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Student-Directed Learning in the 6th Grade Environmental Science Classroom

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Abstract

This qualitative action research study documents the lived and reported experiences of twenty-two 6th grade students and their environmental science teacher as they engaged in student-directed activities, including journal writing and reflecting, small-group activities, and a small-group project. A large part of the research study revolved around social dialogue and student interaction, peer-tutoring, and small-group activities. These activities were included in hopes of promoting more student-directed understanding of environmental science concepts.

Results of participant observations, surveys, interviews, and quantitative assessments, suggest small group work can encourage peer tutoring which can enhance understanding of material. This enhancement did seem to increase as students gained more experience with small groups and group discussions. In addition, authentic learning activities provided better opportunities for reflection and discussion, again, enhancing better understanding of the science concepts being taught.

The researcher questioned the feasibility of journal writing, with ample time given for discussions in groups and subsequent reflection by students, throughout the year, due to time restriction. Difficulty in managing many small groups during projects was also addressed by the researcher as an area that needed checklists specific for each group to help to complete each step of the project successfully. The researcher further discovered that discussions in small groups often needed to be guided by the instructor through the use of open-ended questions and monitoring.

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RESEARCHER STANCE

As an elementary and middle-school student, I became familiar with student-directed learning, where students direct the course of their study, by experiencing it. As a student in eighth grade chemistry class, I worked on a series of experiements with a partner, at my own pace. There were questions and tests that coincided with each unit, and we completed each as we finished the unit. In seventh grade, I put together a leaf collection, collecting and identifying each leaf as I went along. I remember projects in other classes I took that were very student-directed, with research and findings and presentations. Even as early as fourth grade, I remember completing a small group project on a particular dinosaur. These activities were enjoyable for me and obviously, memorable.

As a science teacher, I have rubbed elbows with student-directed learning for much of my career. It began as a science and horticulture teacher at a vocational technical school. I taught my classes of mostly boys the glorious wonders of horticulture and for some, their required chemistry and physics courses. Lecturing was out of the question. Note-taking did not exist. I established a series of goals, and students demonstrated understanding and achievement of those goals through completion of each activity, correctly, on their own. These activities were basic skills I felt they would need to accomplish in order to work

in the horticultural field. After completing the skill successfully, I checked it off as complete. Students needed to complete a set number of checks each marking period to earn a letter grade for the marking period.

The physics and chemistry classes I taught used a set program, which incorporated some reading, with math problems and lab activities included for each new concept. The students worked in small groups and completed each part on a different day. This worked out well for most, since they tended to be both independent and social. I worked with them to keep them focused and on task. I especially enjoyed this set-up since each group consisted of eight to ten students, mostly juniors and seniors mature enough to contribute daily.

When I left the vo-tech to work in a more traditional classroom, I found things to be much different. I had many more students at one time and many different levels and styles of learners. Being a new teacher and a little overwhelmed, I resorted to the way I had been taught science both in high school and college, and the way demonstrated by my cooperating teacher: I lectured. Students took notes, and once a week we completed a lab. Most of my high-school sophomores expected this, and most did fairly well academically. I did find, however, that my below-level group responded even less enthusiastically to my teaching style than my on-level students. Because of this, I had some behavior issues to address in this class and began to think of less traditional ways

of helping them to learn the mandated curriculum.

Wanting to make the curriculum more student and teacher friendly, I incorporated more hands-on activities and labs. I also included more group work. For one unit on invertebrate classification, students broke into groups and investigated one group of invertebrates and presented this to the class with visuals and important facts. Students recorded the information in a chart I had constructed to help them compare and contrast the different groups. This proved to be both successful and enjoyable. The students liked the socialization that naturally occurred and the freedom given to them to complete their research in the library and computer lab. I enjoyed helping them to do some science rather than merely reading about it, and was better able to observe and assess their progress.

Upon my completion of one year of tenth grade Biology, an opportunity presented itself to teach sixth grade environmental science at the middle school. I accepted the position and have enjoyed teaching environmental science for six years. I made the move to sixth grade for several reasons. First and formost was the attraction to the content, but the fact that I felt there would be more opportunities for student-directed activities was another. I thought I would have even more opportunities with younger students than I had found at the high school level for more group work and hands-on activities. I was not mistaken. During the last three years I have incorporated a great deal more of both than ever before;

however I still feel I am doing more talking than I should be. I want student-directed learning more of the time.

What I knew of student-directed learning from these early experiences was that it could be a loud, chaotic experience for the teacher. There were strategies to take to limit this, and I would research and incorporate those, but student dialogue would be a part of this student-directed learning and with twenty-six students, this dialogue amounted to noise. I also had to remember that some students have louder voices than others and some would engage in language more comfortable to themselves, their own colloquial terminology, and that too, had to be acceptable. In order, I believe, for students to understand material being taught, they need to "talk it out" and engaging in "their" language would be a must. I decided this would also have to include their written language as well and would therefore not grade their journals for anything but completion and perhaps depth. Purcell-Gates (2002), a researcher of the consequences of speaking a non-validated language, found that "letting" students talk and write in their own language is helpful in learning to read and write. "Nonstandard, socially marked dialects do prevent people from succeeding in the middle-class world, but they do not prevent people from learning to read and write" (p. 137).

My earliest action research projects investigated some aspect of student-directed learning, usually in the form of reading and writing in the content area.

This was obviously one of the best ways to engage in student-directed learning after all. An elected education course, entitled *Reading and Writing in the Content Area*, focused on ways of incorporating each into the content area classroom. The importance of teaching students how to read the science textbook for instance was addressed. In addition, we looked at other sources of reading, like magazine and newspaper articles, and how these can be incorporated into the curriculum. A large part of the course, however, focused on ways of incorporating writing into the curriculum. A researcher I focused on, Donald Graves, (1985) discussed the need for children to write daily. This eventually led to writing in journals and the use of journal writing as a means of not only perfecting writing skills, but as a tool for understanding curriculum.

I concentrated on journal writing during several mini-action research projects throughout my continued graduate education. These experiences led me to believe that the use of journals in the science classroom was beneficial and was indeed a student-directed approach to learning. I was on the path to helping students achieve better study and learning skills. I knew I needed more than just journals to make the move to more student-directed learning, but it was indeed a start.

In addition to journal writing, I completed a mini-action research for an elective course I took which involved group work. The course, *Urban Issues:*

Rethinking Classroom Practices, stressed diversity in instruction as well as assessment in the urban classroom to promote more equity for different types of learners, which often existed in urban classrooms due to the diversity of races that are included. Because of this, I chose to look at utilizing groups more often when completing lessons, particularly when introducing and reviewing a unit. Surveys conducted by me with my students indicated they preferred the small group set up over both the whole group and individual completion of tasks. In addition, students also indicated they learned the most during the small group activities. This pointed me to the direction of my research question; What are the observed and reported experiences of the students and the teacher involved in student-directed activities during a 6th grade environmental science classroom?

