 (3%)
General positive	31 (9%)	10 (13%)	24 (9%)	7 (19%)	3 (8%)	10 (7%)	14 (11%)
No response	30	29	1	14	15	1	0

Weaknesses	Total (n=50)	1st Year (n=3)	2nd Year (n=47)	1st Yr Fall (n=2)	1st Yr Spring (n=1)	2nd Yr Fall (n=25)	2nd Yr Spring (n=22)
Work w. migrant program	10 (20%)	0 ---	10 (21%)	0 ---	0 ---	6 (24%)	4 (18%)
Summer workshop	4 (8%)	1 (33%)	3 (6%)	1 (50%)	0 ---	2 (8%)	1 (5%)
Summer program pressure	2 (4%)	0 ---	2 (4%)	0 ---	0 ---	1 (4%)	1 (5%)
Logistics, organization	10 (20%)	0 ---	10 (21%)	0 ---	0 ---	7 (28%)	3 (14%)
More younger grade level mat	6 (12%)	1 (33%)	5 (11%)	0 ---	1 (100%)	3 (12%)	2 (9%)
Heavier science theory	7 (14%)	1 (33%)	7 (15%)	1 (50%)	0 ---	2 (8%)	5 (23%)
More follow-up	10 (20%)	0 ---	10 (21%)	0 ---	0 ---	4 (16%)	6 (27%)
No response, none	104	74	30	36	38	15	15

fact, responses by Year One teachers are negligible. Year Two teachers mentioned the need for more follow-up, logistics and organization, and the interface with the Mass Migrant Education Program staff and schedule most often (20%). Some teachers were concerned with the fact that there wasn't enough science theory (14%). Others felt the need for more grade level activities for younger students (12%).

The most important feature of this data is that strengths mentioned outnumber weaknesses by over 7 to 1 (355 to 50). This fact is a strong indication of the perceptions of the NSF PIES Fellows of the worth of the program. Also important is the fact that the strengths mentioned indicate that the project has fulfilled its major goal (learnings in hands-on inquiry science, increased confidence in the classroom, and student outcomes) and that the program design reflects the best in staff development research (the opportunity for collegial interaction, a strong staff, the opportunity to practice and follow-up new learnings).

There are some interesting discrepancies in this data. While Year One teachers mention strengths about one quarter as much as Year Two teachers, they mention almost no weaknesses. Similarly, Year Two teachers are responsible for mentioning most of both the strengths and weaknesses. The evaluator feels this difference is due more to the characteristics of the two groups of Fellows and not to their differing opinions of the project.

While Year Two teachers mention the opportunity to practice at the Mass Migrant Education Program during the summer as a strength, they also mention the interface with the program as a weakness. The evaluator feels that this discrepancy is an honest appraisal by the Fellows of both the opportunities afforded by the Mass Migrant Education Program and the difficulties of being seen as a "specialist" by the Mass Migrant Education Program staff who had no real appreciation or understanding of the people who showed up in the afternoons to teach their students.

Finally, the ratio of strengths to weaknesses goes from 8 to 1 in the Fall to 6 to 1 in the Spring for Year Two teachers. It is beyond the scope of this evaluation, but the evaluator feels that the smaller number of responses in two areas: the learnings gained from the project and the impact on students should be followed up.

Summer Program Questionnaire

Process

Copies of the questionnaires used at the end of the summer programs can be found in the Appendix. Using short instruments and informal feedback, Program staff collected data regularly each week which they used to make adjustments to the program. The questionnaire used at the end of the summer to assess teacher opinion was much longer and was a combination of multiple choice and focussed open-ended questions about each segment of the program. The questionnaire's major areas of concern were: teacher perceptions of their learnings, the relevance of their experience and material, and their opinions of the strengths and weaknesses of the different parts of the program.

In retrospect, the questionnaire was much too long. First, NSF PIES staff were able to make useful changes in the program based upon the day to day feedback they sought out and the brief formative instruments they used along the way. Second, much of the information used to improve the second summer was gathered in this fashion and through the interviews the evaluator conducted during the year. Third, the data were repetitive. Asking the same questions about each segment of the program produced the same information again and again; interesting in the aggregate, but not useful for program improvement or evaluation.

Therefore, the evaluator has grouped the data and discussion in the following six sections:

- -- an aggregation of the multiple choice responses used for both years
- -- short answer responses of teacher confidence and concerns about integrating inquiry science and process writing into their classrooms (Table Six.).
- -- short answer responses of teacher perceptions of presentations and workshop strands (Table Seven).
- -- short answer responses of teacher perceptions of their work in the Mass Migrant Education Program (Table Eight).
- -- short answer responses of teacher perceptions of the Teacher Resource Center (Table Nine).
- -- short answer responses of teacher perceptions of their work in the peer planning groups (Table Ten).

-- short answer responses of Year One teacher perceptions of relevance of presentations and wish for additional information (Table Eleven).

It is important to note here that all the data show that the summer progra~s were very successful for both years.

Data

Multiple Choice Responses. For each workshop strand, individual presentation, or piece of the summer program teachers were asked how well they thought the segment was organized and how relevant they thought it was to their work. In addition, for workshop strands or regular pieces of the program teachers were asked if they thought they had time to get their questions answered and if they had enough time to share with their peers. The aggregate data appear below.

This (strand, presentation, segment) was well organized.

Strongly Agree	222
Agree	131
Disagree	25
Strongly Disagree	3
No Opinion	1

This (strand, presentation, segment) was relevant.

Strongly Agree	204
Agree	125
Disagree	50
Strongly Disagree	8
No Opinion	5

This (strand, presentation, segment) had enough time for my questions.

Strongly Agree	137
Agree	83
Disagree	22
Strongly Disagree	3
No Opinion	0

This (strand, presentation, segment) had enough time for me to share with colleagues.

Strongly Agree	114
Agree	79
Disagree	14
Strongly Disagree	2
No Opinion	1

Discussion. The data from the multiple choice responses are o~erwhelmingly positive. The profile for each response

Table Six.
Major Project Goals of Integrating Inquiry Science
and Process Writing in Classrooms
Teacher Perceptions of Confidence and Concerns
Summers One and Two

	Total	Year One	Year Two
Integrating inquiry science			
I feel confident that			
I will use inquiry science	61 (47%)	34 (44%)	27 (52%)
I am comfortable with it	32 (25%)	23 (30%)	9 (17%)
Students will respond	11 (8%)	3 (4%)	8 (15%)
I have increased resources	17 (13%)	12 (16%)	5 (10%)
I have become a better teacher	1 (1%)	0	1 (2%)
I have become a better observer of students	2 (2%)	0	2 (4%)
I will share this experience	5 (4%)	5 (6%)	0
No response	4	4	0
I have concerns about			
Change will be hard	10 (12%)	6 (14%)	4 (10%)
Integrate for Spanish speakers	3 (4%)	1 (2%)	2 (5%)
How to use in SPED room	1 (1%)	0	1 (2%)
Time, management	30 (36%)	15 (36%)	15 (37%)
Budget, materials	20 (24%)	11 (26%)	9 (22%)
District curriculum fit	4 (5%)	2 (5%)	2 (5%)
I will become unmotivated	6 (7%)	1 (2%)	5 (12%)
I will exclude other things	1 (1%)	0	1 (2%)
I won't integrate writing	1 (1%)	0	1 (2%)
I won't stay focussed	3 (4%)	2 (5%)	1 (2%)
Need for follow-up	4 (5%)	4 (10%)	0
No response	20	16	4
Process Writing			
I am confident that I will			
Use recording as part of science	17 (15%)	10 (16%)	7 (15%)
Integrate writing and science	37 (34%)	18 (28%)	19 (41%)
Develop good writing projects	5 (5%)	2 (3%)	3 (7%)
Do more writing	26 (24%)	24 (38%)	2 (4%)
Involve students	3 (3%)	0	3 (7%)
Students will succeed and learn	14 (13%)	6 (10%)	8 (17)
Increase parent communication	1 (1%)	0	1 (2%)
Use writing to evaluate more effectively	5 (5%)	2 (3%)	3 (7%)
Share with others	2 (2%)	2 (3%)	0
No response	5	4	2

Table Six. (cont.)

