COOPERATIVE SCIENCE RESEARCH PROJECTS: PARTNERING STUDENTS, SCIENCE TEACHERS AND RESEARCHERS

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Abstract

The purpose of this action research project is to investigate the value of the cooperative science research partnerships done in my science classroom. For the last three years my classes have been collecting lake ice data as part of a partnership with the University of Alaska Fairbanks Geophysical Institute. My classes are also involved in other cooperative science research projects. I'm wondering what benefits these projects bring to my classroom? As a teacher, what have I learned from these partnerships? How have these projects influenced my teaching? Overall, is forming this type of partnership a worthwhile use of a teacher's time?

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Introduction:

What is a cooperative science research project? Good question. I wouldn't have known either until I became involved in one. My involvement in such a partnership began when I heard that a scientist looking for teachers and students to help him collect lake ice and snow data. I thought, "Why not?" It will get the students out of the classroom during the dark days of winter. Soon I realized that the partnership offered much more than a chance to laugh at my under-dressed students. The students collected data for a real scientific research project and their data was used in university level research. As part of the partnership, the lead researcher visited the classroom. He explained his research and trained the students in how to collect lake ice data. With his guidance the students began to make the connection between the concepts we were studying in the classroom and what was happening on their local lake. Science had become more than a subject studied during one period of the day. They saw that the topics we were studying in class could relate to other parts of their lives, like snow machining across a frozen lake.

The purpose of this action research project is to investigate the value of the cooperative science research partnerships done in my science classroom. What benefits do they bring to my classroom? As the teacher, what have I learned from these partnerships? How have I changed from the experience? Overall, is forming this type of partnership a worthwhile use of a teacher's time?

In order to answer these questions I organized my action research project to include collecting data from a variety of sources, including reviewing my lesson plans and scoring rubrics, ranking my frustration level for specific lessons, interviewing my colleagues, getting feedback from students and listing my professional accomplishments. After the data was collected I reviewed all of the information, looking for trends, improvements or changes in my teaching. The systematic process allowed me to discover both specific and general transformations in my teaching due to my participation in various research based partnerships.

Problem:

During my years of teaching at Wasilla High School, I have been frustrated by students who haphazardly make inaccurate measurements during classroom labs and activities. As a science teacher I know that the conclusions made from a laboratory are only as good as the data collected during the lab. Sometimes the students write down numbers without making the measurement at all. Activities that don't yield the expected outcome can often be traced back to student errors in measurement or record keeping. When the data is faulty the experiment that was meant to reinforce a concept crashes.

When a problem is widespread and occurs throughout my classes, I blame myself. What have I done to allow this to happen? Were the instructions confusing? Did the students simply not hear the instructions because they were off task? Were my expectations not clear?

I'm sure that the above situations have occurred in my classroom. But I'd like to look at the bigger picture. The students didn't seem to care if their data was accurate or not. They were not motivated to be accurate because they knew this was a one day activity that did not relate to their lives outside the classroom. I wondered if the key to increasing their accuracy and encouraging them to take pride in their work was to show them that the data they were collecting was meaningful, important and would be used in long term studies.

So, how is this done? How do you convince students that their data is meaningful and should be collected with the utmost care? In my case it happened by accident. In 2003, Dr. Martin Jeffries, a research scientist at the University of Alaska Fairbanks Geophysical Institute was looking for classrooms to help him collect data for his lake ice and snow research. I volunteered not knowing what to expect. First he visited the classroom to speak to my students about his lake and sea ice research. The

students were fascinated as he spoke of his travels to do research in the Canadian Arctic and Antarctica. Dr. Jeffries then asked the students for their help. He explained that he would like to collect lake ice data at various locations in Alaska but logistically it was impossible for him to visit 12 different sites in Alaska once a week. He wanted the students, my students, to volunteer to collect the data for him and email it to him. We took a field trip one cold and dark January morning to learn how to collect the data at the "ice observatory" on Lake Lucille. The partnership had begun.

After working with Dr. Jeffries for a number of years I had an instinctual feeling that our partnership was a good thing. The data the students collected for the lake ice project was more precise and accurate than data they produced in a "normal" classroom setting. If a student tried to "fudge" a number out on the ice, another student would remind him or her that this data was being sent to Dr. Jeffries. I noticed that the project was beneficial not just for the students but for myself also. I could feel myself changing as a teacher. Curious as to the exact cause of these changes, I decided to do my action research project in the area of research based partnerships with collaborative data collection. I wanted to investigate research based partnerships so that I would have more than a gut feeling to document changes in my teaching and student achievement. The action research process, using both qualitative and quantitative research methods, offered a means to do this.

Focus Question:

How does my participation in cooperative science research projects that partner researchers, teachers and students influence my teaching?

Context:

Wasilla High School is located in Wasilla, Alaska, 45 miles from Anchorage. The school has a student population of approximately 1200 students. Wasilla is a bedroom community of Anchorage. More than half of the working population commutes to Anchorage for employment. Wasilla is located in the Matanuska-Susitna Valley. This area has the fastest population growth of any community in Alaska. Sixty percent of the students at Wasilla High have lived here for less than five years. Due to the fast growth rate, Wasilla High School is over capacity. We currently have eight relocatable buildings or portables.

I have taught at Wasilla High School for the past nine years. The data for this project was collected over the past two years. During the last two years I have taught three classes: physical science, ecology and AP environmental science. Physical science is the required freshman science class. Class sizes range from 25 to 37 students. The freshmen in physical science are just beginning to figure out the routines of high school. They are often disorganized and forgetful. Physical science is a required class and some students resent being there. In general the students are harder to motivate and classroom management is a bigger concern.

Ecology is an elective science class taken by juniors and seniors. Class sizes have ranged from 18 to 28. Students take ecology for a variety of reasons. Some failed a science class in their freshman or sophomore year so they need the science credit. Others have a genuine interest in science. The focus of this class is conceptual knowledge and application. The class uses a variety of resources including local publications, the internet and occasionally the textbook. Assessments are usually project based and all tests and quizzes are open-notebook.

I also teach AP Environmental Science. This class is for students who are highly motivated. My goal is to prepare them for the AP exam while still focusing on local applications and issues. Much of the book work is done as homework so class time can be used for labs and activities. A strict timeline must be kept in order to cover the required curriculum. Finding a balance between content knowledge and local applications is a challenge.

I have the reputation at Wasilla High School as the "field trip" teacher. Students have been known to sign up for my class simply because it will get them out of their other classes. The ecology and AP environmental science students have field trip opportunities about once a month. Philosophically I believe it is difficult to teach a student about their natural environment if they aren't allowed out in it. We visit the wastewater treatment plant, attend environmental conferences and help elementary students ice fish, just to name a few.

The science department at Wasilla High School is given the freedom to teach our assigned subjects in the manner we feel is most appropriate. We are not given curricular mandates from district administrators or principals. As a department we work together to provide consistency throughout the courses. In the future curricular guides may become stricter with summative exams dictating the focus of the curriculum.

The following demographic information was gathered from the student registration forms of the 158 students currently enrolled in my classes.

- 83.5% White (Caucasian)
- 5.7% Alaska Native
- 3.8% Hispanic
- 3.8% American Indian
- 1.3% Mixed ethnicity
- 1.3% Black (not Hispanic)
- 0.6% Asian or Pacific Islander
- 5.7% receive Special Education services
- 10% qualify for the Indian Education program
- 1.9% are Limited English Proficient
- 2.5% are homeless
- 51% male
- 49% female

Conceptual Framework:

Action Research

> "Action research is about improving practice rather than producing knowledge…" (Elliott, 1991)

When my son comes home with a poor progress report we sit down and write goals, or ways he can improve. Then we discuss what actions need to be taken for him to achieve these goals. We break it down into smaller problems that are easier to correct. After a week of trying out these changes, we re-evaluate the goals. We are essentially conducting a mini action research project. By showing him this process, I'm trying to teach him skills or practices that will hopefully lead to fewer frustrations in the future.