LITERATURE REVIEW

Student-Directed Learning

In reviewing the literature on student-directed learning, I was led toward the term constructivism since the terms are similar in meaning, and constructivism was a “new” teaching style that allowed for students to construct their own meaning, similar to what I was trying to accomplish with my student-directed lessons. I use “new” since in reality, Dewey could be considered constructivist as far back as the 1930s in his progressive ideas concerning student reflection, use of discussions, and students directing their own learning and outcomes. I was a little concerned with my lessons fitting into the constructivist criteria and not just cooperative learning principles, but found some researchers that discerned little difference between the two (Vermette & Foote, 2001). In addition, my intention was to simply incorporate some of these constructivist ideas, including small groups, dialogue, problem solving, and reflection.

To help me define self-directed learning, and what that might mean to my students, I needed to find research that defined and explained what this self-directed learning might look like in a classroom, prior to incorporating it successfully into my own curriculum. One such study conducted by Keedy, Fleming, Wheat, and Gentry (1993) involved nine students enrolled in an advanced placement American History class to see the extent to which self-

directed learning was taking place. Data collected included classroom observations by the teacher and over one hundred interviews of the nine participating students, along with analysis of student papers. At the end of the study, researchers asked the nine students to define student-directed learning. These definitions varied but all included the ability for students to be “doing and completing assignments on their own” (p. 23). Some of the students also included the reading of other related materials outside of class. These individuals cited the need to go above and beyond what is required in class. One student included the ability to ask pertinent questions of other students and teachers to help clarify misunderstandings. Many of the students also included the ability to do research on their own, including greater depth than what was perhaps assigned.

From this study, I was able to develop my own view of self-directed learning by combining these definitions. I felt the need to self-monitor progress was important as well as the ability to complete research independently. In addition, students should be able to complete outside reading material related to the topics discussed in class. I also felt the idea of social dialogue and being comfortable with other students and the teacher enough to ask for assistance and clarification of ideas is very important and showed responsibility and self-monitoring. This I tried to encourage through small group activities, creating comfortable groups where discussions can more easily take place. This student-directed learning included students in small groups reflecting on activities and

observations made during class, discussing videos viewed, and debating articles read.

Teacher researchers Vermette and Foote (2001) developed criteria that must be met for a lesson to be classified as constructivist and not just cooperative learning. They included the ability for students to organize the subject matter themselves, to make connections to prior knowledge and engage in classroom dialogue, problem-based learning, and authentic assessment. The more the activity engages students to search for understanding over recall, the more constructivist it is. The teacher's role in constructivism is more of challenger and facilitator, posing questions that help students create more questions, promoting true student inquiry.

Vermette and Foote (2001) concluded their article by examining the similar outcomes achieved from constructivist type activities and cooperative learning. "The willingness to take risks, to see from different perspectives, to engage in provocative thinking, and to reanalyze and/or reorganize content are all student outcomes that are consistent with constructivist goals and with certain models of cooperative learning" (p. 33). This observation helped me feel better about cooperative learning that may not be quite constructivist in nature. I felt less inclined to change these lessons as long as I was getting the outcomes from the students that I desired.

In a research study conducted by Hudson (2002), pre-service teachers

were taught how to make the transition from constructivist theory to practice. They developed ways of making their classes more constructivist-like, and included more computer technology, journals, small group work and discussions, and whole group pooling of data and analysis. This could be replicated in my classroom through the use of computer technology, journal writing, and small group work and discussions, as well as the comparison of data during lab activities.

Applefield, Huber, and Moallem (2000) found similar results when they investigated the use of constructivist techniques in the science classroom to help students understand major scientific revelations. These techniques included the social interaction and dialogue amongst students, using cooperative learning groups as a way to incorporate this dialogue. Peer tutoring was also seen as a means of incorporating more dialogue between students. Projects, both independent and group, was given as an example for implementing a more constructivist approach, provided student input about the project guidelines and assessment are included. All of these techniques I plan to duplicate in my classroom, including a small group project developed by the students.

Applefield, Huber, and Moallem (2000) did find however, that proper scaffolding was required to ensure sufficient assistance in achieving desired outcomes. Many of the activities, if left to total student design, lacked direction and often incorrect assumptions by the students. To avoid this, scaffolding and

interaction with the teacher is imperative, either by informal meetings with each group, or by more formal conferencing at crucial points during the duration of the project.

From their study, Applefield, Huber, and Moallem (2000) were able to identify several aspects of ensuring success with constructivism. One observation had to do with the teacher and student role, with students encouraged to do the work by discussing, experimenting, and discovering, with the teacher facilitating the learning. Another observation specified that group work should be more cooperative in nature and less perfunctory, with proper structure to keep students on task. The final aspect pertained to the content itself and the evaluation of that content in student learning. Students need to be able to contemplate the material and include reasons for their conclusions based on discussion and reflection of the material. They should not be encouraged to simply memorize the material, rather they need to internalize it and find meaning. The idea is to look for what students can generate, demonstrate, and exhibit concerning the different scientific concepts, based on what they already know, and then to build from there.

In a subsequent study, Beston, Fellows, and Culver (2001) conducted a study to help engineering students become self-directed learners. Training in self-directed skills as well as the use of group projects across the curriculum was put into place to help achieve these goals. The need for more self-directed learning became apparent when teachers felt students did not have time to reflect on what

they were learning in their elective courses.

Researchers found that critical skills for student-directed learning need to be developed at the onset of the program. These skills included cooperative learning, including team projects, and study groups since “effective use of colleagues and experts are needed by the self-directed learner to meet their educational goals” (Beston, Fellows, & Culver, 2001, p. 4).

Problems that arose within the four year study included finding pertinent lecture material that related to all groups at all times, which was difficult since groups were working at different levels and on different topics. Teachers felt they needed to create some form of structure and format to keep track of individual progress in such a way that each student knows and understands where he/she is in the process, and what needs to be done next. Students felt this lack of structure and format made them feel as if they were doing all the work and the teacher was doing very little.

The incorporation of more constructivist techniques was also evaluated in a research study conducted by Marinopoulos and Stavidou (2002), where 11 fifth and sixth grade teachers were divided into two groups. One group taught the environmental science unit on air pollution, global warming, acid rain, and energy combustion in a traditional teaching environment, complete with lectures and few experiments, which were always explained by the teacher prior to student participation. The other group of teachers taught the unit utilizing small-group

collaboration of three to five students, using worksheets and materials necessary for activities and experiments. The students were allowed to talk with other members of the group during and after these activities, and whole class discussions took place at the conclusion of the activity, not before. An identical pre-test and post-test was administered to both classes.

Results showed that answers given by students in the experimental class improved substantially on the post-test, while students of the traditional class answered both the pre- and post-test questions in a similar way. The researchers felt the improvement of the experimental group's answers could be directly attributed to the new curriculum and the new learning activities.

This idea of student dialogue kept reappearing in many of the articles I read. Peters and Alderton (2003) focused on dialogue as a way for students and teachers to think together. Participant observer's field notes, interviews, and outside observers' notes were used to obtain results from the 14 participating adult students. Questions posed in the study ranged from "How do students who engage in dialogue experience the process?" to "What type of teaching and learning is experienced by students engaged in dialogue?"

Results of the study indicate that while learning occurred, this learning depended greatly on the dynamics of the group. These findings indicated that learning the process of dialogue within a group setting takes time, and that groups need to form among members who identify with one another in a trusting,

respectful, and open manner. In fact, many participants identified their role within the group as that of listener. They also cited the importance of the facilitator and of the types of questions used to prompt dialogue and debate. Open-ended questions seem to facilitate the most dialogue.