	Total	Year One	Year Two
I have concerns about			
My lack of experience	25 (34%)	18 (38%)	7 (26)
Bilingual issues	4 (5%)	2 (4%)	2 (7%)
Time, management	21 (28%)	13 (27%)	8 (30%)
How to evaluate writing	1 (1%)	0	1 (4%)
Trying to do too much	4 (5%)	2 (4%)	2 (7%)
Unmotivated students	1 (1%)	1 (2%)	0
Student ability	6 (8%)	2 (4%)	4 (15)
Students won't risk	4 (5%)	1 (2%)	3 (11%)
Lack of system support	5 (7%)	5 (10%)	0
The need for follow-up support	3 (4%)	3 (6%)	0
No response	22	13	9
I learned about inquiry science			
Science as inquiry			10 (17%)
How to use inquiry science			13 (22%)
Hands on is fun and important			13 (22%)
How to develop material, use resources			2 (3%)
That I need to do more			2 (3%)
How to integrate inquiry into other subjects			8 (13%)
I have increased confidence			5 (8%)
That inquiry science increases motivation and self-confidence			7 (12%)
No response			0
I learned about process writing			
Writing helps students understand			17 (39%)
How to intgrate writing with science			7 (16%)
Science can motivate students to write			3 (7%)
Students can record effectively			2 (5%)
How to use the writing process			6 (14%)
Drawing is important for younger children			6 (14%)
Writing helps evaluate inquiry science			3 (3%)
No response			1

with over 50% Strongly Agree and over 84% Agree or Strongly Agree for each question is clear evidence of the positive perceptions of the teachers. When the evaluator examined the individual questions, he found that the only exception to this positive profile occurred with the questions about the experience teaching in the Mass Migrant Education Program. The somewhat problematic responses to this specific segment of the summer program are consistent with other data sources such as the interviews conducted in the fall and spring.

Short answer responses of teacher confidence and concerns about integrating inquiry science and process writing into their classrooms. The goals of the NSF PIES project were to get teachers to implement inquiry science and process writing in their classrooms. Table Six presents the data which reflects teachers' confidence and concerns in fulfilling the goals.

Discussion. Data indicate that the NSF PIES Project was successful in increasing teach rs' confidence in implementing inquiry science in their classrooms and, to a lesser extent, in having confidence to use the increased resources at their disposal. It is important to note that 20 of the Fellows made no response to having any concerns about implementing inquiry science. Indeed, this confidence expressed at the end of the summer workshop is reflected in the LoU data and the observation data that was collected during the year. Expressed concerns about time, management, and materials are to be expected. These are issues are always present in the curriculum and instruction that characterizes hands-on inquiry learning. As the evaluator has said elsewhere, without the continued support of building and district administration and the opportunity to network with colleagues, teachers will find it increasingly difficult to maintain the process in their classrooms over a prolonged period of time.

While the data for the writing process is equally as positive in this summer questionnaire, the other data collected during the year do not show as much implementation as the inquiry science. The evaluator is not surprised by the difference. First, the project simply did not devote as much time to the writing as it did to science. In fact, the second year program added the science emphasis of how to move from "hands-on" to "minds-on" science and the opportunity to participate in more science input strands so that there was even less emphasis on writing. Second, in the face of information and experience overload, teachers naturally worked on integrating the more powerful of the new experiences and knowledge bases.

Short answer responses of teacher perceptions of presentations and workshop strands. The strands represented the major science presentations. In the first year, teachers could only sign up for one strand. As a result of their concern about missing too much science, the staff reorganized

Table Seven.
Year One and Two Teacher Perceptions of Summer Program

	Total	Year One	Year Two
A. Relevance of material covered - Strands			
Enjoyable for student	36 (15%)	7 (9%)	29 (17%)
Fits district curriculum	35 (14%)	7 (9%)	28 (17%)
Can use the activities presented	62 (25%)	23 (30%)	39 (23%)
New ideas to use	50 (20%)	22 (29%)	28 (17%)
Important concepts for students	28 (11%)	1 (1%)	27 (16%)
Good for teaching inquiry skills	9 (4%)	2 (3%)	7 (4%)
Can integrate with other subjects	5 (2%)	1 (1%)	4 (2%)
Students learn responsibility for their own learning	3 (1%)	0 ---	3 (2%)
Affordable materials	3 (1%)	0 ---	3 (2%)
Chance to practice	3 (1%)	3 (4%)	0 ---
Collegial interaction	4 (2%)	4 (5%)	0 ---
Increased my confidence to teach	7 (3%)	6 (8%)	1 (1%)
No response	11	2	9
Wish I had learned - Strands			
More practical activities	24 (22%)	7 (15%)	17 (27%)
More theory, science	56 (51%)	22 (47%)	34 (54%)
More grade level activities	10 (9%)	1 (2%)	9 (14%)
More ideas, units of peers	2 (2%)	2 (4%)	0 ---
More about bilingual education	3 (3%)	0 ---	3 (5%)
Management techniques	2 (2%)	2 (4%)	0 ---
Needed more time	13 (12%)	13 (28%)	0 ---
No response	93	16	77
Learned from the strands			
Activities to use			71 (36%)
Science theory			63 (32%)
Inquiry skills			23 (12%)
Sharing ideas with teachers			20 (10%)
How to adapt units for my class			21 (11%)
No response			7

Table Seven. (cont.)

	Total	Year One	Year Two
Strengths of Strands			
Sharing ideas			5 (2%)
Independent study opportunities			4 (2%)
Materials gained			17 (7%)
Teaching suggestions			74 (31%)
Places to get resources			3 (1%)
Improve my inquiry skills			18 (7%)
Learned science			24 (10%)
Fun, motivating			25 (11%)
Staff			51 (22%)
Important issues for students			5 (2%)
Increased my confidence			1 (1%)
Can integrate into other areas			4 (2%)
No response			5
Weaknesses of Strands			
Critters die			3 (3%)
Need more theory			2 (2%)
Time, management			31 (36%)
More grade level activities			7 (8%)
Getting the material			6 (7%)
My ability			16 (19%)
How to integrate with curriculum			7 (8%)
More time			14 (16%)
No response			48

the second summer so that teachers could sign up for three different strands. "One-shot" workshop presentations were scheduled on a variety of topics throughout the three weeks. Table Seven presents summary data on these input sessions.

Discussion. It is clear from the data that the teachers felt the input session were important. Major areas of response show that the presentations provided teachers with material they could use, are important and motivating for students, and fit the district curriculum. The fact that most teachers did not complete the item "Wish I had learned" is also a clear indication that the presentations met their needs. It is interesting to note that many more Year Two Fellows responded that the concepts were important ones for students to learn. The evaluator feels that the difference is due to the increased direct emphasis "minds-on" science received in the second year summer workshop. Another change in the second year program is also reflected in this table. No Second Year Fellows felt they needed more time as contrasted to 13 First Year Fellows. The evaluator feels that the difference reflects the increased opportunity the Year Two Fellows had in participating in different strands.

Finally, the heaviest areas of concern reflect the differences among the Fellows' prior experience with science and teaching responsibilities. Some people wanted more practical activities, others wanted more theory and background. A few teachers of younger students wanted more grade level activities. These responses reflect the different experiences and needs that are inevitable in a large group (about 85) of elementary teachers. The evaluator feels that the project did an excellent job of meeting these needs. He also feels that the diversity of teachers added to the richness of the experience for them and was an implicit model for the kind of diversity educators should be encouraging in their own classrooms.

Short answer responses of teacher perceptions of their work in the Mass Migrant Education Program. Fellows for both years had the opportunity to work with classes of students in the Mass Mass Migrant Education Program. In afternoon classes, Fellows used the materials and methods they were learning about in the morning strands. Table Eight presents the data for this part of the program.