For the most part teachers don't receive progress reports. I don't have someone lurking over me, telling me where I need to improve. However, I am constantly looking for ways to improve. "Your action stems from a strong personal conviction that things could be better. (McNiff, 2004)" Action research provided a framework or structure for reflecting on my professional goals as a teacher.

The topic I chose for my action research project needed to be something I was passionate about (Mills, 2000). A major passion of mine was the partnership projects I had established with various agencies. These projects were making an impact on my teaching. I wanted to further investigate the changes these programs were making on my teaching.

"Action research is any systematic inquiry to gather information about the ways that their particular schools operate, how teachers teach and how well their students learn (Mills, 2000)." The methods that I chose to gather the information about changes in my teaching needed to be systematic and yet flexible. I wanted to collect data in a

manner that was insightful and yet not a huge obstruction in the natural flow of my day. One strength of action research is that it could be applied to my daily routines (Mills, 2000). Action research helped me build upon the reflective processes that were already in place in my classroom.

The results of action research may be a surprise. In fact, one of the goals of action research is to find out something we don't know already (McNiff, 1996). "Good action researchers take advantage of these unplanned happenings and integrate them into future cycles of action. (McNiff, 1996)" When something unexpected happens, the best action to take is to learn from the experience and then use this knowledge to make future decisions. The goal of my action research project is to discover how I have changed due to partnership projects and then use this information to further improve or change my teaching.

Science is everywhere.

It is my desire to connect kids with science in a way that is meaningful and relevant to their lives. Science is all around us. From the newest sports car to seasonal changes, I see applications of science all around me. Unfortunately, making the connection from the classroom to the real world is not so easy for students. Anderson found evidence of this deficiency in his studies, "Many science programs rarely provided occasions for students to use scientific knowledge in a meaningful way" (Anderson, 1997).

I'm hoping the partnership projects will demonstrate to students that the topics they are studying can be applied beyond the classroom to their everyday lives. Anderson and Lee conducted a study in two sixth grade classrooms in the Midwest. Their goal was to see what factors would cause students to take advantage of

opportunities for meaningful science learning. They found that the best programs engage students in “authentic work” that relates to the world beyond school (Anderson, 1997).

During the lake ice project with Dr. Jeffries students are collecting data using the same protocols and equipment that he uses. The data is used in computer models to predict multiple climate change scenarios. When students collect data for a scientist that is based outside the classroom, they are engaging in authentic, meaningful science learning.

Another effect of a lack of meaningful science learning can be seen when students are sloppy in their measurements and data collection. They absentmindedly take measurements, knowing at the end of the period it will make no difference if the graduated cylinder held 12 or 15 ml of water. Cronan-Hillix (1990) was alarmed at the lack of concern about the rigor and accuracy of the methods used by students to collect data. Errors in data collection can occur for a number of reasons. Poor understanding of research concepts, inexperience, carelessness and apathy could all cause inaccuracy in data collection (McDonald, 1988). One goal of my action research project was to see if the accuracy of student data improved due to the partnership projects they were participating in.

Partnerships

In an effort to improve the meaningfulness of science in my students lives, I’ve formed partnerships with various universities and agencies. According to Bullough (1999) the first step in getting a partnership off the ground is commitment to the project from all partners. Devising a cooperative plan that benefits both parties takes time.

Throughout the whole process three elements in the relationship are crucial: collegiality, collaboration and responsibility (Marlow & Nass-Fukai, 2000). In an ideal partnership the teacher and researcher can openly communicate their needs or goals for the project as professionals. Once the goals are communicated in a respectful manner the collaboration can begin. Both parties should be flexible, realizing the limitations and strengths of their collaboration.

Once a commitment is made it is imperative the commitment doesn't become a disappointment. The communication must continue throughout the project. How flexible are deadlines? What are the chances that an unexpected interruption will change the original schedule of events? These sorts of problems can sour the partnership and lead to unfulfilled expectations. Caton, Brewer and Brown studied teacher-scientist partnerships and found one crucial component of the partnership was to "foster interaction between scientists and educators through experiences focused on a shared vision, inquiry instruction, and learning related to the science content of interest" (Caton, Brewer, and Brown, 2000).

The collaborators many times will be "challenged to move beyond the traditional boundaries of the expected roles and work together to become leaders in the profession," stated Marlow and Nass-Fukai (2000) about their program linking the University of Colorado with the Front Range Colorado school district. The traditional definitions of teacher, student and scientist become blurred. During our lake ice project the students are collecting data for Dr. Jeffries. Dr. Jeffries visits the classroom to instruct the students in the value of the data they are collecting and how it will be used.

Partnerships between teachers and researchers are rare, but they are becoming more common (Anderson and Lee, 1997). The National Science Foundation is putting a stronger emphasis on scientists addressing the "Broader Impacts" of their projects

which often includes an in depth educational outreach component. This is pushing more research scientists into the classroom, or even better, putting more students in the field conducting true scientific research. (National Science Foundation, 2004)

Getting the partnership started can be the hardest part. "Seeking an investment in teacher education, particularly from those not directly involved, was more difficult than we had thought. (Bartel and Young, 1993)". Often I begin the interaction by asking the future partner, "How can we help you?". But it is equally important to decide what you want from the partnership (Stetson, Fournet & Fullwood, 1997). Once both parties see the benefits, the partnership can begin.

A crucial component of the partnership is allowing the students to conduct genuine questioning and investigation (Songer, 1996). Hopefully the students can be collecting data that is meaningful and useful to the university or agency. The students know adults other than their nagging teacher are counting on them for valid data. The data collected by the students will be used beyond the classroom in decision making, computer models or university level research.

Finding information about successful partnership projects in the area of science education was difficult. More data and publicity is needed to prove their value to the everyday teacher. "There is a continued and urgent need to demonstrate how school-university partnerships can affect student achievement" stated Mariage and Garmon (2003) after a five year project between two universities and an elementary school. Knowing this need my action research project is especially relevant. By investigating how partnership projects have influenced my teaching, I am providing data that may encourage other teachers to participate in similar projects.

The Connection.

It is my belief that if students can see that the topics they are studying in class are meaningful and relate to their lives, then they will be more accurate and thoughtful in their data collection. Effective science instruction must start with understanding students' personal agendas and commitments (Anderson & Lee, 1997). If the lab is more than a simulation, if the students are collecting data that will be used beyond that one class period, won't they be more likely to take the activity seriously?

From my experience research scientists are usually passionate about their research, and their passion is contagious. After hearing a scientist talk about his or her research students are excited to contribute to the project. The students understand the value of the project they are participating in. They feel a personal responsibility to provide accurate, meaningful data. If they don't it is more than their own grade that will suffer, the validity of the project they are working on is in jeopardy also.

I've made an effort to incorporate research scientists and agencies into my classroom with the hope of creating the atmosphere where students are accurate, thoughtful and understand the meaning of the data they are collecting. Whether it is Dr. Martin Jeffries from the University of Alaska Fairbanks Geophysical Institute leading the students in a study of lake ice or the Matanuska Susitna Borough's watershed coordinator encouraging water quality studies of local lakes and streams, my students are intimately involved in scientific research projects in the real world. This action research project will further investigate how my teaching has changed due to these projects.