Participants all agreed they experienced dialogue as a dynamic process, but felt this experience was about "developing personal and interpersonal relationships and respecting one another" (Peters & Alderton, 2003, p. 6). They felt this development within the group was imperative "so that an opportunity for learning occurs" (p. 6). This group interaction took time in developing, but once developed, participants described a "special atmosphere in which there was a connection, a feeling, an energy, and a sense of being in balance with others in the group" (p. 6).

This article led to yet another reason for choosing to move toward more student-directed learning. Nearly one fourth of my students are minorities, mostly Latino and African American, and do not always excel in the traditional lecture and note-taking atmosphere. In a research article on collectivism, Rothstein-Fisch, Greenfield, and Trumbull (1999) discussed how cooperative learning and small group work is more in line with Latino cultures. "Within this value system, children are taught to be helpful to others and to contribute to the success of any group they belong to" (p. 64). This will hopefully give these students a better chance of succeeding in science, and prepare them to perform better in future

traditional science classrooms with the tools they have learned in becoming self-directed learners.

Journals

This discussion and social dialogue that I attempted to develop in group work was also used as a means for my students to collect their thoughts prior to writing in their journals. I realized early on that journal writing would have to be an integral part of my action research plan since much of student-directed learning had to do with reflecting and contemplating material learned. Much of what I was looking to accomplish: more student involvement into their learning required some time for student reflection. Dewey, “the man acknowledged to be the pre-eminent educational theorist of the twentieth century” (back cover, 1938/1997), speaks at length about reflection in *Experience and Education.* He discusses it as a means of organizing information in one’s mind about the activity that has taken place:

> There should be brief intervals of time for quiet reflection provided for even the young. But they are periods of genuine reflection only when they follow after times of more overt action and are used to organize what has been gained in periods of activity in which the hands and other parts of the body beside the brain are used. (p. 63)

I would have to include authentic learning experiences for the students to write about, including field trips, trips to our environmental center, and labs. In

addition, I would have to make room in my lesson to include these brief intervals of quiet time.

> But there is no intellectual growth without some reconstruction, some remaking, of impulses and desires in the form in which they first show themselves. This remaking involves inhibition of impulse in its first estate. The alternate to externally imposed inhibition is inhibition through an individual's own reflection and judgment.…Thinking is thus a postponement of immediate action, while it effects internal control of impulse through a union of observation and memory, this union being the heart of reflection. (Dewey, 1938/1997, p. 64)

This need for reflection was imperative for not only understanding of the activity, but the ability for recall it at some further date. Having time in class for reflection on activities and ideas discussed in my science class has always been a double–edged sword for me. I want desperately to include it, but know the clock is ticking and required curriculum needs to be covered. However, I feel that Dewey (1938/1997) brings the importance of reflection to light with the second quote. Reflection is important for understanding, and this reflection needs to take place after activities to fully organize thoughts. But it goes far beyond this when looked at as a means of self-control, something often cited as lacking in middle-school students.

The journal writing that took place in my classroom was often following authentic experiences, as well as after a video, for reflection on what they saw and heard, and before a test as a means of review. I felt this writing might lead to further reflection and analysis of the material being studied. Friere is adamant on reflective practice as a means for action. “Reflection, true reflection, leads to action” (2000, p. 66). Although he was looking at social reform of an entire country, it applies as well to education.

The action I am seeking is student involvement in their learning, or student-directed learning. By reflecting on activities or observations made in class, I can encourage students to see connections and investigate those connections. Reflection, as writing or discussing, helps students sort, digest, and categorize experiences, linking them naturally to previous knowledge. This reflection may help students to become more self-directed. Writing in a journal expands on the experience, allowing students to include feelings about the activity as well as observations. Freire (2000) assures us that reflection leads to action. And that action, in my class, takes place the following day. So this reflection seems important for students to prepare for the next day’s action.

Mayer, Lester, and Pradl (1983) spoke about the use of journals in the classroom. “The journal frees us from the limitations of memory and forces our ability to shape at the point of utterance” (p. 24). Many students already show their limitations of memory often in my classroom. Students are often forgetting

what we talked about the week before, notes recorded yesterday, or steps to follow during a lab. If journal writing might help jolt their memory a little, it will be worth the effort.

Several action research studies have been centered around journal writing. Often these studies concentrate on the increase in writing ability. Many, however include improvement in reflective practices and enhanced understanding of the material being learned. Cole (1994) developed a cognitive model of journal writing as a metacognitive tool based on qualitative research collected from her high school literature class. This model included journals for use by students to increase their reflection on their learning and thinking. Data included students' journals, class comments, interviews, and surveys.

Results of the study indicated students generally viewed journal writing as a flexible cognitive tool which helped them construct meaning. In addition, students felt writing in journals allowed them to attend better to details in the story and develop both questions and answers about the story to aid in understanding. Cole (1994) found that within the journal, students were more apt to admit confusion, ask questions, and generate self-explanations that teachers might not point out in class. This aided them in not only understanding the story better, but in developing self-monitoring and problem solving skills as well.

This is exactly what I am trying to duplicate in my classroom. I want students to develop periods of reflection and self-monitoring by using their

journals after activities and observations. I have found that students still need more experience in journal writing to develop more questions and inquiry. I am hoping these skills will develop over time.

In an action research project by Wong, Kuperis, Jamieson, Keller, and Cull-Hewitt (2002), the effects of guided journal writing on student understanding was investigated. Three 12th grade English classes were randomly assigned to one of three criteria. The first read the story *The Great Gatsby* with no journal writing, only discussion. The second and third classes included journal writing after critical times in the novel, in addition to the reading and classroom discussions. The same teacher taught all three classes and used the same questioning techniques to initiate, stimulate and sustain class discussions among the students.

Results from the test showed consistently that "students who wrote guided response journals gave superior test performances in comparison with students who did not write but participated in class discussions" (Wong, Kuperis, Jamieson, Keller, & Cull-Hewitt, 2002, p. 9). While all three groups indicated having time in class to discuss the novel was highly valuable in understanding the story better, 81% of the students in the two writing groups, felt that writing answers to the questions raised in discussion made them more involved with the story and the main characters. In addition, themes that were generated from the interviews and surveys clearly indicated that students felt that the writing led them

to generate more ideas and enhanced retention of the story. Students also claimed that writing overwhelmingly made them better able to participate in classroom discussions. One student was quoted, “When you’ve put it down in writing, it’s not a mess in your head. You’ve thought about it, written it out, your points are developed. Otherwise you’re not clear. People lose patience and tune out” (p. 11).

In addition to utilizing journals to enhance student understanding of the material, Chanthalangsy and Moskalis (2002) investigated the use of journals in enhancing improved writing skills and language acquisition. In this study, 21 limited English proficient participants, from two different second and third grade classrooms, used journals in class to enhance English comprehension. The use of the journals varied upon the activity, including dialogue journals between student and teacher, journal responses to experiments and other hands-on activities, responses to particular questions after reading the textbook, and the opportunity for students to share opinions, feelings and whatever interested them.

Results indicated that although students started at various levels, all gradually improved their writing skills over time. In addition, students showed more improved performance in content than on any other criterion. Students responded to clear and logical prompts and had to question whether the information made “sense” and why. This engagement in their writing contributed to their higher scores.