Discussion. The major perceived strength of the Granby (place which housed the Mass Migrant Education Program) experience seemed to be the opportunity to practice. However, this experience was perhaps the most problematic of both summers. First, the logistics of getting to Granby on time and ready to teach given the full morning program were difficult. Second, some experienced Fellows felt the need to get more information and materials and did not believe the practice would help them. Finally, the coordination between the Mass Migrant Education Program teaching staff and the

Table Eight.
Year One and Two Teacher Perceptions of Summer Program at Granby

	Total	Year One	Year Two
Relevance of Granby experience			
Enjoyable for students	2 (3%)	2 (5%)	0 ---
Fits district curriculum	3 (4%)	0 ---	3 (12%)
Can use the activities presented	3 (4%)	0 ---	3 (12%)
New ideas to use	3 (4%)	1 (2%)	2 (8%)
Affordable materials	1 (1%)	0 ---	1 (4%)
Chance to practice	50 (74%)	36 (86%)	14 (54%)
Collegial interaction	4 (6%)	2 (5%)	2 (8%)
Increased my confidence to teach	2 (3%)	1 (2%)	1 (4%)
No response	18	12	6
Wish I had learned - Granby			
More practical activities	2 (3%)	1 (2%)	1 (10%)
More theory, science	8 (14%)	7 (15%)	1 (10%)
More ideas, units of peers	6 (10%)	3 (6%)	3 (30%)
More about bilingual education	13 (22%)	9 (19%)	4 (40%)
Management techniques	9 (16%)	8 (17%)	1 (10%)
Needed more time	2 (3%)	2 (4%)	0 ---
General negative	18 (31%)	18 (38%)	0 ---
No response	36	13	23
Learned from the Granby program			
Activities to use in class			2 (6%)
Inquiry skills			3 (9%)
Sharing ideas with peers			1 (3%)
How to adapt units for my class			9 (27%)
Problems of inquiry science			3 (9%)
Communication skills			7 (21%)
More about bilingual issues			8 (24%)
No response			5
Strengths of the Granby Program			
Chance to practice			23 (68%)
Students enthusiastic			3 (9%)
Work with PIES team			5 (15%)
Chance to work with different students			3 (9%)
Management issues			4 (12%)
Weaknesses of the Program			
Working with Granby staff			15 (33%)
Logistics			10 (20%)
Unclear expectations			9 (18%)
Not enough time for lessons			6 (12%)
Disinterested students			5 (10%)
Not relevant			2 (4%)
Language issues			1 (2%)
No response			4

Fellows was not good. Some of the Fellows were not welcomed into the classrooms. The evaluator is not surprised at the problematic coordination. The Mass Migrant Education Program teachers are interrupted by others who come into their classrooms to offer a lot of "fun" activities with the students without any of the responsibility for achievement. The Fellows are juggling a complex schedule and have no chance to set up classroom expectations or procedures. While NSF PIES staff did attempt to address the issue in Year Two by designing an effective introduction to the Mass Migrant Education Program for incoming Fellows and the Mass Migrant Education Program did a better job of getting its teachers ready for the scheduled interruptions to their programs, there was no chance for the two sets of teachers to work together.

The evaluator finds himself on the horns of a dilemma. While issues of diversity and equity need to be addressed, the work with the Mass Migrant Education Program may have had the wrong effect on Fellows because not enough time could be spent in helping Fellows make important, personal meanings from the experience.

<u>Short answer responses of teacher perceptions of the Teacher Resource Center.</u> During the summer program, staff from the Hitchcock Center ran a resource center for the teachers. This center was moved back into the Hitchcock Center during the school year. As part of the NSF PIES Program, Fellows were given memberships in the Center as one way of encouraging them to use the resources in their classrooms. Table Nine presents data about teacher perceptions of the summer center.

<u>Discussion.</u> There is not much doubt that the teachers found the Hitchcock Center and staff to be very helpful. In fact, 60 Fellows had no concerns about the Center and the most mentioned concern was the need for more time to spend looking through the materials.

<u>Short answer responses of teacher perceptions of their work in peer planning groups.</u> Teachers worked in small groups to process the work they did in strands and to get ready to teach in the Mass Migrant Education Program. Table Ten presents data for their perceptions of that sharing time.

<u>Discussion.</u> It is interesting to note that 16 teachers in Year One expressed some negative feelings about the planning time. There were some strong issues which surfaced around the differences between urban and suburban teachers. These differences led to problematic relationships. In addition, Year One teachers felt a need to learn more about the activities in other strands because they were limited to one. Finally, one of the components of the Year One Summer Program was a piece on Peer Observation. As with the writing, the added conceptual and personal demands were too

Table Nine.
Year One and Two Teacher Perceptions of Summer Resource Center

	Total	Year One	Year Two
Relevance of the Resource Center			
Enjoyable for student	2 (2%)	1 (1%)	1 (3%)
Can use the activities presented	36 (31%)	16 (20%)	20 (53%)
New ideas to use	45 (38%)	36 (46%)	9 (24%)
Affordable materials	5 (4%)	1 (1%)	4 (11%)
Increased my confidence to teach	2 (2%)	2 (3%)	0 ---
Helped me to plan for year	6 (5%)	2 (3%)	4 (11%)
Staff	10 (9%)	10 (13%)	0 ---
General positive	11 (9%)	11 (14%)	0 ---
No response	6	2	4
Wish I had learned - Resource Center			
More practical activities	6 (23%)	3 (19%)	3 (30%)
More ideas, units of peers	1 (4%)	0 ---	1 (10%)
More about bilingual education	2 (8%)	1 (6%)	1 (10%)
Management techniques	1 (4%)	1 (6%)	0 ---
Needed more time	13 (50%)	8 (50%)	5 (50%)
Other	3 (12%)	3 (19%)	0 ---
No response	60	35	25
Learned through the Resource Center			
Materials to use			28 (72%)
How to locate resources			11 (28%)
No response			3
Strengths of the Resource Center			
Learned about resources			33 (63%)
Staff			17 (33%)
Improve my classroom, confidence			2 (4%)
No response			2
Weaknesses of the Resource Center			
Can I maintain motivation to use it			(12%)
Can I find time to use it			9 (53%)
Logistics			5 (29%)
Can they maintain the staff for us			1 (6%)
No response			19

Table Ten.
Year One and Two Teacher Perceptions of Summer Planning Time

	Total	Year One	Year Two
Relevance of Planning Time			
Fits district curriculum	1 (1%)	0 ---	1 (3%)
Can use the activities presented	4 (4%)	0 ---	4 (11%)
New ideas to use	16 (14%)	7 (9%)	9 (24%)
Good for teaching inquiry skills	1 (1%)	0 ---	1 (3%)
Chance to practice	3 (3%)	0 ---	3 (8%)
Collegial interaction	50 (44%)	33 (43%)	17 (46%)
Increased my confidence to teach	2 (2%)	1 (1%)	1 (3%)
Helped me to plan for year	20 (18%)	19 (25%)	1 (3%)
General positive	16 (14%)	16 (21%)	0 ---
No response	10	6	4
Wish I had learned - Planning Time			
More practical activities	2 (5%)	0 ---	2 (22%)
More theory, science	4 (10%)	4 (13%)	0 ---
More ideas, units of peers	7 (17%)	6 (19%)	1 (11%)
More about bilingual education	1 (2%)	0 ---	1 (11%)
How to integrate into other subjects	1 (2%)	0 ---	1 (11%)
Management techniques	2 (5%)	1 (3%)	1 (11%)
Needed more time	8 (20%)	5 (16%)	3 (33%)
General negative, not relevant	16 (39%)	16 (50%)	0 ---
No response	57	30	27
Learned from Planning Time			
Activities to use			1 (2%)
Shared ideas with teachers			20 (38%)
How to adapt units for my class			17 (33%)
Communication skills			14 (27%)
No response			1
Strengths of Planning Time			
Shared ideas			20 (59%)
Learned how to work with peers			6 (18%)
Fun, support			7 (21%)
Chance to practice inquiry skills			1 (3%)
No response			5
Weaknesses of Planning Time			
Groups too large			2 (13%)
Not enough time			5 (33%)
Group effectiveness			8 (53%)
No response			17

much for the Fellows to incorporate. The evaluator feels that these concerns are behind the negative feelings.

By and large, however, Fellows from both years felt strongly that a major strength of the program was the opportunity it gave them for collegial interaction around professional issues. This feeling was expressed in the Summer Questionnaire, the interviews during the year, the attendance at the school year follow-ups, and the ongoing activities that continue even after the formal project has ended.

