Teaching About Normal and Severe Weather with Inquiry and Literacy

Final Report

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July 19, 2007
2. Project Summary

The Teaching About Normal and Severe Weather with Inquiry and Literacy project focused upon weather concepts for Missouri Grade Level Exceptions. A total of 25 mid Missouri grades 3-8 teachers were selected and participated in the 10 day workshop conducted on the Moberly Area Community College campus in July, 2006. Throughout the workshop, participants used personal science notebooks (literacy component) to record aspects associated with the weather concepts and inquiry. The final day of the workshop was attended by building administrators to be eligible for $500 science equipment. Each group of teachers devised plans for implementing concepts presented in workshop. Daily participants provided project staff with best part and suggestions for improvement as a formative assessment which allowed project staff to make needed modifications.

During the 2006-7 school year, project staff interacted with several participants. In addition, three follow-up sessions were conducted at the Interface, National Science Teachers Association (NSTA) convention, and meeting on the University of Missouri campus. Each participant submitted a written evaluation addressing various components of the project that will be addressed later in this report.
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4. Participating Schools in Teaching About Normal and Severe Weather with Inquiry and Literacy Project (July 2006- April 2007)

<table>
<thead>
<tr>
<th>School</th>
<th>n</th>
<th>Attendance</th>
</tr>
</thead>
<tbody>
<tr>
<td>North Callaway</td>
<td>1</td>
<td>67</td>
</tr>
<tr>
<td>Columbia Public Schools</td>
<td>3</td>
<td>105</td>
</tr>
<tr>
<td>Moberly</td>
<td>4</td>
<td>85</td>
</tr>
<tr>
<td>Northeast R-V</td>
<td>3</td>
<td>85</td>
</tr>
<tr>
<td>Higbee</td>
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<td>85</td>
</tr>
<tr>
<td>Middle Grove*</td>
<td>2</td>
<td>85</td>
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<tr>
<td>Macon</td>
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<td>67</td>
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<tr>
<td>Monroe City</td>
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<td>Harrisburg</td>
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<tr>
<td>Hallsville</td>
<td>3</td>
<td>85</td>
</tr>
<tr>
<td>Community R-VI</td>
<td>1</td>
<td>105</td>
</tr>
</tbody>
</table>

* High Need School

5. Activities Completed

Each participant maintained a personal science notebook of all aspects associated with the project. The science notebooks were critiqued and returned. This became a model they implemented in their classes. The notebook contained the background information that was presented during the workshop. The four-question strategy was
modeled and participants practiced for several investigations. The participants, working with peers, developed weather lessons which were critiqued by project staff for accuracy.

During the academic year, participants participated in professional development activities, including Interface and NSTA, utilized the science equipment purchased via the project, and incorporated weather concepts into their curriculum.

6. Modification

Dr. Rebecca Litherland was unable to participate due to her husband’s terminal illness. These responsibilities of assessment alignment were covered by project staff.

7. Objectives

The Teaching About Normal and Severe Weather with Inquiry and Literacy project will address the following objectives:

1. *Increase teacher participant’s knowledge and understanding of concepts of weather.*

   The curriculum focused on Missouri’s Show-Me Science Framework (Stands 5, 7 and related GLE’s). Specifically, this includes 1) the hydrosphere is composed of water and atmosphere is composed of a mixture of gases, 2) water cycle, atmospheric properties, weather vs. climate, and 3) causes and impacts of severe storms. We located a pre-post test to determine increased teacher participants background knowledge about weather related concepts.
2. To improve teacher participants in inquiry-based instruction

   The Inquiry and National Science Education Standards (NRC, 2000) was used as one of the textbooks. Each participant submitted more than one inquiry investigation for weather concepts in their science notebooks, which will be critiqued by project staff.

3. To enhance participants’ use of assessment data to monitor the effectiveness of their science instruction.

   Through the use of science notebooks, participants were prepared to assess their students’ understanding of weather concepts.

4. To improve student achievement for weather concepts.

   The weather validated instrument from Operational Primary Physical Science project was shared with the participants. This instrument has been used nationally for students in grades 3-7. However, none of the participants used the entire test. Individual participants reported use of some of the items on a weather unit. A lack of use makes it impossible to assess. The upcoming fifth grade MAP could result in future use.

5. To demonstrate a measurable impact on the preparation of pre-service teachers through improvements in science context and pedagogy courses.

   Project staff utilized Digital Earth Science Library electronic resources with future pk-6 teachers in their science methods course.