The results of this project show some success in advancing students’

abilities to become more independent writers. They also showed an improvement in second language acquisition through writing journals. Since I too have many English Language Learners, this added benefit for them is a plus. It should be noted however, that lack of time was a concern by both researchers, who wanted students to self-correct their journal entries and felt this was an important aspect of the journal writing, especially in improving grammer and punctuation.

RESEARCH DESIGN AND METHODOLOGY

Design of Research

My objective in the study was to document the reported and observed experiences of the students and teacher involved in student-directed activities during a sixth grade environmental science class. My goal was to see if certain activities would promote more student-directed learning. I documented student reflections and interpretations of these activities to evaluate the benefits and difficulties of working in a more student-directed environment. I responded to the difficulties encountered during these student-directed activities with scaffolding techniques to promote greater success and a more positive experience for my students. Furthermore, I investigated the impact of student-directed activities on student understanding of environmental science concepts and curriculum.

These student-directed activities included the use of small group work, and a small group project. I further encouraged peer tutoring during individual activities and included more opportunities for discussion and dialogue to occur after those authentic learning experiences and offered time for reflection with journal writing. I evaluated how effective these experiences and activities were for student learning through observations, interviews, surveys, and assessment scores including tests, projects, and labs.

Small Group Activities

A large part of my action research stems from social dialogue and the interaction of students with each other. My goal was to limit the amount of teacher talk and to increase student dialogue. I did not want to be the teacher described by Delpit, in her book, *The Skin That We Speak*, (2001). “The percentage of talk by the teacher far outweighs that by all the students put together” (p. 40). I was hoping by incorporating these small group discussions after viewing videos, reading articles, or upon completion of activities that student dialogue would increase and eventually become second nature.

Journal Writing

In focusing on ways of developing self-directed learners, I realized that reflection must be included. I utilized journal writing about once a week to offer opportunities for student reflection of activities, concepts, and literature (Hudson, 2002), although I had initially intended to include journal writing more than I eventually did. The use of journals helped me to evaluate the nature and quality of students’ self-reflection. Students were able to reflect on activities completed in class in that this reflection would help them become more self-directed learners.

The journals were also intended to serve as a tool for students to monitor what they were doing in class, including reflecting on upcoming assignments and when due dates were, but this part of the plan never completely materialized. We simply ran out of time to incorporate more journal prompts, especially when

coupled with discussion before or after. I was hoping by including this aspect of journal writing, students would become aware of what they didn't know, and would be better equipped to ask questions of partners, group members, or me, to clarify misunderstandings. I thought this would better prepare students for tests, since they were reflecting on activities by summarizing, and this summarization might serve as a review.

In addition, I felt that some students might need time to write through their thinking process, in essence talk to themselves for better understanding. I feel the journals helped to do this. I read the journals periodically to monitor this process, however the journal itself was not graded per se. I did count the completion of the journal entries as a homework grade.

Small Group Project

I provided opportunities for students to design and complete a small group project, which included a presentation by students (Alesandrini & Larson, 2002). This project was done at the end of the Scientific Method Unit. Student groups of 3-5 developed a rubric for the activity that included designing an experiment based on a student-created hypothesis. The students tested this hypothesis and then presented their findings to the class. The presentation was part of the overall grade and included an overview of the hypothesis and experiment conducted and a visual including the seven scientific method steps along with an explanation of

the results. The rubric created for assessment was also used as a checklist to monitor student progress (see Appendix A).

Data Collecting

Field Log

My data collecting included keeping a field log to record my observations and thoughts on activities being performed and evaluating these activities for effectiveness (Arhar, Holly, & Kasten, 2001). As Ely, Anzul, Friedman, Garner, and Steinmetz note (1991, p. 69), "Field logs are chronological records of what we learn and our insights about how we learn it." I anticipated that my field log would serve as the base for much of my data collecting and analysis, and I was correct.

Since much of my data came from my observations, I developed an observation sheet (see Appendix B) to use to record the individual(s), the action or observed response, and then a third section for my reflection or analysis of this action. I gave myself time at the end of the day to make reflections while the activity was still fresh. I conferred with students to ensure this interpretation was accurate and to get their view on the action or response. I recorded incidences of peer tutoring, student dialogue, student questioning and inquiry and evidence of connections to personal life.

In my log I not only explained and evaluated the lesson but reflected on how I thought the students performed during the lesson. I included how well they

worked and how much assistance was needed. I reflected on what I might be able to do differently based on what I saw. This self-reflection helped me to identify what scaffolding was needed during these student-directed activities, in order to achieve the desired outcome. This log also reported characteristics or actions I was specifically looking for in my students and monitored improvement in those areas during the year. These characteristics included student dialogue, peer-tutoring, and student connections to real life situations. All things I felt would enhance student understanding.

Interviews

I used small group interviews (see Appendix C) to get a better idea of student confidence and self-reliance during certain activities and to gain more detailed views of student's feelings about the activities performed and the knowledge gained (Eder & Fingerson, 2002). During previous action research, this seemed to serve as the best evaluative tool for me. Students were usually very honest when asked about their participation during group work, so this was used to evaluate partner and group work effectiveness. I also used interviews as a means of evaluating the activities I was using in class and the scaffolding methods included.

Surveys

I inquired as to how students felt about working independently and in small groups through two surveys (see Appendix D and E), one given at the end

of the microscope unit, to ask specific questions about peer-tutoring and the use of small groups, and one following the small group project to ascertain student feelings about the project itself and working in small groups to complete it. Names were optional, although most did provide identification.

Student Work

In addition, I included student work as part of my data collecting including test scores, project scores, and journal analysis for reflective quality. I compared test scores for units utilizing more student-directed activities to those with less to see if these activities did indeed enhance learning. I evaluated the effectiveness of the small group project by comparing these scores with other forms of assessment (see Table 1). I also evaluated journal entries for reflective quality and content.

Methodology

All of the students in the class participated in all of the activities during their regular environmental science class. All students completed assignments as part of the regular science curriculum. All students completed the two surveys and participated in at least one of the interviews. Only information gathered from students who have agreed to participate in the study was used in the publication of the thesis.

Student identities were kept confidential by using pseudonyms in both my observations and when discussing results of interviews. Surveys were completed with student identification optional, giving students the opportunity to make

comments without me knowing who they were. Students that did not wish to participate in the study were not singled out or penalized academically. They too completed the surveys and interviews but their responses were not included with the rest of the students. Students had the option to withdraw from the study at anytime without any impact on their grade.

Trustworthiness

I began my action research by obtaining necessary permission based on my thesis proposal, from the Human Subjects Internal Review Board (see Appendix F). I ensured trustworthiness in my research by obtaining necessary permission from my students and their parents and my principal. All students in the class were given a letter explaining the research study to share with their parents (see Appendix G). This letter was distributed on September 7, 2004. This letter explained the research and how it would be incorporated into the classroom curriculum. Student rights were addressed in the letter. Those students wishing to participate returned the form signed by both themselves and their parent(s) or guardian(s) indicating their understanding of the research study and their approval to participate. My building principal was also informed of the study and agreed to my participation in the study (see Appendix H). I, along with my building principal, was available for questions and concerns by students or parents.