Short answer responses of First Year Fellow perceptions of the relevance of strands and workshops and the wish for additional information. The data in Table Eleven represent questions that were asked in Year One and not Year Two. Tables Six through Ten include analogous questions that were asked in Year Two and not Year One.

Discussion. The information again shows that the project has fulfilled its major goals of providing Fellows with ideas, materials, and confidence to implement an inquiry science curriculum in their classrooms.

Table Eleven.
Year One Teacher Perceptions of Presentations
Relevance and Wish for Additional Information

Relevance of presentations	
Enjoyable for students	1 (1%)
Fits my curriculum	4 (3%)
Can use activities	13 (10%)
New ideas to use	49 (37%)
Important concepts for students	14 (11%)
Good for inquiry skills	5 (4%)
Can integrate in other subjects	4 (3%)
Chance to practice	1 (1%)
Collegial interaction, shared ideas	5 (4%)
Increased my confidence	14 (11%)
Improved my teaching	9 (7%)
General positive	13 (10%)
No response	39
Wish I had learned from presentations	
Practical activities	6 (5%)
More theory, science	13 (11%)
Grade level activities	9 (8%)
Peers ideas, units	3 (3%)
More about bilingual issues	2 (2%)
Management issues	5 (4%)
More relevant to my situation	27 (23%)
Need more time	52 (44%)
General negative	2 (2%)
No response	41

Parent Questionnaire

Process

The Parent Questionnaire was designed to assess how parents perceive their children's attitude toward science. It was not meant to provide any definitive data on the impact of the NSF PIES program but rather serve as part of the context in which to see the program. Questionnaires were mailed to the NSF PIES Fellows. In turn, they distributed the questionnaires and stamped, addressed envelopes to a representative sample of children in their rooms. The first year, 5 questionnaires were sent to 40 NSF PIES Fellows. Of these, 51, or 25.4%, were returned. The second year, 8 questionnaires were sent to 35 NSF PIES Fellows. Of these, 78, or 27.9%, were returned.

In keeping with my informal contract with the teachers as part of the evaluation, I did not choose to identify the teachers in any way. I had no way of determining which teachers chose to distribute the questionnaires or encouraging them to get involved if they hadn't. Thus, the data exist across a wide range of variables with no real way for us to determine how to weight them in interpreting the parent responses.

Data

Nonetheless, the parents who responded were very positive towards their children's experience in science for the year. Table Twelve presents the results.

Table Thirteen presents the aggregated total of parent comments for both years as there was no real difference between the two years. As expected, there were more comments (30) in Year Two than in Year One (22).

Table Thirteen.
Optional Parent Comments

General favorable comments		11
Reaction of child has been positive		22
Child's interest has grown	7	
Talked about experiments	8	
Brought science home	5	
Favorite subject	3	
Good teacher		3
Science is important		13
Have more hands on science	8	
Hands on science good for students	4	
Good science background important	1	
Did more science in scouts		1

Table Twelve.
Parent Questionnaire Responses by Year and Total

1. My child has talked about the science work he/she has done in school this year.

	strongly agree	agree	disagree	strongly disagree	no opinion
Yr1 (n=51)	21 (41.2%)	28 (54.9%)	1 (2.0%)	1 (2.0%)	0
Yr2 (n=78)	36 (46.2%)	39 (50%)	0	1 (1.3%)	2 (2.6%)

2. My child has brought his/her science work home to do and show us this year.

	strongly agree	agree	disagree	strongly disagree	no opinion
Yr1 (n=51)	15 (29.4%)	31 (60.8%)	1 (2.0%)	2 (4.0%)	2 (4.0%)
Yr2 (n=77)	28 (36.4%)	38 (49.4%)	7 (9.1%)	2 (2.6%)	3 (3.9%)

3. My child has been interested in science topics and activities this year beyond the work he/she does in school.

	strongly agree	agree	disagree	strongly disagree	no opinion
Yr1 (n=51)	22 (43.1%)	23 (45.1%)	4 (8.0%)	1 (2.0%)	1 (2.0%)
Yr2 (n=78)	32 (41.0%)	34 (43.6%)	6 (7.7%)	2 (2.6%)	4 (5.2%)

4. My child's interest and involvement in science has increased this year.

	strongly agree	agree	disagree	strongly disagree	no opinion
Yr1 (n=51)	20 (39.2%)	23 (45.1%)	6 (12.0%)	1 (2.0%)	1 (2.0%)
Yr2 (n=78)	35 (45.0%)	35 (45.0%)	3 (3.8%)	2 (2.6%)	3 (3.8%)

Did not notice increased interest in science	1
Did not do any hands on science	1
Had a poor teacher	1

Discussion

The parent data are all positive. The percentage of positive responses ranges from 84% to 96%. In addition, the optional written comments show that parents feel very positively toward the program both in their favorable comments and their feelings that science is an important subject.

As I said in the beginning of the presentation of this data source, the information from this data source cannot be used to present proof of the impact of the NSF PIES program. Nonetheless, it does add to the positive context in which we see the program.

Follow-up Questionnaires for Year One Fellows

Process

Based upon the LoU interview data, the evaluator designed a short questionnaire which he mailed to the Year One Fellows in May, 1989, one full year after they had completed their formal project work. Thirty-one of the Fellows returned the questionnaire which is about a 75% rate of return. The questionnaire offers a series of responses for each question. These responses are based upon the Fellows' responses to similar questions asked during the LoU interviews. Fellows checked as many of the options as they felt applied and had the opportunity to write in other answers they felt were relevant. While this questionnaire does not provide the more telling information contained in either classroom observations or a prolonged interview, the evaluator feels that the data does reflect the positive impact of the NSF PIES program.

Data and Discussion

Table Fourteen presents the data. It is not surprising. First, Year One Fellows see that the strengths of hands-on, inquiry science in terms of its impact on students far outweigh its weaknesses of time, management, and materials. The evaluator has said elsewhere in this report that the strengths and weaknesses are inherent in the inquiry approach and that the weaknesses can be dealt with successfully by supportive building and district administration.

It is also interesting to note here the first positive data about how Fellows are integrating writing into science since the questionnaire they completed in July, 1987. Then, the Fellows expressed confidence in their being able to integrate writing with science. However, in subsequent inteviews, the Fellows did not mention having success with the writing process. Here, however, 16 of the 31 Fellows who returned the questionnaire mention that the NSF PIES Project was instrumental in their integrating writing into their science curriculum. It is possible that once the Fellows felt confident about their abilities to integrate inquiry into their classrooms they were able to turn their attention to another innovation. The evaluator is also aware of the growing focus on process writing by school districts in the area and the accompanying staff development opportunties in process writing. Some combination of the two factors for the teachers is the probable reason for the change.

Second, the strengths of the NSF PIES Project lie in its staff, the collegial and growth opportunities it offers teachers, and ideas and resources it provides them for their classrooms.

Finally, the Fellows feel strongly that the NSF PIES program has had impact upon them as professionals. Not only

Table Fourteen.
Follow-up Questionnaire for Year One Fellows
(n = 31)

What are the strengths of hands-on, inquiry science?

Motivates, interests students	31
Activity oriented	27
Students learn cooperation	27
Students learn, remember better	27
Non-verbal students succeed	25
Students learn problem-solving, inquiry	23
Students learn responsibility for own learning	13
There is a carry-over to other subjects	17
Student centered	1
None	0

What are the weaknesses of hands-on, inquiry science

Time for preparation	21
Maintaining supplies	17
Space in room	14
Finding time for	11
Management, noise	10
Administrative support	5
Student background	2
Student learning style	1
Energy level required	1
None	1

What impact has PIES had on my teaching?

Grown as a professional	24
Take more risks	21
Use the inquiry process in my science teaching	20
Have become more focussed on students	18
More comfortable with science	17
Integrating writing with other subjects	16
Use the inquiry process in other subjects	14
No response	2

What are PIES program strengths?