6. To promote science programs with parents.
The evening science activities were used by participants for a local parent night where science is the emphasis.

8. Progress Related to Each Objective

Each participant submitted a summative evaluation of their involvement in the project. Several quotes from their submission are used for evaluation.

1. Participants knowledge

- The difference between pretest and post test did not show significant growth. This instrument was the only instrument we could find and probably was not designed for grades 3-8 teachers.

Science Content

- Positive Comments
  - …vast amount of content knowledge
  - Very challenging concepts
  - I thought the meteorologist, Chris, was an excellent resource of information.
  - The information and hands on activities that I had the opportunity to be involved with this past summer at the weather workshop will make me a better educator for years to come.
  - I was introduced to information that helped to explain the gray areas of weather to me.

- Negative
  - I felt confused coming out of class last summer. Need to re-read texts and spend time planning lessons.
  - I was more than a little apprehensive about all the new information that I took in during our two week course last summer.

2. Inquiry-based instruction

There were two aspects of this focus-science notebooking to address literacy and four question approaches for inquiry. The greatest success of the project was the notebook and most thoroughly completed aspect of the project.
Science notebooking

- Implemented SN during school year
  - Science notebooking was not completely new to me, but was very overwhelmed with considering starting it in my classes, worried about how both my students and myself would get along with it. Day 1 of the severe weather course, we started our very own science weather notebooks. My notebook was a very good tool for starting my students in their notebooks, and my students enjoyed looking through my notebook.
  - My class looks forward to me telling them to get out their notebooks. They understand they will be doing hands-on learning…They have become very attached to their books.
  - I had heard of science notebooks before, but did not really understand what they were or how they were used in the classroom. This class taught me how to use them correctly and become a better science teacher…I have noticed several times throughout the school year that the students will look back through their notebooks to find answers to questions, to see how to set up an experiment, or to even reminisce about an experiment or unit completed.
  - I have learned to let go more of the science notebooking for the kids to do on their own.
  - This became a very useful organizational tool for some of the students who needed extra help.
  - Science notebooks have been one of the best tools I have used in my classroom this year. Science notebooks have helped my students become more organized, and it is nice to look back and reflect on where we have been throughout the year. My students have taken ownership of their notebooks and are always anxious to rush to the page their assignment was on and check the comments that I wrote.
  - Science notebooks have been a great addition to my teaching strategies.
  - I fully implemented science notebooks in my science classes this school year…I believe that my students understand that scientific inquiry requires documentation of observations, thoughts, analysis, reflections, revisions, further questions, and conclusions based on evidence; and that the documentation comes in the form of an ongoing science notebook.
In my class, we notebook from the very first day of class…All of our investigations are conducted in the notebooks…The notebooks are a tool students can use to help them study and prepare for assessments, take notes for research projects, and are a way to formally and informally assess their progress…I feel that notebooking is a crucial part of an inquiry based classroom, and it has totally changed the way that I teach…In notebooking, the students have more ownership into their learning, and come up with more and better information through investigation, research, and collaboration between students than they ever did before.

- Continued using science notebooks during school year
  - The science notebook has become a valuable resource for formative assessment. They guide my teaching and tell me so much about what my students are thinking and any misconceptions they are still holding on to. They also tell me what they are interested in and what they are still wondering about.
  - Slacked off on helping students keep up with the Table of Contents.
  - Used scoring guides and had students peer grade each other’s notebooks.
  - Students used their notebooks so much that many of them needed a second notebook.
  - Notebook was the most successful part of our school year. Perhaps the most beneficial aspect of using notebooks is to help students become more organized. Previously when this information was kept in folders, components of a project would become lost. The notebook format gave the students a better understanding of “Table of Contents”.

- Continued using science notebook through successive years
  - What a great tool! I am near the end of my second year of teaching with the science notebook. The overall response from the students has been great!…I have found that the notebook is also a great organizing tool for the students. Once they caught on that they were responsible for making entries and keeping the table of contents up-to-date, they could see how important notes and organization were.

- Other
  - Notebooks were a great tool to review many concepts before the MAP test.
  - Used notebooks for social studies as well as science (note taking, making timelines, and to record big ideas).
  - Students have used the notebook as a journal, a sketchbook, and to record data.
  - I was honestly amazed. I think I felt this was an organizational tool that I would use more for my benefit, when actually it became a very powerful learning tool that the students relied on and took ownership of. I was
extremely surprised and excited to see them so eager to use these notebooks as actual tools for learning.