I ensured strict confidentiality of my students and the data collected, by not partaking in discussions outside of class with other individuals or groups. I

kept the researcher log in a secure location at my residence, and students did not have access to the researcher log, however they did share in discussions of my observations and analysis for accuracy. Because I identified students by pseudonyms, I kept the pseudonym name list at my house for my reference only. I strove to be objective in my observations and the analysis of these observations, allowing as many possible viewpoints to be presented through numerous types of data analysis. I self-reflected throughout the study as a means of analyzing my recorded data to ensure accuracy and clarity.

"According to Miles and Huberman (2000), "Data collection, analysis and interpretation take place continually and simultaneously throughout the study" (p. 25). Arhar, Holly, and Kasten (2001) agree saying "Interpretation is an ongoing process…Thus it includes everything from making sense of baseline data we collect at the beginning of the study, to making sense of selected pieces of data even as we write up the report" (p. 186). With this in mind, I have included analytic memos and narrative devices throughout my field log to help shed light on my ongoing research. These memos help me to understand and evaluate both the students' actions and my own during student-directed lessons, thereby increasing better facilitation on my part, and better student outcome on theirs.

Data Analysis

Bins and Themes

Data analysis was completed using coding of my field log and then sorting data into categories, called bins, to help me in identifying relationships and patterns or themes in my data (Ely, Vinz, Azul, & Downing, 1997). These developing themes were used to help me form conclusions about my study; more specifically, identifying which activities provided more connections, peer tutoring and true student-directed learning.

Figurative Language

I also took time to analyze my own language and the language of my students for the use of metaphors to analyze the data. I used analytic memos and narrative devices to help me to analyze data. This proved to be very beneficial for me when I had previously taken part in action research.

Student Interviews and Surveys

I included analysis of student views and performances utilizing student interviews and surveys. According to Ely, Anzul, Friedman, Garner, and Steinmetz (1991), “Interviews are at the heart of doing ethnography because they seek the words of the people they are studying, the richer the better, so that we can understand their situations with increasing clarity” (p. 58). In past studies, these interviews and surveys supplied valuable insight into the students’ perception of the activity and their feelings about it. Often, I had misread their

actions in class when evaluating their likes or dislikes about an activity. I included open-ended questioning as I have found students may elaborate more when asked why they feel that way. The authors also suggest the use of open-ended questions. “Open-ended questioning can unearth valuable information that tight questions do not allow” (p. 66).

Literary Devices

I included a layered story of our class field trip to Merrill Creek Reservoir as a means of seeing this experience from the eyes of three different students. Ely, Anzul, Friedman, Garner, and Steinmetz (1991) suggest “authors should experience those lives as best they can through their imagination, and write those up as part of the reports on research” (p. 78). By evaluating what I recorded of the day’s experience, the dialogue heard, the pictures taken, I feel I was able to make an accurate assessment of the individual students portrayed in the story. This method of analysis proved to be useful as I had to acknowledge that not all students are equally enriched from authentic learning experiences. After completing the observations on the scientific method project, I was feeling rather overwhelmed by the amount of work it had required of me. The students, however, all responded positively to informal interviews that were completed over the duration of the project and to the survey they completed. I knew it had been a great learning experience for them, and that I should feel good that student-directed learning had indeed taken place successfully. My problem with

the project stemmed from my inability to place the responsibility of actually doing the experiment on them, rather than with me during my study hall class period. After completing a pastiche, I felt my feelings of frustration with these logistic problems were equally balanced with the students' enthusiasm over the project itself.

Student Work

The last piece included in my data analysis was student work. I analyzed journal entries, short answer test questions, finished projects, as well as grades for the small group project and unit test grades for the first two units. I saw themes emerging here that might again address whether the activities I included were indeed successful academically for my students. I looked for areas of reflection as well as student learning, and evidence of connections being made to previous knowledge.

I believe this variety of data analysis ensured triangulation of data. As Arhar, Holly and Kasten (2001) suggests, trustworthiness is increased when several sources are included. Participant observations, interviews, surveys and participant checking all help to encourage accurate conclusions to observations and statements made. My goal is to make my teaching most effective for student learning.

THIS YEAR'S STORY

Setting

My sixth grade classroom is in an old high school that now houses just two grades, fifth and sixth. The school is located directly downtown of a moderate size northeastern city. There are many students who walk to school. In addition, there are many large suburbs surrounding the city where most of the student population lives. Distribution by race is about seventy percent Caucasian, eighteen percent African American, and twelve percent Latino. This diversity is also evident in the socioeconomic distribution, with about twenty-five percent of the students qualifying for the federally funded free lunch program, while other students shared their experiences of elaborate and expensive vacations. These students are further divided by levels; with an enriched level, a proficient level, a basic level, and an inclusion class.

My classroom is not a true "science lab," although there is a lab bench along one wall with two sinks and a storage area. I use this bench mostly for a place for tanks with various animals and an assortment of plants. Students perform labs and activities at their tables. These tables are designed for two and are pushed together forming groups of four. I have another two tables pushed against the opposite wall forming a makeshift lab bench, for laying out lab materials and storing projects and journals. I have five computers along the back wall for student use. My desk is near the door in the corner, and I long for a

window to brighten up the room. My attempt to imitate a window includes a plant light, plants, a fish tank, a snake in a tank, and many colorful posters and student work. It is hot most of the time so with the aid of a fan and a humidifier, plants and people fair a bit better.

Participants

The class that I chose to study for my action research was my first period class. They are a very cooperative proficient level group who I felt would respond well to the student-directed activities I had planned to incorporate into my 6th grade environmental science class. I was a little concerned about how quiet they initially appeared, especially compared to several more talkative classes, but thought the added emphasis on social dialogue might be more easily monitored because of this.

The other concern I had was that the class was seventy percent female. Would this affect my study? It certainly would be something I would have to evaluate upon completion. Other than gender, this class was my most racially diverse proficient level class and I was interested in seeing if the student-directed activities might prove more useful for certain groups of students. Even so, sixty percent of the class is Caucasian, thirty percent of the remaining population is African American, and ten percent are of Latino descent, several enrolled in the intermediate or advanced ESL class. The class seemed very friendly and helpful

with one another, which again, I felt would be beneficial for the planned activities.

When I first introduced the idea of my action research project, the class seemed interested but not overly concerned. They seemed to understand that lessons would be the same across the board in my other classes, but that I would be using their journal entries and my observations of them to help me in completing my degree. All but two brought back their permission slips signed within the first couple of days of school. They also inquired about what pseudonym I would be using for them, since I told them their identity would be kept secret.

As the semester continued however, I had very little inquiry about my research or the outcomes of my observations. Students seemed to forget that it was an on-going project on my part. They were reminded during interviews and surveys, but otherwise, questioned me little about the progress.

Journals

When first told about the journal writing, students seemed, for the most part, pleased with the idea. Out of the twenty-four students in the class, only three failed to produce a journal after one week. The journal prompts that I included were more about describing and explaining what they had seen or done during the previous day's activity. I included these prompts as a way for students to reflect and think about the activity and their observations. I also felt it would help them

prepare for tests and future activities by sharpening their observation and memory skills. In imparting the need for such written reflection, Strieb (1993), an author on the use of journals, notes,

> When children or adults describe what they see, they are doing some important scientific and language work. They must observe carefully and must use words that allow them to be as specific as possible so that they can accurately describe what they see (p.128)

Students completed their first journal entry after a trip to the environmental center to make summer observations. Students were instructed to use their senses in making as detailed observations as possible and recording these observations in their journal. Students were allowed to roam freely, alone or in groups, throughout the environmental center, which included a pond, many plants, and animals. I directed their attention a little, as I wanted them to feel the soil, note the air and water temperature, and be able to compare these characteristics throughout the year as they observe each season.