Staff	25
Materials, resources to use	17
Collegial experience	15
I am more comfortable with science	13
The Hitchcock Center and staff	12

The summer program	8
Students learn and remember better	7
Program's organization and logistics	7
The chance to practice during the summer	6
Follow-up activities	5
Diverse, rich program and people	1

What are PIES program weaknesses?

We need more science, theory and practice	21
Interface with the migrant program	14
None	5
More follow-up activities	3
Some summer presentations	2
Program's organization, logistics	2
No response	2

do many of the respondents talk about the changes in their classrooms, but the evaluator is aware of other important data which indicates that the "professional growth" and "willingness to risk" teachers mention go far beyond the classroom. About ten of the Fellows have enrolled for graduate work. Two of the Fellows have become resource teachers in science for their districts. Another teacher received one of ten Lucretia Crocker Fellowship awards in Massachusetts for the 1989-1990 school year. Her fellowship was in elementary science and enabled her to work with teachers in many Massachusetts school districts during the past year. A number of teachers received state grants awarded through their own districts to develop elementary science curriculum and work with their peers in disseminating the information. Three are currently working as staff at SPACEMET, another NSF science program funded through the Five College Public School Partnership.

Observation

Process

The evaluator worked with two (one in each year) assistants, both of whom were very familiar with the idea of hands-on, inquiry science. The observation criteria were established the first year and appear in Appendix Two. The evaluator scheduled times for the observations with the NSF PIES Fellows because of his previous contact with them. All the observations were conducted in the spring of the year with the assumption that the teachers would have had time enough to feel some level of comfort with the inquiry process and new curriculum. Testing, field trips, and other end of the year activities as well as observer schedules made getting to all the Fellows' classes problematic. However, the observer for Year One Fellows visited 26 teachers and the observer for Year Two visited 24 classes. The evaluator considers both the number and range of classrooms to be representative of the Fellows. The observer for Year One did not include a summary of the classes so the evaluator specifically requested this sort of summary from the observer for Year Two.

Data

Given the criteria established in Appendix Two, the observers noted the following:

	Minimal Hands-on No Minds-on	Hands-on Minimal Minds-on	Minds-on
Year One Fellows	3	10	13
Year Two Fellows	3	6	15

Discussion

"First and foremost, there seemed to be quite a bit of confusion about the meaning of hands-on science and inquiry science and how these related to the major goals of the NSF PIES program. I asked a few teachers what they believed I was there to see and they replied hands-on science. I suggest to avoid this confusion that more time be spent on defining and distinguishing between these two terms. As I see it, the hands-on method is in most instances (except in rational inquiry) an essential prerequisite of inquiry science."

(Year One Summary)

"Of the twenty four classrooms I observed, fifteen showed clear evidence that the ideas, philosophy and skills learned by the teachers through NSF PIES had become an important and integral part of their science teaching. These were classes in which students not only were learning to "do" science, but to question, reflect on and verbalize about it. In these classes, teachers, as a rule, asked open-ended questions, encouraged divergent thinking and shared their students' enthusiasm for discovery. They created a structure for inquiry and a student-centered learning environment that let students know their ideas and conclusions were interesting and valid.

"These were also the classes in which science was typically integrated with math and writing, and in which there was usually a good discussion before and after the activity. Students in these classes were more verbal and better able to make sense of what they were doing and observing and how it fit into a bigger picture.

"There were six classes I observed that showed signs of minds-on but were predominately hands-on. In these classes, teachers asked some open-ended questions while circulating in the room, but during group discussions not much supposing and hypothesizing was elicited from students. These teachers relied mostly on the GEMS or ESS specified procedures to carry them through.

"Two classes exhibited hands-on science activities in a comfortable environment, but there was evidence of student independent thinking or problem solving. One class had no evidence of either hands-on or minds-on activity on the part of students.

"In nearly all of the classes I observed, the students were enthusiastic about the activities, seemed used to doing hands-on, and were eager to share their observations. In the more minds-on classes, they were able to discuss hypotheses and often went beyond the prescribed activity to test a new theory.

"Three fourths of the classrooms had lots of science and problem solving "stuff" around the room-- on shelves, table tops and in learning centers. Only two were totally devoid of stuff and the rest had at least one center set up, usually related to the current unit."

(Year Two Summary)

Classroom observations indicate that NSF PIES Fellows were using hands-on science in their classrooms and that many were involving the students in the inquiry process. It is interesting to note that a higher percentage of Fellows were using the inquiry approach in Year Two and that there was some confusion on the part of Year One Fellows as to the difference between the two. NSF PIES staff directly taught the difference between hands-on and minds-on science in the Year Two summer program; and, the evaluator believes that the difference is directly related to the change.

Citations for the Concerns Based Adoption Model

Hall, Gene E., Richard C. Wallace, and William Dossett. "A Developmental Conceptualization of the Adoption Process within Educational Institutions." Austin, TX; R&DCTE, 1973.

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_______. "Innovation Configurations: Analyzing the Adoption of Innovations." Austin, TX: R&DCTE, 1978.

Loucks, Susan. "Levels of Use of the Innovation: The Conceptualization and Measurement of a Variable Useful for Assessing Innovation Implementation by Individuals." Austin, TX: R&DCTE, 1978.

APPENDIX ONE

QUESTIONNAIRES AND INTERVIEW PROTOCOLS

Questions for PIES Interview

1. Are you currently using hands on inquiry science?

if NO,

2. Have you made a decision to use hands on inquiry science in the future?

3. If so, when?

4. Can you describe hands on inquiry science for me as you see it?

5. What do you see as its strengths and weaknesses in your situation?

6. At this point in time, what kinds of questions are you asking about it?

7. Do you ever talk with others and share information about it? What sort of information do you share?

8. What are you planning with respect to it? Can you tell me about any preparation or plans you have been making for the use of hands on inquiry science?

9. Can you summarize for me where you see yourself right now in relation to the use of hands on inquiry science?

10. How would you characterize your school district's support for science?

11. Has the PIES Project had any impact on you as a teacher? Please elaborate.

12. As a way of summarizing, what do you you see as the major strengths and weaknesses of the PIFS Project?

if YES

2. Please describe for me how you use hands on inquiry science.

3. What do you see as the strengths and weaknesses of it? Have you made any attempt to do anything about the weaknesses?

4. Are you currently looking for any information about hands on inquiry science? What kind? For what purpose?

5. Do you work with others in your use of it? Have you made any changes in your use of hands on inquiry science on the basis of this collaboration?

6. Do you ever talk with others about it? What do you tell them?

7. Are you doing any evaluating, either formally or informally that might affect your use of it? What have you done with the information you have gotten?

8. Have you made any changes recently in the way you use it? What have they been? Why have you made them? Are you considering making any changes?

9. As you look ahead to later this year, what plans do you have in relation to hands on inquiry science

10. How would you characterize your school district's support for science?

11. Has the PIES Project had any impact on you as a teacher? Please elaborate.

12. As a way of summarizing, what do you see as the major strengths and weaknesses of the PIES Project?

Summer, 1987

GOALS

There are two major goals of this project, integrating inquiry-based science into the classroom and integrating writing into the teaching of science. Please comment on how comfortable you now feel in these two areas?

Goal I: integrating inquiry science into my classroom

I feel confident that...

I have concerns that...

Goal II: integrating the writing process into the teaching of science

I feel confident that...

I have concerns that...

PLANNING NEXT YEAR

There were, of course, many different components to this summer's program. Please comment upon each of these so that we can plan effectively for next year.

1. Which STRAND did you attend?..............................

Please comment on the content and structure i.e. the amount on time spent on one topic, the meetings on this topic during the three weeks, of the STRANDS.

relevant to my teaching because...	I wish I could have learned...

2. Comment on the seven-afternoon program in Granby.

relevant to my teaching because...	I wish I could have learned...

3. Presentations on Inquiry/Process

relevant to my teaching because...	I wish I could have learned...

4. Presentations on Peer Coaching

relevant to my teaching because... | I wish I could have learned...

5. Presentations on Writing Process

relevant to my teaching because... | I wish I could have learned...

6. Mini-workshops of specific topics (please list what you attended)

relevant to my teaching because... | I wish I could have learned...

7. Single presentations to the whole group by guests and staff

relevant to my teaching because... | I wish I could have learned...