Methods:

My teaching is influenced by many things. From a new administrative mandate to an invigorating summer class, the teaching strategies I use are constantly changing. The purpose of this project is to focus in on the ways that my teaching has changed due to cooperative partnerships that involve students, teachers and researchers collecting data for a common goal. To accomplish this task I will look at a number of data sources. These include lesson plan evaluations, ranking my frustration level during activities, seeking feedback from students and other teachers, an evaluation of changes in my expectations, and a gathering of professional accomplishments due to the partnerships.

In my efforts to see how cooperative partnerships have influenced my teaching I included a number of partnerships that my students and I have been involved in. All of these partnerships involve students and researchers collecting data that is used in a study that goes beyond the walls of the classroom. A summary of these partnerships is below:

- Salmon egg incubation with ecology and AP Environmental Science classes (Partner: Alaska Department of Fish and Game)
- Green-down phenology studies with ecology and AP Environmental Science classes (Partner: GLOBE Program)
- Water Quality Evaluations with ecology and AP Environmental Science classes (Partner: Wasilla Soil and Water Conservation District and the Matanuska Susitna Borough Planning Department)
- Lake Ice Monitoring with ecology, AP environmental science and physical science classes (Partner: University of Alaska Fairbanks Geophysical Institute)

Lesson Plans: The first data source that I evaluated was my lesson plan book. I use my lesson plan book as a place to document the types of activities I use in my classroom. Each entry is brief, including a list of the activities, assignments and needed materials for each class period. The book is also used as a planning tool. I try to have a general plan written in the book two or three weeks in advance. Very rarely am I able to stay on schedule so the lesson plans are always written in pencil so they can be modified on a regular basis. A sample from my lesson plan book can be found in Appendix D.

The purpose of the lesson plan investigation is to see how many of my lessons are related to the cooperative partnerships and data collection for these projects. This will hopefully quantify the size of the influence partnerships are having on my teaching. If very few of my lessons are related to the partnership projects then it will be difficult to argue that the partnerships have had a significant influence on my teaching. This information will also serve as background information to help explain other data.

How did I determine if a lesson or activity relates to one of the partnership projects? The criteria I used was simple. The lesson or activity needed to provide the students with background information or skills that would help them understand and be better prepared for the data collection component of the project. For example, we spent many days in the classroom practicing how to use the water testing equipment before the students visited Cottonwood Creek to do water monitoring. This lesson would count as being linked to the on-going water monitoring project with the Wasilla Soil and Water Conservation District.

During the time period of October 4, 2004 through November 30, 2004 and also from October 3, 2005 through January 27, 2006 I reviewed my lesson plan book. Each lesson or activity was grouped as either “part of a partnership project” or “not part of a

partnership project". Data was collected separately for the physical science and ecology/AP classes.

Frustration Level: The next source of data was a frustration level ranking that was recorded in the lesson plan book. For each lesson or activity a ranking from one to five was given, with a five being very frustrating and a one being no frustration. Lessons can be frustrating for a number of reasons so I tried to focus in on frustrations that came from inaccurate or sloppy data collection by students. Questions that I would ask myself included, "Did I feel the students were taking the activity seriously?" and "Were they dedicated to taking the most accurate measurements possible?"

Sloppy data collection by students has been a frustration of mine. My hope was that by incorporating cooperative partnerships the students would be more accurate and thoughtful in their data collection. If I am feeling less frustration in this area then this may be one way the cooperative projects have improved my teaching.

Determining the frustration ranking for each lesson was not always easy. Sometimes the lesson would go well with one class and then flop for the next. I tried to ignore outside influences such as fire drills and generally rowdy days. The key to consistency was keeping in mind the overall goal I was trying to evaluate – if the students bought into the activity and were giving it a genuine effort, then the frustration ranking was low. If the students were detached from the activity and were unengaged in the data collection, then the frustration ranking was high. Only activities or labs that involved data collection were evaluated. For example, I did not rank my frustration on days when we watched a video or did student presentations.

The frustration ranking data was analyzed by calculating a mean for both the physical science and ecology/AP classes for both years combined. Also the number of lessons that were ranked at each frustration level were recorded.

Feedback from other teachers: The next source of data was my fellow teachers. Many of the cooperative projects that I am involved with have teachers doing the same project at different schools. I interviewed a number of these teachers to see how being involved in these projects has changed their teaching. Do they see any change in student motivation with these projects? What have they done to ensure data is accurate? Are they enjoying the projects? Do they see them as worthwhile additions to their classrooms? I interviewed other teachers involved in the lake ice project. Because they are scattered throughout the state of Alaska the interviews were all done via email. A sample of the interview questions that I used can be found in Appendix A.

I also interviewed colleagues at Wasilla High School. I asked them if they have seen changes in my teaching due to the partnership projects. Some of these interviews were more formal with a sit down question and answer session. Other times the atmosphere was more casual including quick conversations in the hall, debriefing sessions after school and emails. After these conversations I would jot down notes to give me a general idea of what was discussed. I put these notes in a folder on my desk. Due to the general busyness of an average day I did not keep a record of every conversation, nor every topic that was discussed.

The analysis techniques used to evaluate the interviews were two fold. My first strategy was to be direct. If I am interested in how they believe their teaching or my teaching has changed, then I simply asked them. Of course other topics were discussed, but to be consistent I wanted to focus on questions that directly answered

my action research focus question. My second strategy was to scan through my notes from these conversations or emails looking for evidence of change. My goal is to evaluate how these projects have influenced or changed my teaching. I highlighted any passage that had then/now statements, comparisons of the past to the present or used quantifying words such as less, more, increase or decrease. After the text was highlighted I made a list of general categories of change that I saw and tallied how many times this observation reoccurred. For example, “Increased confidence level” was a common trend that occurred multiple times in my notes.

Expectations: I am curious to see if my involvement in cooperative partnership projects has changed the expectations I have of my students. Scoring rubrics should make your expectations clear, so your students know what is important and where to focus their efforts. So, it would make sense to look at the scoring rubrics that I have created to see if the partnership projects have influenced what I see as important or where I direct students to focus their efforts. A sample scoring rubric can be found in Appendix B.

Evaluating all of my scoring rubrics would be an enormous job. Instead I chose to look through the rubrics for unit projects that were linked to the partnership projects and compare them to rubrics from non-partnership projects. These included the lake ice data project, the water monitoring project and the phenology project write up. I looked for trends and similarities between the rubrics. Were there any science process skills that were important in all of the rubrics for partnership projects? Can I see any influences that the partner in each partnership projects may have had on the rubrics?

Overall I looked for items that occurred in nearly all of the partnership project rubrics or items that showed a link to the partnership project. For example, “data is accurate”

was a rubric category found in many rubrics and was added because of the partnership projects. I also compared rubrics for partnership projects to non-partnership projects. This helped me see what parts of the projects had the most emphases (based on point value).

Feedback from students: I was especially curious about the impression these partnerships were having on my students. In order to get feedback from the students I conducted a survey assessing students' beliefs about the relevance and meaningfulness of science to their lives. The students will identify classroom activities that they found particularly meaningful and relevant to their lives. The survey will also include questions asking why and when they would take sloppy or inaccurate data measurements. The survey given to each class (physical science, AP environmental studies and ecology) was slightly different or customized for each class. Some of the questions on the survey do not pertain to this action research project. A sample survey can be found in Appendix C.

The survey was given at the end of the first semester for both 2005 and 2006. Data from both years was combined. The data from the AP and ecology classes will be combined, with the physical science data tallied separately. Some of the questions were true/false or ranking questions. For the true/false question a percent was calculated for each answer. For the ranking questions an average rank was calculated as well as a tally of how many students chose each answer. The other questions were short answer. For these questions a list was made that included all responses given and how many times each answer was given by different students.