- Special education students had a difficult time organizing their notebooks and needed additional time and assistance doing so. Next year I plan to meet with the specialist to provide scaffolding for these students.

- Problems encountered with science notebooks
  - Students lost them or forgot to bring them to class.
  - Need a more effective way to take them home and grade them.
  - I did find that, in concept, notebooking is a great idea, but does not work well for those students who are not strong in literacy.
  - Students didn’t keep the Table of Contents going throughout the year.
  - I stopped mid-year using the notebooks due to frustration on my part and theirs (students). But I’m going to attempt once again this week because I really like using them.

4-Question strategy

- Positive
  - It has been exciting watching them (students) think and evaluate their own and each other’s ideas. I can see that this process is making them critical thinkers.
  - This strategy makes investigations easy for students to follow. Students can easily identify the variables in an investigation.
  - The four question science model for inquiry-based approaches helped my students think like scientists, ask questions, collect the data, and then find meaning for their experimentation. Through their observations and experimentations, students began to think more “outside of the box”.
  - I actually combined my class with another class and we split them into groups of miniature scientists. Students recorded the question, made a hypothesis, wrote down and gathered the materials we would need, and discussed how the experiment would be performed. They took ice cubes with just plain water and ice cubes with sand frozen in them and rubbed them on aluminum foil to see how the two ice cubes affected the “land” or aluminum foil. The students had a blast working with new people from a different class, testing their hypothesis, drawing pictures of how the aluminum foil was changed, and then reflecting on how they could change the ice cube for a new experiment.
  - For the first time, I did an overhead of everything I wanted the students to write down and we really focused on talking about what we were doing and why we were writing down all these “things” instead of just doing the experiment. It turned out to be a wonderful learning opportunity for myself and my students.
  - Students are writing their own testable questions and working with the four question strategy.
The four question strategy was a struggle at the beginning of the year. Students were so comfortable with being told what to do, what to do it with, and how to go about it, they didn’t know quite how to react when I stood back and let them figure it out on their own. However it did not take them very long to take clues from their environment. The classroom has a different feel about it on days that we have labs….Now they have more ownership of the experience and can not follow the “recipe”, they must work together to get the work accomplished. They are also not just working to “get it done”, they want to improve on the original design and rework the lab.

I feel very comfortable with this strategy because I know the students are on task and I am meeting the standards set by both the district and the state.

The students were very excited about the science notebooks and their excitement turned into motivation. They took pride in their notebooks, so when it came time to use them, they put in the extra effort for all of the steps.

We have just finished our unit on experimental design where we used the four-question strategy to design 4-5 experiments.

I really liked using the four question strategy with the students. It appears that they were more able to apply and focus on what the question was and how to find the answer by way of experimentation.

I have shared this strategy with my mentee this year and he was impressed with the results and became more confident with his own abilities to guide the students through an experiment.

• Negative
  o I still do not use the four questions on a regular basis…The science book that I am required to use has regulated activities.
  o I didn’t end up using the four question strategy in my classroom this year. I hope to change that next year.
  o I did not use the four questions approach because I didn’t really feel very comfortable or understand very well how to use this method.

• Neutral
  o I am still trying to get a handle on the 4-question strategy. I believe that the more I work with the strategy, the more comfortable I will be at using it.
  o Four-question strategy was used to do several investigations about temperature.
  o I did attempt the four question strategy, but felt more comfortable using this with specific experiments that had pre-determined outcomes…Because I didn’t fully understand the practice myself, I worked through this with the kids every time. They picked it up, and I think will use it next year in science easier because of the experiences they had this year.
  o I think the 4-question strategy, when put as stepwise as it is, can help make explicit to students the different variables and their affects, however,
I found that the strategy could also be confusing and needs to be reordered for those students that are not used to scientific habits of mind.