8. Resource Center and visits to Hitchcock Center

relevant to my teaching because... | I wish I could have learned...

9. Planning time with other teachers

relevant to my teaching because... | I wish I could have learned...

10. Physic. l, time and support arrangements (space, food, resources, schedule of the day, etc.)

helpful to me because...

it would have been better if...

11. In retrospect, how helpful were the two Saturdays? What changes should be made for next year in the dates, activities, topics covered?

12. There are certainly aspects of the program which have not be covered by these questions. Please use the rest of this page (and additional pages if you would like) to provide any additional feedback to us about the program so far or about changes that you suggest for this next year and for the second cycle of Fellows.

Thank you.

July 18, 1988

Dear PIES Fellows,

Here is the evaluation for the Summer Program. While it is somewhat lengchly, it should not take you too long to complete. Because the PIES Project is a model of staff development, it is important for us to get feedback from you about the each of the different components of the program; and I have designed the evaluation with that purpose in mind.

Here is a brief guide to the questions.

> **Section One** asks for your comments about the two major goals of the project: integrating inquiry science into your classroom; and, integrating the writing process into the teaching of science.
>
> > Please **briefly** complete the sentences **in the space provided** for each question in this section.
>
> **Section Two** asks for your opinions about the different major components of the project. For each component,
>
> > Please circle whether you Strongly Agree, Agree Disagree, or Strongly Disagree with the first statements, and
> >
> > **in the space provided, briefly** complete the sentences or phrases that follow. Please note that we ask you for your ideas about what you learned **and** what you wish you had learned and what will be relevant for your classroom **and** what won't.
>
> **Section Three** asks for your opinions about the single presentations. For each presentation,
>
> > Please circle whether you Strongly Agree, Agree Disagree, or Strongly Disagree with the first statements, and
> >
> > **in the space provided, briefly** complete the sentences or phrases that follow.
>
> **Section Four** asks for your comments about the Spring program and the organization of the coming year.

The small space for the brief responses is my attempt to cut down on the time it will take you to complete the questionnaire. If you do need more room for a question, please use the back of the page. Thanks for your time. I look forward to seeing you in the Fall.

Sincerely,

SECTION ONE. PROJECT GOALS

1. **Integrating inquiry science into my classroom.**

   I have learned that

   I feel confident that

   I have concerns that

2. **Integrating the writing process into the teaching of science.**

   I have learned that

   I feel confident that

   I have concerns that

SECTION TWO. MAJOR PROJECT COMPONENTS

1. **WEEK #1 MORNING STRAND (please list)** ________________

The organization (mix of activities, pacing) of this strand was conducive to learning.	SA	A	D	SD
I had enough time and encouragement to get my questions and concerns answered.	SA	A	D	SD

The material I learned in this strand will be relevant to my classroom.	SA	A	D	SD
I had enough time to exchange ideas and experiences with my colleagues.	SA	A	D	SD

In this strand I learned wish I learned

This strand is relevant to my teaching because is not relevant because

The major strength of this strand are

My concerns about this strand are

2. WEEK #1 AFTERNOON STRAND (please list)________________

The organization (mix of activities, pacing) of this strand was conducive to learning.	SA	A	D	SD
I had enough time and encouragement to get my questions and concerns answered.	SA	A	D	SD
The material I learned in this strand will be relevant to my classroom.	SA	A	D	SD
I had enough time to exchange ideas and experiences with my colleagues.	SA	A	D	SD

In this strand I learned wish I learned

This strand is relevant to my teaching because is not relevant because

The major strengths of this strand are

My concerns about this strand are

3. **WEEK #2 MORNING STRAND (please list)**________________

The organization (mix of activities, pacing) of this strand was conducive to learning.	SA	A	D	SD
I had enough time and encouragement to get my questions and concerns answered.	SA	A	D	SD
The material I learned in this strand will be relevant to my classroom.	SA	A	D	SD
I had enough time to exchange ideas and experiences with my colleagues.	SA	A	D	SD

In this strand I learned wish I learned

This strand is relevant to my teaching because is not relevant because

The major strengths of this strand are

My concerns about this strand are

4. **WEEK #3 MORNING STRAND (please list)**________________

The organization (mix of activities, pacing) of this strand was conducive to learning.	SA	A	D	SD
I had enough time and encouragement to get my questions and concerns answered.	SA	A	D	SD
The material I learned in this strand will be relevant to my classroom.	SA	A	D	SD
I had enough time to exchange ideas and experiences with my colleagues.	SA	A	D	SD

In this strand I learned / wish I learned

This strand is relevant to my teaching because / is not relevant because

The major strengths of this strand are

My concerns about this strand are

5. The afternoon program at Granby/Holyoke

The organization (mix of activities, pacing) of this program was conducive to learning.	SA	A	D	SD
I had enough time and encouragement to get my questions and concerns answered.	SA	A	D	SD
The material I learned in this program will be relevant to my classroom.	SA	A	D	SD
I had enough time to exchange ideas and experiences with my colleagues.	SA	A	D	SD

In this program I learned / wish I learned

This program is relevant to my teaching because / is not relevant because

The major strengths of this program are

My concerns about this program are

6. Use of the resource center

The organization (mix of activities, pacing) of this opportunity was conducive to learning.	SA	A	D	SD
I had enough time and encouragement to get my questions and concerns answered.	SA	A	D	SD
The material I learned in this opportunity will be relevant to my classroom.	SA	A	D	SD
I had enough time to exchange ideas and experiences with my colleagues.	SA	A	D	SD

From this opportunity I learned wish I learned

This opportunity is relevant to my teaching because is not relevant because

The m.jor strengths of this opportunity is

My concerns about this opportunity is

7. Planning time with other teachers

The organization (mix of activities, pacing) of these opportunities was conducive to learning.	SA	A	D	SD
I had enough time and encouragement to get my questions and concerns answered.	SA	A	D	SD
The material I learned in these opportunities will be relevant to my classroom.	SA	A	D	SD

From these opportunities I learned wish I learned

These opportunties are relevant to my teaching because

are not relevant because

The major strengths of these cpportunties are

My concerns about these opportunties are

SECTION THREE. SINGLE PRESENTATIONS

1. Working with Migrant Students/Mary G.

The organization of this presentation was conducive to learning.	SA	A	D	SD
The material I learned in this presentation will be relevant to my classroom.	SA	A	D	SD

The major strengths of this presentation are

My concerns about this presentation are

2. Management of materials/Staff

The organization of these presentations was conducive to learning.	SA	A	D	SD
The material I learned in these presentations will be relevant to my classroom.	SA	A	D	SD

The major strengths of these presentations are

My concerns about these presentations are

3. Working with Administrators/Gwen

The organization of this presentation was conducive to learning.	SA	A	D	SD
The material I learned in this presentation will be relevant to my classroom.	SA	A	D	SD

The major strengths of this presentation are

My concerns about this presentation are

4. Theory of Inquiry Science/Dick K.

The organization of this presentation was conducive to learning.	SA	A	D	SD
The material I learned in this presentation will be relevant to my classroom.	SA	A	D	SD

The major strengths of this presentation are

My concerns about this presentation are

5. Teaching about Space Science/Juanita, Mary Alice

The organization of this presentation was conducive to learning.	SA	A	D	SD
The material I learned in this presentation will be relevant to my classroom.	SA	A	D	SD

The major strengths of this presentation are

My concerns about this presentation are

5. **Final week pot pourris/Staff**

The organization of these presentations was conducive to learning.	SA	A	D	SD
The material I learned in these presentations will be relevant to my classroom.	SA	A	D	SD

The major strengths of these presentations are

My concerns about these presentations are

SECTION FOUR FINAL COMMENTS

1. In retrospect, how helpful were the two Saturdays (what did you learn, how were they relevant to your teachi how did they set a helpful context for the summer)?