Professional accomplishments: I will document significant achievements (such as awards, publications or professional development opportunities) that have occurred because of my participation in these partnerships. Although very straightforward, this method allows me the opportunity to take a step back and look at what I've accomplished in the last two years. Each accomplishment was linked to the projects it relates to, if possible.

The final method of evaluating my focus question was to keep an open mind. I was expecting to find concrete evidence proving my gut feeling that research based partnerships are a wonderful addition to the science classroom. But I didn't want to be blind to any surprise findings. By collecting data from multiple sources, I was hoping to discover that these partnerships have changed my teaching in ways that I never expected at the beginning of the action research process.

Data and Analysis:

Data was collected from October 4, 2004 through November 30, 2004 and also from October 3, 2005 through January 27, 2006 from my physical science, ecology and AP environmental science classes. The sources of data included my lesson plan book, teacher journal, frustration rankings, rubric reviews, reviews of student work and a student survey. Results will be discussed by source.

Lesson Plans: During both years of data collection, the freshman physical science classes covered the topics of chemistry (properties of matter, states of matter, atoms, periodic table, chemical bonds, chemical reactions, solutions, pH, carbon chemistry and nuclear chemistry) and a unit on heat and energy.

During the first year of data collection physical science students participated in 26 labs or activities. Three of the 26 activities were part of the heat and energy unit. The heat and energy unit uses the lake ice project to teach the concepts of heat transfer through conduction, radiation and convection, phase changes, temperature, specific heat etc. During the time period data was collected 12% of the activities were part of a research based partnership.

During the second year data was collected for a longer period of time, but many of the activities were the same. The main difference was that the data was collected until the end of the heat and energy unit which includes a field trip onto Lake Lucille to learn how to collect lake ice data. Thirty-two labs or activities were conducted and ten of them were part of the heat and energy unit. For the second year of data collection 31% of the activities were part of a research based partnership.

My ecology and AP environmental science classes do virtually the same lessons so I will combine my summaries for these classes. The topics covered in these classes

include: watersheds, water quality, streams, lakes, groundwater, aquatic ecosystems, food webs, nutrient cycles, current events related to environmental issues, biomes, evolution and biodiversity. The students had the opportunity to participate in field trips to the wastewater treatment facility, Spring Creek to witness salmon fertilization, ice fishing and lake ice data collection. During the first year of data collection 12 of the 36 activities (33%) were linked to partnership based projects. During the second year of data collection 11 of the 35 activities (31%) were linked to partnership based projects.

The ecology and AP environmental science classes participated in four long term data collection projects. The first is a phenology (the science of seasonal changes) study called “green down”. Students documented the color of four leaves on a branch in a nearby forest two to three times a week until the leaves fell. The data was entered into a website (www.globe.gov) where it is used by scientists in a study of global warming. Students then compared this year’s data with data collected at Wasilla High School from the past five years.

The second project was very simple. The Alaska Department of Fish and Game provided the classroom with a salmon incubator. Students traveled to Spring Creek to witness the fertilization of coho salmon eggs early in the school year. The eggs were brought back to the classroom incubator. Every day students record the temperature of the water in the tank. By recording the accumulated thermal units each day the students can predict when the salmon will change from eggs to eyed eggs to alevin and on through the salmon life cycle.

The water quality unit was implemented differently each year. The first year the cumulative assessment was a student generated project. The students chose to collect data in one of the following areas: streams, lakes or groundwater. The students wrote a report documenting the purpose, methods, results and conclusions of their study.

Experts from Alaska Fish and Game and the Borough Watershed Program guest presented, were available as resources and evaluated the data the students collected.

In 2005-2006 students were trained as volunteer water monitors by the Wasilla Soil and Water Conservation District. After a week of training the students were given tubs of materials so they could continue monitoring the stream for the next four months. The data was turned in to the Wasilla Soil and Water Conservation District.

The ecology and AP environmental science students also participate in the lake ice project. Dr. Jeffries visits the classroom showing them the equipment and explaining how the data will be used. The students then visit the lake to learn how to take the measurements. Students volunteer to visit the lake once a week after school to continue collecting data. The data is sent to Dr. Jeffries in Fairbanks and used in his research on lake ice.

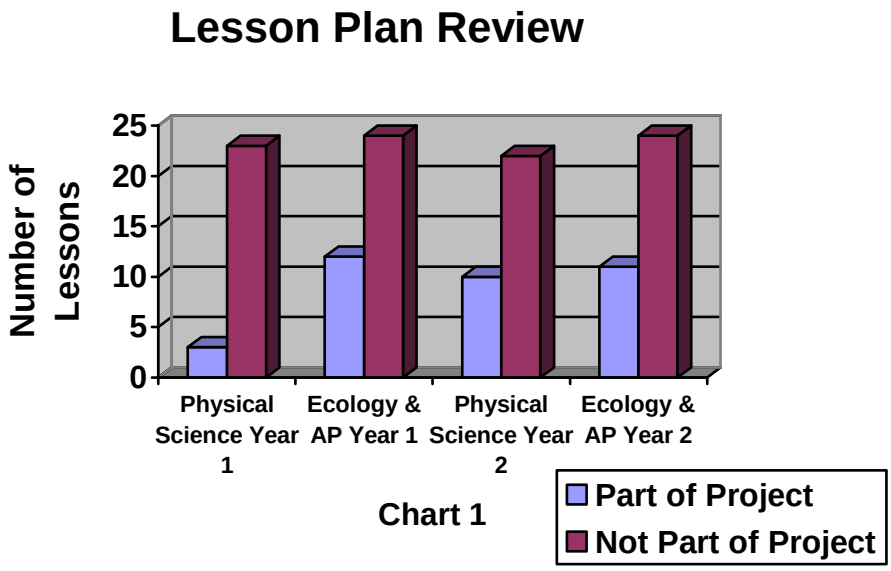

Chart 1: This chart displays the number of lessons for each class (physical science and ecology/AP) that were connected with a partnership project.

Frustration Level: For each lesson I ranked my frustration level with students being sloppy or inaccurate in their data collection for each lesson. A five was considered the highest frustration level. A one was a low frustration level.

In physical science my average frustration ranking was a 3.8. With both years of data combined there were 52 lessons that were ranked. Out of the 52 lessons, there were nine lessons that I ranked at a level five (high frustration), and four lessons at a level one (low frustration).

In ecology and AP environmental science the average frustration ranking was a 2.2. With both years of data combined there were 48 lessons that were ranked. Out of the 48 lessons there were five lessons that ranked at a level five and nine at a level one.

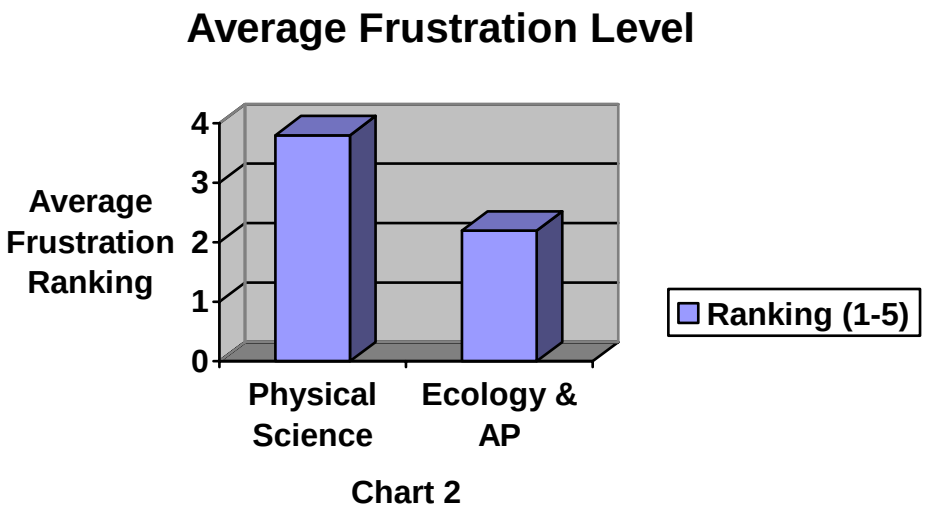

Chart 2

Chart 2: I ranked lessons from 1-5 (1=very frustrating, 5=not frustrating) in regards to the accuracy of student obtained data.