Students went directly to the pond that is located at the center of the environmental center. It contains fish and frogs but is covered almost completely by water plants. Right away questions emerged, a true sign of inquiry taking place:

> “What the heck is that?”
>
> “What kind of plant is that?”

“Is that algae or moss?”

Students started at the pond, which is a focal point of the environmental center, but soon dispersed into small groups of two and three and made their way around the rest of the center. Several groups were gathered around a pile of rocks and turned them over, per my previous discussion based on where to make observations.

‘What’s back here?”

“Probably snakes.”

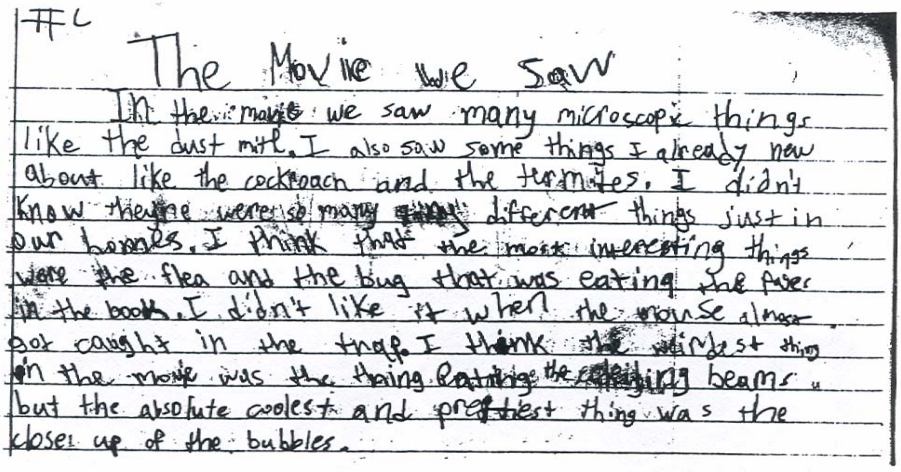
“Ooh did you say snakes?”

A group of girls were admiring the wildflowers, although not as pleased with the bees that the flowers attracted. Jane noticed the wild-bird seed was the same as she fed her cockatiel at home. All of these connections were observed and documented as well, in some of the students’ journal entries. However, most of the entries were short and void of much detail. Although this was a little disappointing for me, I realized that students would need some time and practice to increase reflection and observation skills. My peer-writing group offered suggestions on making the journal entries more specific. I reviewed my journal prompts to see where more specific and direct questioning could be included.

The next time I assigned a journal entry was following a video on the microscopic world. The video followed a day in the life of one family using microscopic techniques to see the endless microscopic organisms that reside in

and around their house. The journal prompt (see Appendix I) specifically asked students to apply what they had seen in the video to their life, asking if they knew there were so many microorganisms in their everyday life. Students left the class excited, and talk of the video lasted several days. Many of the journal samples captured the essence of the video with a good amount of detail (see Figures 1 & 2). Many of these entries also showed student connections to their own life (see Figures 3 & 4).

Figure 1

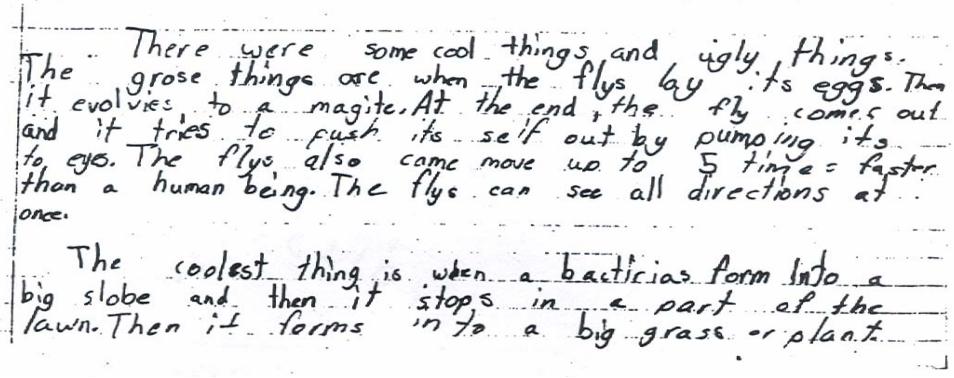


#L

The Movie we saw

In the movie we saw many microscopic things like the dust mite. I also saw some things I already new about like the cockroach and the termites. I didn't know there were so many different things just in our homes. I think that the most interesting things were the flea and the bug that was eating the fiber in the books. I didn't like it when the mouse almost got caught in the trap. I think the coolest thing in the movie was the thing eating the [illegible] beams but the absolute coolest and prettiest thing was the closer up of the bubbles.

Figure 2



There were some cool things and ugly things. The grose things are when the flys lay its eggs. Then it evolves to a magite. At the end, the fly comes out and it tries to push its self out by pumping its to eyes. The flys also came move up to 5 time = faster than a human being. The flys can see all directions at once.

The coolest thing is when a bacticias form into a big slobe and then it stops in a part of the lawn. Then it forms in to a big grass or plant.

Figure 3

September 15, 2004 #2

Now I know whats in my house. The movie was cool. Its really weird. I'm going to vacum every day from now on. My poor dog. I know! There's alot of stuff in dust. The gross part was the magits in the walls. Its cool how theres alot of stuff in your house. and also kind of scary!

Figure #4

Wednesday September 15, 2004

After watching that movie I'm a little grossed out. I found out that there are bugs in my carpet, couch, and sofa. The other things that grossed me out was that there are bugs in my wall and coting eating the wood. And when the flys land on your food they are eating it too you can't tell because they eat with their back legs. And last night I was thinking if you sit or lay on the carpet the bugs might go on you but you wont know because they are so small. Yikes!

The next two journal prompts I included were after several microscope labs. The first prompt was completed after using the easier binocular microscope for several days, while the second microscope prompt was completed after viewing pond organisms with the more difficult compound microscope. I included many open-ended questions to try and encourage more writing by the students (Ely, et al., 1991). Many students simply listed what they saw. Some told me which were their favorites and why. A few included pictures.