2. As you think ahead to the coming school year, what concerns do you have about the PIES project?

3. If you wish, please use the back of this page to provide us with other ideas or opinions that are important to you.

June 1, 1989

Dear First Year PIES Fellows,

As the PIES Project officially draws to a close, I would like to get a final view of the project from you. Your reflections would be most helpful to me in evaluating the project because it isn't often that I get the chance to hear from people over a prolonged period of time. Would you please take a few moments to answer the questions on this page and return it to me in the enclosed stamped, addressed envelope? I realize that the end of the year is a busy time, and don't mind if I get these in early July. The numbers are to help me keep track of who has completed the form and who hasn't, not to identify your answers. Thanks.

Sincerely,

Tim Wolf

1 What do you see as the major strengths and weaknesses of hands on, inquiry science in your situation? Please circle as many responses as you feel appropriate.

Strengths

a. Motivates, interests students
b. Activity oriented
c. Non verbal students succeed
d. Students learn, remember better
e. Students learn problem solving, inquiry
f. Process carries over into other subjects
g. Students learn cooperation
h. Students learn responsibility for learning
i. None
j. Other (please list)

Weaknesses

a. Management, noise
b. Time for preparation
c. Finding time in schedule for
d. Space in room
e. Materials
f. Administrative support
g. Student backgrounds
h. Student styles that don't fit with the process
i. None
j. Other

2. Have you made any changes in teaching hands on, inquiry science (organizing for instruction, organizing your classroom, teaching, evaluating students and not just using different units)? Please briefly list the most important ones for you, if you have.

3. Has the PIES Project had any impact on you as a teacher? Please circle all that apply.

a. I am more focussed on the learning process of students.
b. I am more comfortable with science.
c. I am using the inquiry process in my teaching.
d. I am more enthusiastic.
e. I am using the inquiry process in other curriculum areas.
f. I am integrating writing into other subject areas.
g. I take more risks, don't need to feel I have to know all the answers in class.
h. I have grown professionally, doing different things.
j. No impact.
k. Other (please list)

4. What are the major strengths and weaknesses of the PIES Project. Please circle up to three most important that apply.

Strengths

a. Collegial experience
b. PIES staff
c. Students learn, remember better
d. I have become more comfortable with science
e. I got good materials, resources
f. Hitchcock Center and staff
g. Follow-up activities
h. The summer gave us the chance to learn the way we would be teaching the students.
i. The chance to practice with students in the summer.
j. Organization, logistics, communication
k. None
l. Other (please list)

Weaknesses

a. Follow-up not as extensive as it could have been.
b. Organization, communication, logistics
c. Interface with migrant program
d. Organization of summer strands
e. Not enough chance to go into depth with content areas
f. Not enough chance to cover enough content areas
g. None
h. Other (please list)

Dear Parents,

I am the evaluator of a federally funded program which is working on science education for elementary school children. Would you please help me by taking a few moments to answer the following questions and returning this questionnaire to me in the stamped enveloped I have provided. Your opinions are important, and I hope you will take the time to complete this form and mail it back to me. Thank you for your time.

Sincerely,

Thomas E. Wolf, Evaluator
PROGRAMS IN ELEMENTARY SCIENCE

1. My child has talked about the science work he/she has done in school this year.

strongly agree	agree	disagree	strongly disagree	no opinion

2. My child has brought his/her science work home to do and show us this year.

strongly agree	agree	disagree	strongly disagree	no opinion

3. My child has been interested in science topics and activities this year beyond the work he/she does in school.

strongly agree	agree	disagree	strongly disagree	no opinion

4. My child's interest and involvement in science has increased this year.

strongly agree	agree	disagree	strongly disagree	no opinion

If you have anything you would like to add that we have not asked about with these questions, please write it in the space below.

APPENDIX TWO

OBSERVATION CRITERIA

PIES - Partners in Elementary Science Classroom Observation and Evaluation

Submitted by Julie Rypysc, July 1, 1988 for Tom Wolf

As the classroom evaluator for the PIES program, I realized my goals from two sources:

1. The PIES grant proposal
2. Tom Wolf, the Evaluation Coordinator

Based on the goals of the program stated in the grant proposal, I was to evaluate the teachers' ability to teach inquiry/process science. A secondary goal was to note if the integration of science and writing was occuring in the classrooms under observation.

Tom Wolf instructed me to provide feedback in three areas:
1. Note to what degree was the lesson hands on, inquiry oriented.
2. Note does the teacher exercise effective classroom management during the lesson.
3. Note is there time set aside at the end of the lesson when the teacher reflects on the lesson and reinforces or summarizes the major concepts or themes covered during the lesson, with the students.

I believe it is important to state an operational definition of inquiry/process science that I based my observations and evaluations on. The following are statements taken from 2 sources that help formulate my definition.
From: Teaching Science Through Discovery by Carin Surd, Fourth Edition.

A discovery (or inquiry) activity is a lesson you design so your students, through their own mental processes, discover concepts and principles for themselves.

From: Teaching Elementary Science - 4th Edition by William and Mary Esler

Inquiry techniques help children to develop process skills.
Teachers are teaching by inquiry when 1. students are involved in problem solving, 2. students are developing manipulative and higher-level cognitive skills.
To recognize inquiry ask your self 2 questions :
1. Are the children required to go beyond the given information to gain new insights?
2. Are the children problem solving - looking for answers or generalizations origional to them?

According to the Eslers, there are three types of inquiry learning activities:
1. rational approach
2. discovery approach
3. experimental approach

1. Rational approach - The teacher indirectly guides a class, with open ended questions and careful responses, from the presentation of a problem to a successful conclusion that takes the form of a scientific concept. The final response must come from the students themselves not the teacher. The teacher uses selective reinforcement where the strenght of the reinforcement for each student

response serves to guide and direct the flow of the verbal interaction toward the desired principle or generalization. Sometimes the teacher must supply additional information by saying "What if I told you that..?" or "What about this...?"

Pure Discovery

2. Discovery Approach - The students are given material and no guidelines. Curiosity leads them to their own discoveries (pure messing about). The teacher moves about as a guide or advisor. The teacher refrains from answering questions directly rather he/she should help students organize their thoughts and investigations so as to answer their own questions. "How can we test this?", "How can we find out?"

Guided Discovery

The teacher gives the whole class or group organizing question to guide or direct their discovery.

3. Experimental Approach - Children formulate and test hypotheses. This approach teaches children to define and control variables in experimental situations, to experiment and to interpret datas as well as to hypothesize.

Definition of Process Science - Inquiry techniques help children to develop process skills. In process science students exercise mental activities that are used to acquire knowledge. These "processes in science" are also termed inquiry processes and are listed on the attached handout entitled - The Processes in Science - (observing, classifying, predicting etc.)

Evidence of Inquiry Learning in the Classroom

Since I was only able to observe each PIES participant for 1, 45-60 minute science lesson, I identified pieces of evidence that indicate inquiry/process science is going on in the classroom by 4 means:

1. Observing teacher teach lesson to children
   a. Teacher behavior
   b. Student behavior
   c. activity itself

2. Noting physical evidence in the classroom - materials etc.

3. By talking to the teacher

4. By talking to the students

I used these criteria for evaluating inquiry/process science because I believe that they indicate that inquiry/process science is going on:

Teacher Behavior:

1. Does the teacher go with students interests?
2. Does the teacher ask divergent/open ended questions?
3. When students ask teacher question, does he/she encourage them to experiment or think to find out themselves, i.e. What do you think?, How can we find out? rather than giving them the answer?

(Teacher Behavior Con't)

4. While students are investigating, does the teacher circulate around the room in a facilitator role checking in with individuals or small groups?
5. Where does the teacher's style fall on this continuum:

open classroom child centered ———————————————— authoritarian traditional classrrom

I found open child-centered classrooms to be condusive to inquiry learning while authoritarian traditional classrooms to hinder or suppress inquiry learning.

6. Does the teacher direct the students to exercise inquiry processes? (see handout for list)
7. When reviewing content or processes done previously in class, does the teacher illicit the information from the students with questions, engaging them and exercising their thinking skills?
8. How confident and relaxed does the teacher seem doing inquiry/process science?

Student Behavior

1. Do the students pose questions freely, reflecting curious, inquiring minds as well as an environment that is safe and encouraging them to do so?
2. Do student remain on task and demonstrate appropriate behavior? (i.e. do they demonstrate independent learning skills?)