Feedback from other teachers: Four people were crucial in helping me evaluate this project. They include:

- Marc Swanson – now retired elementary teacher in Seward, Alaska, also participates in lake ice project with Dr. Jeffries

- Todd Hindman – middle school teacher in Nome, Alaska, participates in lake ice project with Dr. Jeffries also
- Krysti Klueber – science teacher at Wasilla High School
- Claudia Berkley – student teacher for two physical science classes

Using the methods described earlier, the notes, interviews and emails were examined. The following changes in my teaching were identified:

- More collection and analysis of data (Krysti)
- More graphing of data (Krysti and Claudia)
- More teacher created lessons and less textbook created lessons are used (Todd and Marc)
- More applications to the local environment are used (all)
- More exchange of lessons with other teachers (Marc and Todd)
- More enthusiastic during partnership projects (Krysti and Claudia)
- Creative and motivated to find ways to expand partnership projects (all)
- Increased confidence in sharing of lessons, activities, units (all)
- More encouraging of other teachers (all)
- Spend more time preparing for partnership projects than other units (Krysti and Claudia)
- More familiar with state science content standards (Todd, Marc)
- Reorganized curriculum to include time for partnership projects (Krysti)
- Increased self-confidence in general about teaching abilities (Krysti, Marc)
- More cooperative interactions with other teachers to build and expand projects, grant writing etc. (Marc and Todd)

Expectations:

At the end of the action research session I reviewed the scoring guides I had created and looked for trends. The following trends were observed:

- All of the rubrics emphasized graphs and data tables. Rubrics for non-partnership projects did not have a strong data component. The graphs and data tables were worth 25% of the project grade for the water quality partnership project. In other non-partnership projects the graphs and data tables were only worth 5-10% of the grade.
- The rubrics included opportunities for students to correctly identify appropriate "areas of error" and "recommendations". These topics had been included in rubrics in the past for most lab write ups. Their point value increased in partnership project rubrics, showing a stronger emphasis in the partnership projects.
- The rubrics specifically asked the students to defend why their data was valid, accurate and reliable. One scoring rubric asked, "What did you do to ensure that your data is valid, accurate and reliable?" (See Appendix B) In the past students had not been asked to defend the validity, accuracy and reliability of their data.
- Each rubric showed the personality and priorities set by the outside of school partner. The lake ice project stressed accurate data collection and comparison of data from other locations. The water monitoring project emphasized cooperative learning and a solid understanding of the necessary background information. The phenology project used technology to graph the data.

Feedback from Students: The students were given a survey at the end of the first semester each year. Five of the questions were analyzed for use in this action research project. The results of the surveys are in the table below. A sample survey is found in Appendix C.

Question	Physical Science	Ecology and AP Environmental Science
1. List three activities or labs that you feel were especially meaningful and relevant. (top 3 listed)	Bubble Gum Lab (2005) Gak Lab (2005) Baggie Lab (2005) Ice Headache (2006) Hot Rods (2006) Diaper Lab (2006)	Eco-Column Fish Egg Incubation Water Project (same for both years)
2. When you are recording data, how accurate do you feel your data is? (1-5, 5=always accurate)	3.6 (2005) 3.6 (2006)	3.8 (2005) 3.7 (2006)
3. What motivates you to be accurate in taking measurements? (top 3)	Good grades Don't want to be wrong Want to do my best	Good grades Get it right when no one else did Not having to redo it
4. True/False I see science as meaningful and relevant to my life.	True = 75% 2005 62% 2006 average = 68.5%	True = 88% 2005 92% 2006 average = 90 %
5. The biggest reason that I would take sloppy data or measurements is: (top 3)	Not enough time Don't like assignment Half awake/tired	X
5. How do you feel about having guest speakers, field trips and partnerships? Are they worthwhile? What do they add to the class? (top 4)	X	Makes class more exciting, interesting or fun Helps me learn better More careful and accurate Pay attention and participate more

Table 1: Student Survey Results

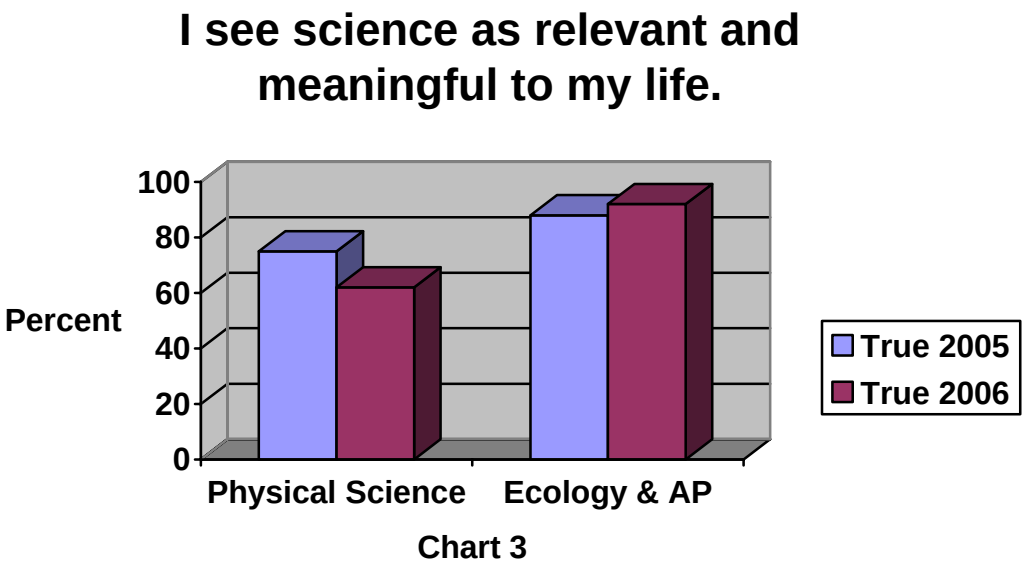

Chart 3: This graph displays the percentage of students that responded "true" to the statement "I see science as relevant and meaningful to my life on the student survey.

Professional Accomplishments: Below is a list of professional achievements, awards, grants and professional development opportunities that have occurred in the last two years as a result of my participation in partnership projects.

- BP (British Petroleum) Teacher of Excellence Award (2004)
- Toyota TAPESTRY Grants for Teachers $10,000 for lake ice project (2004)
- Led professional development session at district in-service for lake ice project (2005)
- Attended and presented at national NSTA conference for lake ice project (2005)
- Published article in national journal The Science Teacher titled "A Rewarding Partnership" (2006)
- Co-presenter and facilitator at weeklong workshop for ALISON teachers (2004 & 2005)

- Co-wrote “Educator’s Guide to ALISON measurements” and “ALISON Guide to Heat and Energy Activities for the Classroom”. Both were published locally and distributed to ALISON teachers. (2004 & 2005)

Interpretation:

The next step was to explore the data to see exactly how I may have changed as a teacher due to the partnership projects. For some data sources making conclusions based on the data was straightforward. For other data sources the connection was not so clear. The results led to conclusions that I was expecting, and others I was not. Each data source will be discussed separately.