In the first prompt of the microscope unit, I specifically asked students what kind of detail they were able to see using the binocular microscope. I then said to reflect and write about these specimens. I also suggested describing to me or drawing their favorite specimen and telling me why it was their favorite. I got many more descriptive entries with this prompt than either of the first two (see Figures 5 & 6)

Figure 5

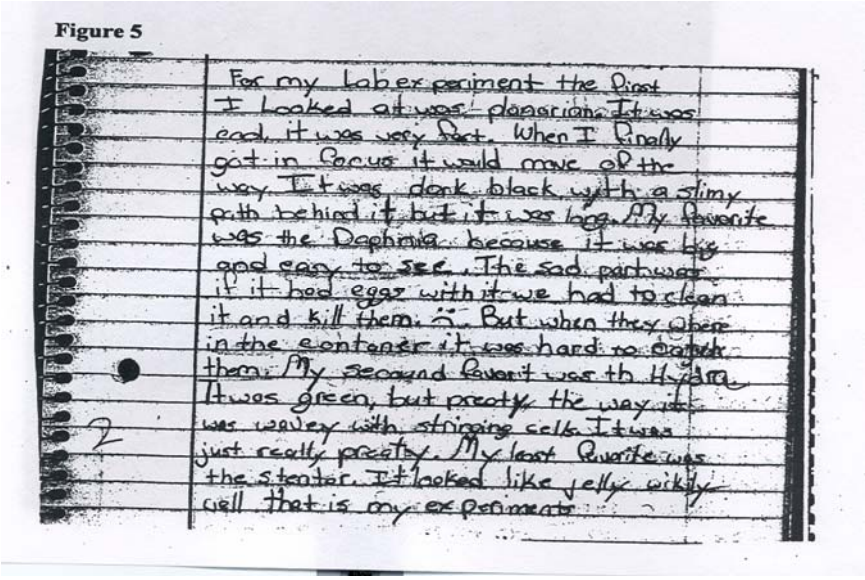
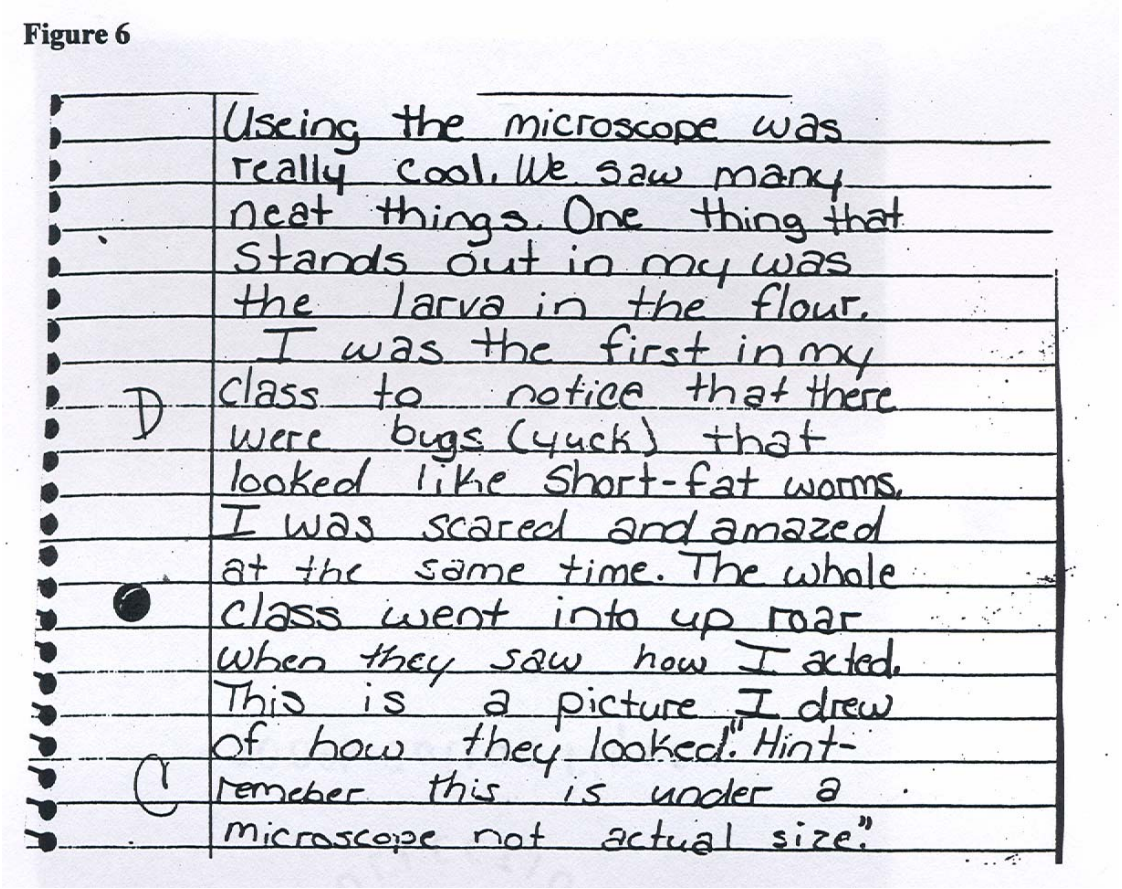

For my Labexperiment the first
I Looked at was planarian. It was
cool, it was very fast. When I finally
got in focus it would move off the
way. It was dark black with a slimy
path behind it, but it was long. My favorite
was the Daphnia because it was big
and easy to see. The sad part was
if it had eggs with it we had to clean
it and kill them. :(But when they were
in the container it was hard to catch
them. My second favorit was th Hydra.
It was green, but pretty the way it
was wavey with stinging cells. It was
just really pretty. My last favorite was
the stentor. It looked like jelly wikly
well that is my experiment

Figure 6



Useing the microscope was
really cool. We saw many
neat things. One thing that
Stands out in my was
the larva in the flour.
I was the first in my
class to notice that there
were bugs (yuck) that
looked like Short-fat worms.
I was scared and amazed
at the same time. The whole
class went into up roar
when they saw how I acted.
This is a picture I drew
of how they looked. "Hint-
remeber this is under a
microscope not actual size."

The second prompt I used was for the pond organisms and unfortunately, students did not answer the specific questions I had asked. I told them to think about the many pond organisms they had observed over the past few days and to tell me how they moved, what color they were, and to draw their favorites. I specifically said “Be descriptive.” Again, I was trying to get students to notice things that might later show up on the unit test, like which ones were photosynthetic, which were transparent, which had cilia, which had a flegella, etc.

Very few included these aspects even though I specifically asked for them. Most simply described a few of their favorites.

These microscope labs however were great opportunities for students to engage in authentic learning or "learning through experience" (Dewey, 1997, p. 19). The journal entries were much better overall, with many indications of connections being made to their personal life. Many students recalled details they enjoyed seeing and some surprises as well. Finding real-life maggots in the flour, something that was not planned, was a real eye-opener to many and gave all something they could not only relate to, but were concerned with as well.

"I'm gonna tell my daddy to sift the flour from now on when he's making fried chicken."

"Now you better think twice before jumping into a pond!"

"I didn't know bed bugs were real, I thought my sister was trying to scare me."

The next journal entry followed a field trip that we took to Merrill Creek Reservoir. I felt the trip would offer an exceptional opportunity for students to experiment nature first-hand and the deciduous forest, which we would be studying shortly when we reached the Biome unit. In addition, we were able to include a fresh water study, another biome we would be studying, of both Merrill Creek, a pristine native creek, and the reservoir. This would allow a nice comparison of the two fresh water sites. The students all started together at the

nature center, where there was many samples of birds and animals found throughout the region. After a brief introduction about the formation of the reservoir, and an opportunity to look at all the stuffed animals, birds and fish, we split into two groups and walked a mile through the woods to our water sites.