Design of Activity Itself

1. Is there an initial question to answer or problem to solve? (i.e. arethe students engaged in problem solving?)
2. Are the students actively involved in the physical manipulation of materials? (hands-on learning)

Physical Evidence in Classroom

1. Are there materials available around the room for students to freely mess about with and or observe?
2. Are therelearning centers or science centers with materials and books for independent inquiry?
3. Any other signs of inquiry/hands-on learning?

****

While writing up my observations for each Lesson I evaluated, I used this organizational format:

1. Class size - # of students
2. Grade level
3. Indicate ongoing unit / beginning of new unit / one-shot lesson
4. Indicate topic / concept / problem
5. Description of lesson (including material, teacher and student roles)

*6. Evidence of hands-on inquiry/process science (see criteria described earlier)
*7. Effective classroom management
*8. Reflection time, summarization of lesson/concept/skill
*9. Integration of science and writing

-9 criteria listed

If above is not refered to in the evaluation, then it shoud be assumed that it did not occur.

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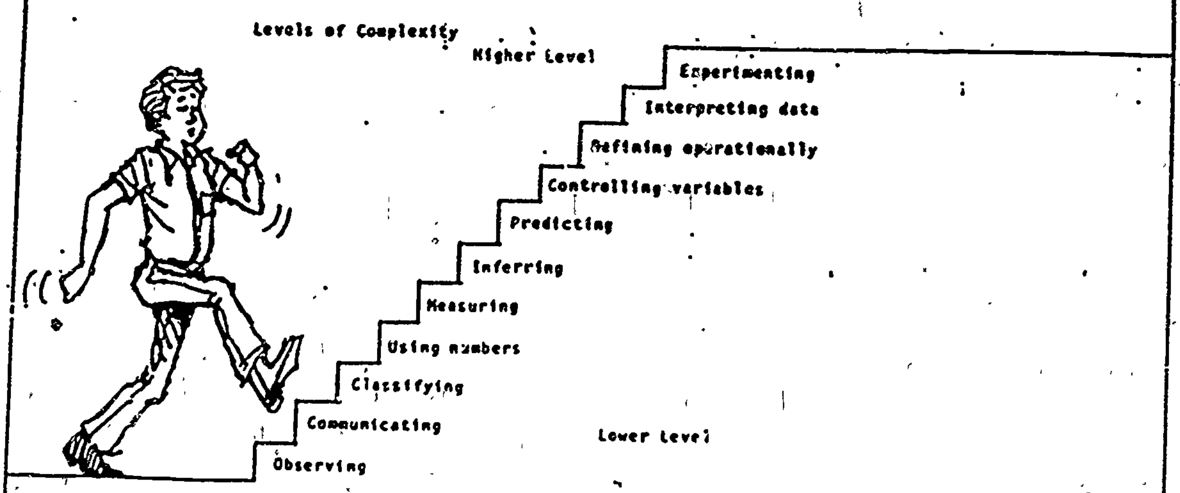
THE PROCESSES IN SCIENCE

Processes are mental activities that are used to acquire knowledge. Processes are important to the teacher because they are the means by which the pupils become more efficient at problem-solving and gaining general knowledge including facts, concepts, skills, techniques, attitudes, and values.

Some processes which have been found to have relevance for science teaching are listed below:

BASIC PROCESSES	*INTEGRATED PROCESSES*
Observing	*Controlling variables*
Communicating	*Defining operationally*
Classifying	*Interpreting data*
Using numbers	*Experimenting*
Measuring	
Inferring	
Predicting	

HIERARCHY OF THE INQUIRY PROCESSES



The independent learner exercises creativity in inquiry.

from: Examining Your Environment
Wentworth, D.F.
Holt Rinehart & Winston of Canada
Toronto

APPENDIX THREE

PROJECT CHRONOLOGY

Chronology: Partners in Elementary Science (NSF/PIES)

Winter-Spring 1987: Recruiting 1987 NSF/PIES Fellows. Two all-day Saturday workshops (Feb. 28, March 14) designed to introduce inquiry science and process writing, and to build community. Pre-institute evaluation interviews conducted.

Summer 1987: Three-week summer workshop (July 6-24). The first week was an intensive science program. The second and thrid weeks included science workshops in the morning for participants. During the afternoons participants developed and taught science classes for the Migrant Education Project. Weekly evaluations.

Winter 1987-1988: Three release day activities and four after-school workshops brought NSF/PIES Fellows together to share their classroom experiences and be introduced to additional resources.

Oct. 16 Reunion/Workshop (all-day), Franklin Patterson Hall, Hampshire College

Dec. 7 Reception/Workshop for PIES Principals

Jan. 25 Project Learning Tree Training, (all-day) Franklin Patterson Hall, Hampshire College

After-school Workshops by Fellows and Staff, Red Barn, Hampshire College Feb. 24, March 7, April 7)

April 5 Re-scheduled (snow) Principal's workshop, Hitchcock Center for the Environment

A half-time PIES Resource Teacher working with the Fellows in their classrooms. The evalution program continued with interviews, written questionnaires. Two NSF/PIES Fellows present projects at the Massachusetts Teachers Association Conference, March 1988.

Spring 1988: Recruiting 1988 NSF/PIES Fellows (much of the recruiting was done by the 1987 Fellows). Two all-day Saturday workshops (March 5, April 9) similar to those the previous year. Pre-institute evaluation interviews of new Fellows.

Summer 1988: Three-week institute for 1988 NSF/PIES Fellows (July 5-22) following a similar pattern to the previous year, but with more science-focused workshops. Ten of the 1987 Fellows completed curriculum packets. Weekly evaluations of the institute.

Winter 1988-1989: Again three-release days and four after-school events. 1988 NSF/PIES Fellows invited the 1987 NSF/PIES Fellows to participate in all of these events.

Sept. 29. Workshop and Reception for PIES Principals (after-school, Red Barn, Hampshire College)

Oct. 12/13 GEMS Master (University of California, Berkely) Teacher Training Workshop (release day) Campus Center, University of Massachusetts.

Nov. 15 Presentation of Summer Curriculum Packets and Pot Luck Supper, Red Barn, Hampshire College

Jan. 23/30 Pratt Museum: Resources at Amherst College (after-school)

Feb. 6: Lunar Sample Workshop for teachers requesting Resource Teacher to bring samples to the classroom (after-school) Amherst High School

Feb. 27/28 Evaluation Students' Progress in Science (after-school) Hitchcock Center for the Environment

March 28. Water Power: Resources in Holyoke (release day) Holyoke Children's Museum and adjacent Heritage Park Museum.

April 25. First Annual Elementary Science Conference First event open to all Elementary teachers. (after-school), Franklin Patterson Hall, Hampshire College

May 24. Post-PIES Planning Meeting and Closing Picnic, Red Barn, Hampshire College

Half-time Resource Teacher continuing to work with Fellows. Evaluation interviews and written questionnaires for both cycle of Fellows continued. Panel presentation at Norteast Regional NSTA Meeting, Portland, ME, October 1988. Wanita Sioui Laffond, 1987 NSF/PIES Fellow and 1988 staff member, selected as Lucretia Crocker Fellow to spend 1989-1990 visiting classroom across Massachusetts giving workshops in "Hands-On, Minds-On Science."

Summer 1989: Eight NSF/PIES Fellows worked with Co-Director Richard Konicek to test PIES projects using constructivist approach.

Winter 1989-1990: Two release-day and four after-school workshops scheduled to continue NSF/PIES activities:

Oct. 3. Evaluating Student's Understanding of Science (PIES Fellows only, all-day) Willits-Hallowell Center, Mount Holyoke College.

Jan 10. Second Annual Partners in Elementary Science Workshop (all-day) Carr Lab, Mount Holyoke College

Four Friday afternoon seminars: Getting the Word Out: Preparing A Workshop (Feb. 2), Preparing for Conference Presetations (March 2), Writing for Professional Journals (March 28), Finding Small Amounts of Money for Good Projects (April 27).

Follow-up interviews and questionnaires, four papers being prepared for publication. Planning meetings for 1990-1991 academic year scheduled for April-June. Poster presentation at AAAS, February 1990.

END

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Date Filmed

March 29, 1991