Lesson Plans: The purpose of reviewing my lesson plans was to see how many of my lessons are connected with a partnership project. The data shows that for physical science 12% of the lessons were linked with a partnership project during the first year data was collected (2004-2005). During the second year of data collection this number increased to 31%. The reason for the increase is purely based on the time period in which the data was collected. During the first year the physical science classes hadn't finished the lake ice unit when the data was collected. During the second year data was collected after the end of this unit.

The ecology and AP environmental science classes maintained a fairly constant percentage of lessons that related to the partnership projects. During the first year 33% of the lessons were linked to the partnership projects. The second year this number decreased to 31%. The 2% change can be credited to natural variations in the lessons that were conducted.

How does this show that I have changed as a teacher? My involvement in partnership based projects has flourished in the last three years. When I began teaching I did not have any partnership projects in place. As the years went by my confidence grew and I continued to add more partnership projects in my teaching. Now,

in my ninth year of teaching, slightly less than a third of my lessons are linked to a partnership project. This increase displays the impact partnership projects has had on my choice of lessons. The projects are not one or two day events that happen once or twice a year. Students are collecting data for our partners on a regular basis throughout the year. I've chosen to make the partnership projects a priority in the curriculum my students are taught.

Frustration Level: The hope with this data collection method was to see if my frustrations due to sloppy or inaccurate data collection changed due to the addition of partnership projects. Upon analysis of the data, it is very difficult to find evidence that supports the partnership projects being the cause of any changes in my frustration levels.

Overall my frustration level was less (2.2) with the ecology and AP environmental science students than with the physical science students (3.8). The difference between the two groups could have occurred for a number of reasons. First of all, juniors and seniors are more mature, making them less frustrating in general than the freshman physical science students.

The ecology and AP students had more lessons that were connected to the partnership projects, especially the first year, than the physical science students. It is possible that students are more accurate during lessons that relate to the partnership projects, leading to fewer frustrations on my part. However, I don't think there is enough evidence to support this conclusion.

Days that scored a high frustration marking occurred when students were asked to collect data and they didn't follow the directions or did a hurried job. Often I would observe students copying data from a tablemate instead of obtaining the data

themselves. Sometimes this occurred because the students were confused or didn't understand how to take the data. Because the labs that are linked to the partnership projects are usually written by me, they haven't been field tested and sometimes they are difficult for students to understand. This actually increases the chances that I will be frustrated, even though the lesson is part of a partnership project.

Days that received low frustration markings occurred when students followed the directions and collected accurate data. On these days the labs were straightforward and easy to understand. We were able to discuss the lab at the end of class, even if the data collected wasn't as good as I had hoped. Some of the partnership project lessons fall in this category, others do not.

I've discovered that ranking my frustration level of individual lessons is not a good indicator of a change in my teaching. For example, if I used a simplistic, textbook lab that did not have any local applications or complex, conceptual thinking, the students may follow the directions perfectly, collecting accurate data. I would have ranked the day very low on the frustration scale. But does this mean it was a good lab? Does it mean I have challenged myself as a teacher? I think not. Part of being a good teacher is being frustrated and then exploring various solutions to eliminate the frustration the second time around.

Feedback from other teachers: The information gathered from the four key teachers in this action research project revealed many changes in my teaching. Some of them I had expected them to identify, others I did not. It is important to remember that I've gathered the opinions of my colleagues. What they perceive as a change in my teaching may or may not be an accurate observation. Their opinions are given more validity when multiple people, on multiple occasions identify the same change in my

teaching. This section will provide a more detailed look at the changes listed in the data and analysis section.

It was difficult for Claudia, my student teacher, to comment on how I have changed as a teacher because she worked with me for only one semester during this study. She observed that I am more enthusiastic about the lessons that are linked to a partnership project, than other lessons. She believes the enthusiasm carries over to herself and the students.

Claudia helped me improve how I conclude an activity or lab. Many of the activities related to the partnership projects are data driven labs. Sometimes the students would collect the data incorrectly or we simply wouldn't get the results we were hoping for. Claudia observed that when I took the time to discuss with the students why this occurred, I was more confident that they had learned the desired concept. If I had time I would make the students redo the lab using better data collection techniques the second time, further reinforcing the concept being taught.

Marc and Todd are also participating teachers in the lake ice project with Dr. Jeffries. As far as we know, no one has ever used lake ice to teach the concepts of heat and energy. This has led us to create new lessons and labs to provide additional applications of the lake ice concepts for the classroom. We would often email these activities back and forth asking for feedback or advice when something didn't work. We found ourselves using textbook created activities less frequently.

Multiple times there were references to discussions of how to expand the partnership projects. Todd, Marc and I discussed additional lessons, activities and cooperative projects that we could implement. Claudia and Krysti would ask how they could become involved with the projects or start their own. As my confidence grew I

would invite them to join my partnerships and gave them information about starting their own, such as joining the GLOBE network.

Because partnership projects are fairly rare and are not part of the traditional classroom curriculum, Marc, Todd and I would struggle with fitting the partnership projects into the already overwhelming curriculum requirements. In our efforts to obtain grant funding we would be asked to verify the legitimacy of these projects. I became more familiar with state science standards in my efforts to defend partnership projects. I also realized that the "less is more" philosophy applies to partnership projects. The partnership projects cover required curriculum with additional depth and applications that traditional units do not have. The additional depth and application takes longer to complete than traditional units. Although it was frustrating to not cover as much content as I had hoped due to time restraints, I was confident that the topics that were covered with partnership projects were done at a level far superior to how I had done them in the past.

The final benefit of partnership projects that was revealed through the interviews, emails and conversations was the additional interactions between teachers. Having a network of teachers to share your successes with or vent about a disappointment was incredibly valuable. We were able to encourage each other to continue with the partnership projects even when we felt overwhelmed and started to wonder why we were devoting so much time to the project. I found myself interacting with my fellow teachers more regularly due to the partnership projects.

Expectations: The expectations I have of my students have changed due to the partnership projects. After looking at scoring rubrics I have found that I put more

emphasis on graphs, data tables, identifying errors and being accurate and reliable when collecting data.

At the end of each lab students are asked to identify “areas of error”. This forces students to be self reflective and critical of their own accuracy and mistakes. At first the students want to use “my lab partner talked too much during the lab” as an area of error. But by the end of the year I overheard one student say, “Now that is an area of error!” after her tablemate spilled some of the experiment on the table. The students were starting to identify ways to be more accurate as they went through the lab, rather than brainstorming at the end. In the past I had not stressed the areas of error as an important part of a lab report.

Rubrics for big projects that involve collecting data now ask the students to identify what they did to ensure the data is valid, accurate and reliable. This puts the responsibility on the student to be more scientific in their collection of data. The partnership projects have pushed me to be more contentious about making sure every scoring guide encourages students to be accurate and thoughtful. In the past I was not as consistent as I am now.

Feedback from students: The purpose of the student survey was to determine how the students felt about the partnership projects. The surveys included an assortment of questions. Most of them did not ask the students how they felt about the partnership projects directly. Instead they asked questions about the relevance and meaningfulness of specific activities and science in general. The survey also asked questions about the accuracy of data collected by students.

One way that I hoped the partnership projects had influenced my teaching was by helping students realize that science is relevant and meaningful in their lives. The

ecology and AP environmental students felt that the partnership projects were more relevant and meaningful than the other activities we did. They also had a higher percent (90% vs. 68.5%) of students that saw science as meaningful and relevant to their lives, compared with physical science students. Perhaps having long term data collection as part of a partnership project increases how relevant and meaningful the students see the activity.

However, there could be other reasons why the ecology and AP students found science to be more relevant and meaningful in their lives. The ecology and AP environmental students are older and have taken more science classes than the physical science freshmen. This may give them more opportunities recognize the relevance of science in their lives. It is difficult to determine if the partnership projects have influenced my teaching in a way that helps students see science as meaningful and relevant in their lives.