**Inquiry**
- Continued to use inquiry throughout the school year
  - When they (students) are made to think about all the possible solutions and find the answers themselves, understanding is much deeper and longer lasting.
  - I added more inquiry to my weather unit this year.
  - When we have switched classes in our fourth grade group for a unit, I noticed such a difference between my students and other classes where inquiry is not used on a regular basis. My students are much more open to exploring and investigating on their own.
  - Inquiry based lessons have quadrupled in my classes this year. My experiences during the weather class made me feel more comfortable with the whole process, and the new classroom materials gained from our class have helped greatly.
  - I intend to have students be more of the directors of the inquiry, i.e., continue along the spectrum of inquiry toward full inquiry. I would like to develop my instruction so that my current 5th grade students by the end of their 8th grade year will be engaged in full inquiry for a question that interests them.
  - The students are able to develop and reach higher order thinking and learning a higher level of learning when they use inquiry. The students also learn problem solving skills and a form of independence over their learning.
  - I can finally report that I am much better at using questions rather than answers as a way to guide the students on their quest for answers or even more questions! I have noticed that the students pick up on the technique and use questions to guide their peers rather than just let them copy or look up an answer.
- Problems with inquiry
  - Lack of time to develop new investigations.
  - I became confused and did not feel that the lesson was strong nor that it had direction…I did feel that inquiry was a powerful scientific skill, but when it came time to turn the kids loose with an inquiry experiment I didn’t feel they had the background knowledge to follow it through.

3. Effectiveness
   Addressed in the participants evaluation of science notebooks and comments from next section.
   a. Achievement
Participants had limited comments about student achievement. Participating schools did not like student achievement, similar to MAP, to become public. Their comments are more on particular activities from the workshop they utilize.

**Student responses**

- **Positive**
  - To science notebooks: “Notebooks helped me to remember and to be organized.” “This helps me to study for tests and helps me to be organized.”

- **Negative**
  - Some students behaved in an immature manner when teacher attempted to show them how to use weather websites in the computer lab. Teacher never took them back.

**Other comments**

- I presented model lessons to colleagues based on activities from this workshop.
- New safety restrictions put in place in October prevented us from doing a daily (weather data) collection very easily.
- Currently I am working on improving their (students) inquiry skills in the force and motion unit.
- For the first time in my teaching career, my fifth grade students have been taking daily weather data…The students made psychometers like those we made in the summer weather workshop. They glued a relative humidity chart into their science notebooks and use the psychometers to record daily temperature readings along with relative humidity. The students also use the Beaufort wind scale chart to record wind speed. After recording and sharing their weather data, the students compare their observations to various weather sites on the internet. My students also learned how to interpret a weather station model and read a weather map. They predicted weather based upon weather maps and weather observations.
- The weather class was very challenging with the concepts covered. It was also very enlightening for me with the information on science notebooks and other teaching techniques. It made me question some of my practices and improve my teaching.
- After participating in the weather workshop, I was more confident in answering weather questions and being able to find the answers.
- This class helped me understand what being a science teacher is all about. I can definitely say that I have improved my teaching because of the knowledge that I learned last summer.
- This workshop has been an excellent professional development opportunity. I believe it is the best professional development course I have ever participated in.
I really enjoyed taking the class this summer and got a lot out of it. Not only new information about weather and how to teach it in my classroom, but a new perspective on inquiry teaching, notebooking, and the four question strategy.

Funds for equipment/supplies

- Positive comments
  - The convection boxes that I ordered with the money from the workshop really helped to demonstrate what convection was and my students’ conversations about convection were so much better than in other years. They actually connected it to weather!!
  - My second grade students loved reading the rain gauge, taking the daily temperatures and using the mychron timers for different experiments.
  - The students used the puppets we ordered (from grant funds) as part of their televised weather forecasts.
  - Participation in the class allowed me to receive classroom weather related supplies that I share with my fellow teachers.
  - I plan to use the convection boxes to demonstrate convection currents in air and water which I will use within the next two weeks.

Technology

- Last year, I used the textbook and “Windows on Science” laser disk to teach weather. My students identified weather instruments, but they had little experience with them. This year, my students only used their textbooks as resources for information about weather. They learned a lot about weather through their daily observations and through United Streaming video clips.
- In one school students gathered weather data from an outdoor weather station, created forecasts, and presented them as part of a weekly news show that is shown over the school’s TV network. As part of the production, weather puppets were used to help explain about weather and the forecasts to students in kindergarten through fourth grade. The puppets were purchased with funds provided through the grant. Not only did the students learn basic weather facts, they got to teach other students those concepts.
- Tried to use websites from class, but the students were too immature to handle being in the computer lab I tried to use some of the weather sites to teach them (second grade students) how to predict a front or the weather patterns that were evolving, however some of that was a little over their heads.
- Each day one of the students records on a classroom chart the sky cover, amount of snow or rainfall, temperature Fahrenheit and Celsius, wind direction and speed, then checks on the computer for our local weather to see how he/she compares in their observations.
We are doing more projects involving the Internet sites featured in our class. Our middle school library purchased twelve new laptop computers this year, so Internet research is not limited to the library area.