I had also hoped that the partnership projects had influenced my teaching as to increase the accuracy of student data collection measurements. The students consistently ranked themselves at 3.6 - 3.8 out of 5.0 for the accuracy of their measurements. A 3.0 represented “sometimes accurate”. Even with the partnership projects the students do not see themselves as being exceptionally accurate when they collect data. When asked what factors motivate them to collect accurate data, their answers do not have anything to do with the type of project they are working on. The biggest factor they identified was “getting a good grade”. Based on the survey, the partnership projects do not seem to have improved student accuracy when collecting data.

This was disappointing news, especially since improved accuracy was one of the key benefits of partnership projects that I had hoped to establish. Two realizations

helped dissolve the sting. First, in the survey I asked the students to rank their data collection accuracy in general, for all activities. Some of the students' comments helped me realize that their accuracy may improve for the partnership projects, but remain average for other activities. One student responded, "It makes me feel like I am important enough for these people to come in, so I pay attention." If students are paying attention to the instructions, their data will be more accurate and reliable.

Secondly, I do not have any data about how students ranked their data collection accuracy before the partnership projects. It is possible that they could have been far below a 3.0 of "sometimes accurate" before the partnership projects.

The last question on the survey asked the freshmen in physical science to identify the biggest reason they would take sloppy data or measurements. I appreciated their honesty. Many students said they didn't have enough time or were rushed. Others said they didn't like the assignment, were having a bad day or were tired. These situations could exist during a partnership project or a non-partnership project, so again the partnership projects do not seem to have an effect on the accuracy of student data.

The ecology and AP environmental science students participated in more partnership projects, so I asked them how they felt about having guest speakers, field trips and partnerships. For this question I did get a positive response. Students said these activities made class more exciting, interesting and fun. They felt they learned better, participated more and paid attention better during these activities. When taking data for a partnership project they said they were more accurate and careful with their measurements.

I found a number of responses in this section of the survey that were especially interesting. I chose these responses because they bring up benefits of partnership projects that I had not thought of or validate benefits I had already established.

- "They show us examples of jobs that we can follow if we are into science."
- "It makes me appreciate science more."
- "I always make my measurements accurate because I don't want people wasting time plotting and graphing inaccurate data."
- "I want to be accurate so their study isn't for nothing."
- "I participate more to make sure I get what is going on."
- "We can relate what we do in class to actual events."
- **"**I think it is a mistake to trust teenagers to do the leg work."

Finally, some results I had been hoping for. Perhaps, at least for some students, my teaching was helping them see science as meaningful and increasing the accuracy of their measurements. Even the student who thought it was a mistake to trust teenagers to take reliable data understood the importance of being accurate in these projects. In everyday situations, the data showed that the students were being accurate only somewhat more than "sometimes". But when asked directly about the partnership projects, the results were different. During the partnership projects I was pushing them to make sure they were providing the most accurate data possible.

Professional accomplishments: The list of professional achievements was a surprise to me. I had never put them all in a list and noticed how many of them are linked to a partnership project. After reviewing the list it is clear to me that I have made some significant strides as a teacher in the last three years.

I have been awarded a number of grants and awards due to my participation in partnership projects. The partnership projects have increased my confidence when applying for grants and awards. I have a network of professionals working with me on the projects who can verify that the project is a worthwhile use of our time. The

partnership projects are unique and allow students to do things they don't normally get to do in a science classroom. Knowing all of this, I'm more likely to apply for grants and awards than I was before I participated in the projects.

I've become a leader at my school. Before the projects I would never have volunteered to lead a professional development session for fellow teachers. The partnership projects gave me a cause that I believed in. I was enthusiastic about sharing the benefits of partnership projects with colleagues both at a local level and nationally.

The projects have improved my writing skills. I've co-authored two booklets for ALISON teachers and an article for The Science Teacher (NSTA). My goal is to help others be successful in partnership projects also. If the booklets or article encourages a teacher to start or continue involvement with a partner, then it was worth the effort. I am more comfortable writing and sharing because of partnership projects.

When a project is successful, both partners reap the benefits. Dr. Jeffries has been given many compliments for the unique partnerships ALISON offers. He has thanked me for my participation in the project and my eagerness to try new ideas with my students. I am equally grateful to him for providing the opportunity to grow as a teacher due to ALISON. My growth as a science educator is a constant that will remain, even as groups of students come and go.

Value:

After looking through all of the data and the conclusions that can be drawn from the data, a number of themes become evident. Even before this action research project I knew that being involved in a partnership project has allowed me to improve as a teacher in many ways. The purpose of the action research project was to collect data to document these changes. The data has led me to the following overlying beliefs about partnership projects.

First, the partnership projects caused me to change the number and types of activities that I use in my classroom. I reorganized my curriculum in order to make time for the partnership projects that I thought were so valuable. Anytime curriculum is changed there should be justification that the change is truly what is best for the students. To justify the changes in my curriculum I became more familiar with state standards and grade level expectations. I chose to do my action research project on partnership projects as another way to verify the legitimacy of using these projects in my classes. The partnership projects forced me to be more aware of the decisions I make regarding the curriculum I teach in my classes.

I put more emphasis on data related science skills, such as graphing and identifying areas of error, due to my involvement in partnership projects. Data tables and graphs are how I view the data that students have collected for the partnership projects. Obviously I want the tables and graphs to be clear and easy to understand. I also want them to be able to recognize when their data is not as accurate as it could've been. These expectations are stated on my scoring rubrics.

Participating in a data based partnership project does require additional time and energy. I found myself putting many more hours into units that had a partner waiting in the wings. In the partnership projects it wasn't just me on my own trying to do

something exciting for the students. I had a core group of partners to encourage and motivate me. Other teachers noticed my enthusiasm increased because of the support I received in the partnership projects.

The partnership projects provided many professional opportunities that were not available before I was involved in the projects. I found myself not just leading students but also leading other teachers. I volunteered to write articles and booklets to further share what I was learning through the partnership projects. When the projects were successful my confidence increased and I wanted to find ways to maintain and expand the programs.

Not all of my assumed benefits of partnership projects could be verified with data from the action research project. Based on the data I collected, I can not make the claim that partnership projects help students see science as relevant and meaningful to their lives. Nor did the data support that students are more accurate and thoughtful when collecting data because of partnership projects. These benefits of partnership projects could still exist, however the data I collected did not confirm it. I still believe the partnership projects help students see science as relevant and meaningful while helping them become more accurate with data collection. With the proper tweeking of data collection techniques, this connection could still be established. For example, I could collect data from classrooms that are not involved in partnership projects so that I have a better idea of the attitudes and accuracy of students before experiencing a partnership project.

Although these results were disappointing, I haven't given up hope. Trying to get a teenager to think or do anything is quite a challenge. The problem could have been with the methods I used to collect the data. There is also the possibility that the

students won't realize the meaningfulness of these projects until they are older. In this case the action research has revealed more questions than answers.

As with all good action research projects, the research will continue. The classroom is a constant learning experience for the teacher as well as the student. Although the formalities, due dates and structured atmosphere are over, I will continue to look for ways that my teaching has changed due to the partnership projects. The action research process has given me the ability to identify why I am so confident that cooperative data collection projects are a worthwhile endeavor. Now when a fellow teacher asks me why they should become involved in a partnership project, I have legitimate data and research on my side.

In the words of Geoffrey Mills, "Action research is a process, but it is also a way of thinking and being. Becoming a teacher researcher means making a commitment to continually reflect on the way things are in our classrooms and schools and striving to learn what we can do to make them better." For me the action research process has come full circle. Action research has allowed me to view science education as relevant and meaningful to my career and my life.