My interest in the internet weather sites we learned of in the class led me to access them regularly at school. Soon the students began congregating around the computer when I was looking at the weather sites.

The fourth grade classes work to write, research, and produce a weekly news show that is shown on our school TV network. One of the features we cover is weather. The students used their knowledge from class to help with understanding weather forecasts.

5. Professional Development

The impact of the project included teacher background, which has been noted earlier, curriculum including technology applications, and participation at Interface/NSTA.

**Interface/NSTA**

- Positive comments
  - During the NSTA convention I attended several meetings about a science parent night.
  - Because of you and the books you provided for us to read, I also went to an NSTA presentation by Mr. Robertson, the “don’t fake it” science guy. It was great!! I also got a lot of useful information from attending the NSTA conference, and I appreciate your help financially for making this possible as well.

**Curriculum**

- Rewriting weather curriculum
  - Our district was rewriting curriculum this year and I used the vast amount of content knowledge and wide variety of activities presented in this workshop to help create a curriculum.
  - Background knowledge (content) was very valuable during the curriculum writing process…I used the background knowledge I gained and the activities presented in the workshop to help guide the activities that we incorporated into the curriculum. When we actually implement the curriculum next year I will rely heavily on what we learned this past summer.

- Incorporated weather concepts into other science units
6. Family Interaction

This project component used the Evening Science materials while were developed with earlier CBHE funds.

- Positive comments
  - The science fun night involved some parents we don’t normally see.
  - Interesting conversations between parents and children
  - Turnout was good.
  - We had to almost push people out of the door to get them to leave by the end of the night.
  - It was so nice to have all of the equipment and instructions right at their fingertips...It was really neat to see families working together and having fun while being involved with science.
  - The best part of our night was that we had a variety of activities all in one place and parents could come and go as they pleased with their children, and they could pick and choose the activities they wanted to explore.
  - Although attendance was somewhat of a disappointment, families who attended enjoyed what they participated in.
  - The kids and parents were having great conversations about the different changes they could make to experiment different aspects of the kit.
  - We had two evening science sessions this year, one in October and one in March. The session in October was for grades 3-5. We had over 200 people in attendance, and the reception was very enthusiastic.
  - Our parent night was a great success for all those who attended.

- Negative comments
  - Attendance was disappointing
  - Attendance not as good as hoped for.
  - Some kits (e.g. “Whirligigs”) did not have good directions and rubber bands were so old that they broke.
  - Attendance was disappointing, perhaps because food was not provided.
  - Lower attendance than hoped for.
  - Attendance was disappointing. There was potential for approximately 75 students in attendance, when in reality only 14 students came.

9. Connections

The content of the workshop was designed based upon GLE’s for strands 5 and 7.

The focus of the four question strategy was on inquiry (strand 7). Specific GLE’s were identified when an activity or background information was shared.
10. Dissemination

a. “Forget about Inquiry When Teaching Weather” attached and will appear in
the summer 2007 issue of The Earth Scientist.

b. The project staff of Wissehr, Ratly, and Barrow have submitted a proposal to
the 2008 National Science Teachers Association Convention in Boston.

Wissehr and Barrow have submitted a proposal to 2008 Interface A.

During the 2007 Interface A and National Science Teachers Association Convention in
St. Louis, Wissehr and Barrow made formal presentations. At Interface A, four of the
participants made presentations.

11. Conclusions

Based upon the overall evaluation by the participants (in narrative comments) was
extremely positive. Key aspects of this success is having a content expert (Chris Ratley)
who can relate to teachers of science, organizational skills of PI, familiarity with unique
aspects of Moberly Area Community College campus, PI is a veteran professional
developer, utilization of technology (real-time weather and Digital Earth Science Library)
and veteran presenters use of science notebooks and four question strategy. Since the
focus on weather was the result of interests of grades 4-8 teachers there was not a
recruitment problem.

The project staff’s utilization of daily formative assessment allowed for
modification of things that needed to be revisited/modified, by assigning participants to
different groups daily, the clicks were avoided. We had our lunch daily in the classroom
and social aspects developed. Ratley maintained an on-going development of big ideas
of weather which allowed participants to see how individual concepts built the big ideas.

Throughout the project, the staff attempted to model exemplary science lessons.