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Appendix A

Sample Interview Questions

1. Describe how you have participated in a partnership project such as the lake ice project?

2. What do you feel are the benefits of partnership programs?

3. What are the drawbacks?

4. How have you changed as a teacher because of these programs?

5. What changes have you seen in my teaching because of these programs?

APPENDIX B

WATER UNIT PROJECT

Facts:

- You may have a partner – or group of three. Choose your group carefully as you will all get the same grade.
- My expectations increase based on the size of the group. What is an "A" for an individual project will not be an "A" for a group.
- Except for the initial planning stages this project will be done outside of class. (but no OTC credit – you're getting a grade)
- Reports must be typed for full credit.
- Extra credit will be given for individuals or groups who want to make brief presentations of their projects to the class.
- **Due: Tuesday, October 26th.**

Choose one of the following topics:

1. **STREAMS** – Choose a local stream, creek or river. Conduct macro-invertebrate sampling, water chemistry tests and habitat survey. Write a professional report judging the overall health of the stream. This requires you to visit the site at least once.
2. **LAKES** – Using data from the volunteer lake monitors, compile, graph and draw conclusions about the health of a local lake. Write a professional report judging the overall health of the lake. On-site measurements are not recommended.
3. **GROUNDWATER** – Visit the local DEC office to obtain the well and septic information for your house. Make an "area of influence" map labeling all the potential and existing sources of pollution near your house. Bring in a sample of your drinking water and test it for hardness, chlorine, iron and sulfate. Write a professional report describing the drinking water conditions at your house.

All reports need to have the following sections: (25 points each)

1. **Purpose** – What is the overall goal or purpose of your study? Explain why doing this study is important. Provide background information explaining all scientific terminology. What is your hypothesis?
2. **Methods** – Describe the materials and procedures you used to obtain your data. What did you do to ensure that your data was accurate, reliable and valid?
3. **Results** – List observations you made during your study. Provide data tables and graphs of your data. Summarize your results.
4. **Conclusion** – State and defend your overall judgment about the health of the stream, lake or groundwater. What is causing the water to be healthy or unhealthy? What can be done to fix any unhealthy results? What can be done to maintain healthy results? Describe any areas or error or ways you could improve your data. What studies should be done next?

APPENDIX C

STUDENT SURVEY – PHYSICAL SCIENCE

Class: _____

Approx. Grade: _____

1. List three activities or labs that we've done in this class that you felt were especially meaningful and relevant.

2. What is your favorite thing about this class?

3. What frustrates you about this class?

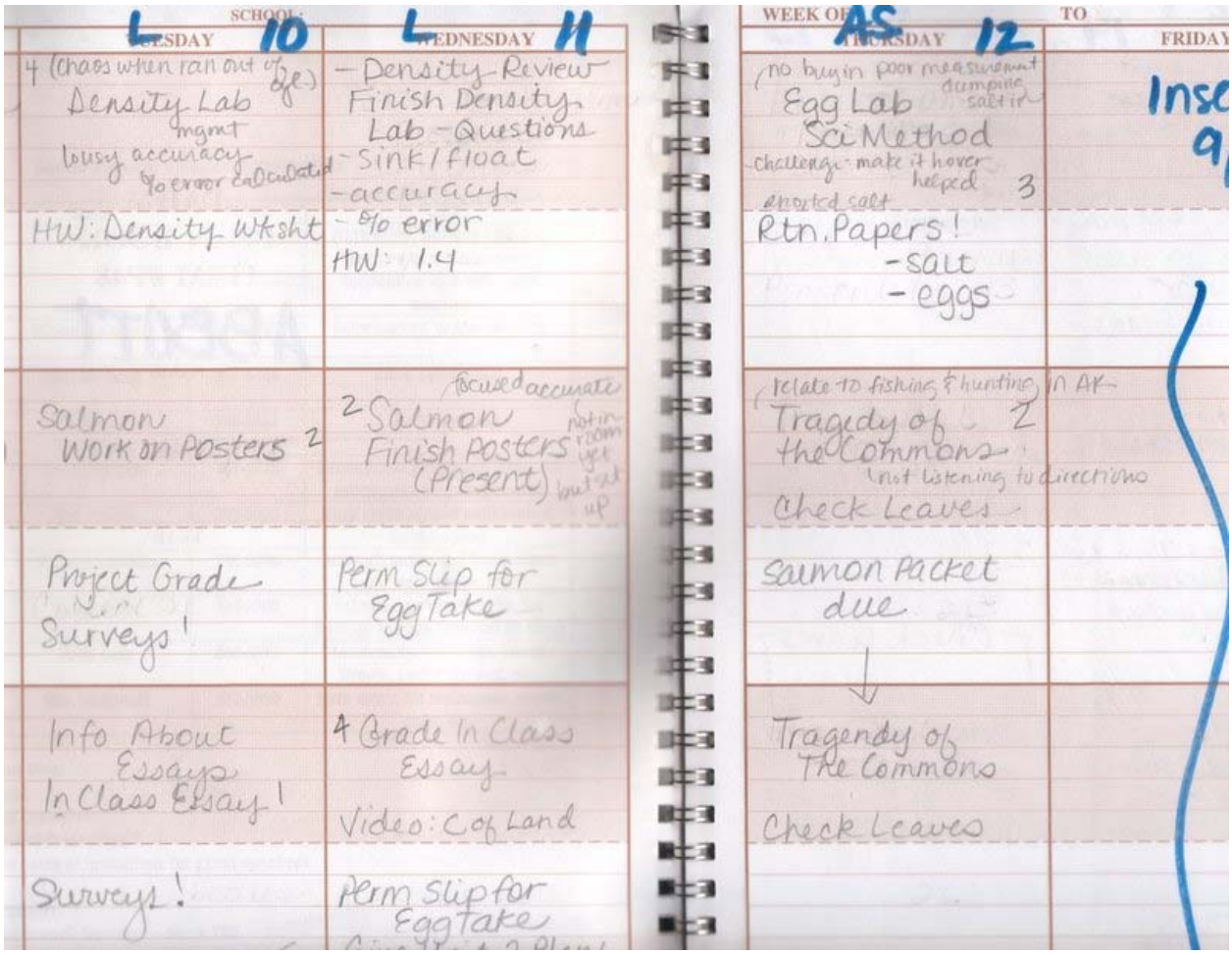
4. When you are recording data or taking measurements for labs or activities, how accurate do you feel your data is? (1= rarely accurate, 3=sometimes accurate, 5=always accurate) _____

5. What motivates you to be accurate in taking measurements?

6. T/F I see science as meaningful and relevant to my life. _____

7. The biggest reason that I would take sloppy data or measurements is:

Appendix D


SCHOOL:
TUESDAY 10
WEDNESDAY 11
WEEK OF AS 12
TO
THURSDAY
FRIDAY
4 (Chaos when ran out of Qfc)
Density Lab
mgmt
lousy accuracy
% error calculated
HW: Density Wksht
- Density Review
Finish Density Lab - Questions
- Sink/float
- accuracy
- % error
HW: 1.4
no buy in poor measurement dumping salt in
Egg Lab
Sci Method
challenge: make it hover
helped 3
spoiled salt
Rtn. Papers!
- salt
- eggs
Salmon
Work on Posters 2
2 Salmon
Finish Posters (Present)
focused accurate
not in room yet but set up
relate to fishing & hunting
Tragedy of the Commons 2
not listening to directions
in AK
Check Leaves
Project Grade
Surveys!
Perm Slip for Egg Take
Salmon Packet due
Info About Essays
In Class Essay!
4 Grade In Class Essay
Video: Cof Land
Tragendy of The Commons
Check Leaves
Surveys!
Perm Slip for Egg Take