At both sites, students were given nets to use to scoop up water insects and other invertebrates that we had discussed earlier. I also had identification sheets available so that students could identify what was being collected. Students were very excited and practically ran through the woods. Many had never even experienced a day in "nature" so this was a unique experience for them.

Layered Story: The Field Trip

Joy. What is wrong with these kids? Ms. Conway told them three times already to be quiet. We'll never see any wildlife if they keep this up. What? A deer with her baby? Where? Let me see. Oh, how beautiful. Look, they don't even see us yet. Oh, great, now they are gone. I'm so glad I'm up front!

Which way do we go? Oh, Ok, I see the reservoir from here. Can we just go in? Wow, it's cold. I hope I don't sink too deep, the water will get into my boots. Oh well. Hey, what is this? Ms. Conway, where's the ID sheet? I've found something. It looks like a damselfly larvae. Man is this thing creepy. Don't push, I'll put it in the bucket so everyone can see it. Watch it. Ok, let me through, I'm going in again. Hey Suzanne, what did you get? Let me see!

Edgar. Wow, is this beautiful. I've never seen a deer before, at least not up close.

Wow, this is kinda far, I hope we get there soon. I hope I brought enough water. Oh great – there it is! Come on Royce, lets go upstream. Oh man, the water is so cold. I'm glad I brought my other shoes. What the heck is that? Wait, I got it, it looks like a slimy lizard. What? A salamander? Its really smooth and pretty. This is unbelievable. Look – there's more. Come on Royce, let's keep going, Ms. Conway said there might be crayfish. Lets look for some. Man, I wish we could come here everyday!

Kathy. Oh no, I'm never going to keep these sneakers clean. Maybe if I stay to the outside of the path. There, that's better. Oh these bugs, I should've brought my bug spray. Ms. Conway should have told me. Maybe if I wrap my scarf around my face. When will we be there already? What now, get in? What, is she crazy? I'm not getting in. Its muddy and the water is cold. Look at Joy, what is she doing? Yikes, what does she have? Get that away from me!! Ms. Conway, where's the bathroom?

The journal prompt that I used after this trip was intended to see what the students got out of the experience. "What benefits did you get from the field trip? What did you learn? What did you see? Reflect and write about your experience." Again, I wanted students to give details and I tried to be more direct in what I wanted them to write about. I also wanted students to use their journal as a means of recording what they had seen or done as a way to hold on and remember the experience. As might be expected, many of the journal entries were

more vivid with detail (see Figures 7, 8, 9, 10, 11, & 12). They seemed more descriptive than any of the other entries, with the exception of perhaps, a few of the pond specimen entries. Certainly, the authentic experience allowed for more opportunities for students to express themselves.

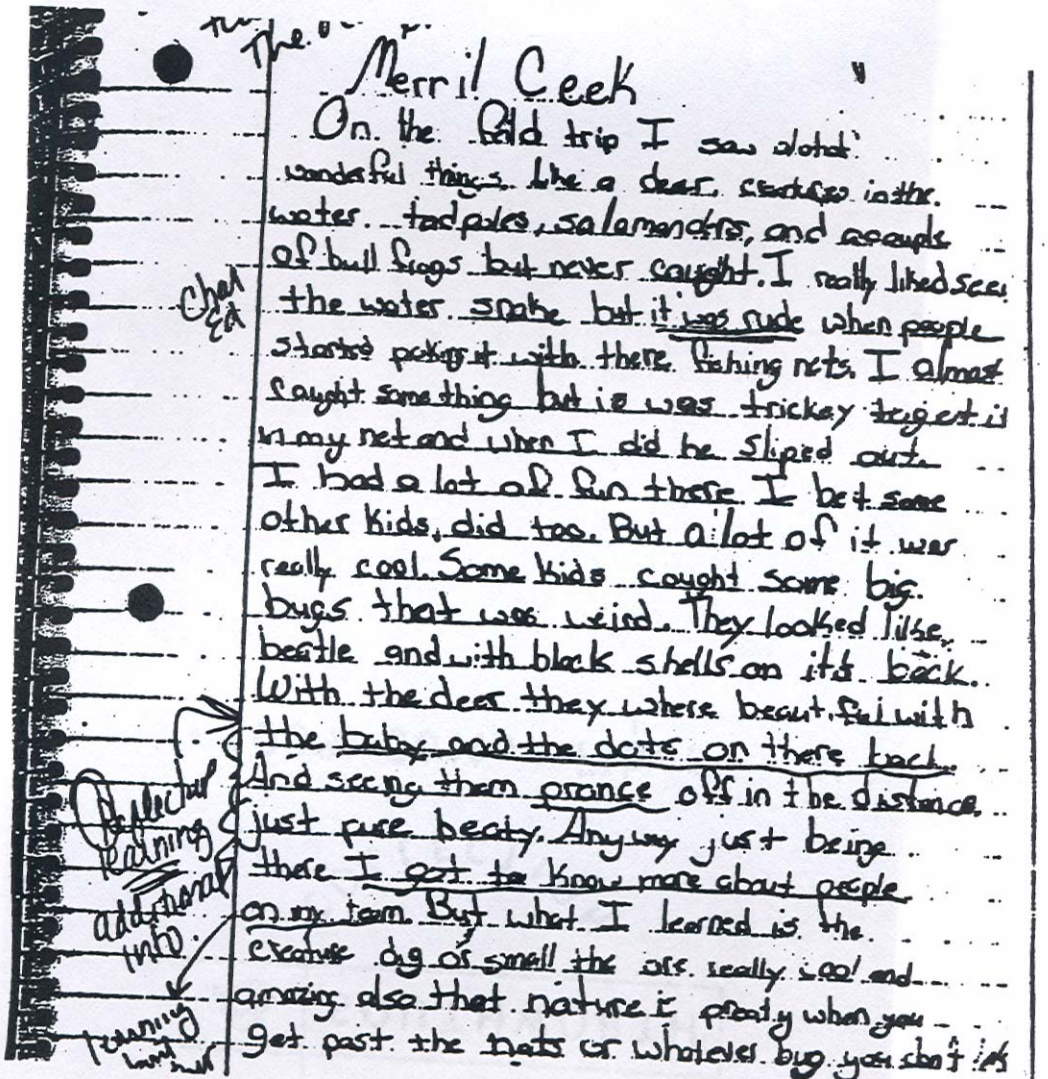
Figure 7

I liked the field trip to Merrill Creek because we saw a lot of animals. We saw a water snake, Newts, deer, fish and wolly bears. I liked the water snake the best. First we learned about Merrill Creek. Then we took a hike. After that we when fishing. Then hiked back and ate lunch. Then we went home.

Figure 8

10-19-07
On Thurs. we went to Merall Creek. It was really neat. I saw some of their stuffed birds. We also went on a hike I caught 2 fish and a tadpole in the water. We also went to a creek I didn't catch anything but I got soked. On the way back Mike caught a turtle it was a baby. That was our fieldtrip.

Figure 9



The Merril Creek

On the field trip I saw alotof wonderful things like a deer swimming in the water. tadpoles, salamanders, and a couple of bull frogs but never caught. I really liked seeing the water snake but it was rude when people started poking it with there fishing nets. I almost caught something but it was trickey to get it in my net and when I did he sliped out. I had a lot of fun there I bet some other kids, did too. But a lot of it was really cool. Some kids caught some big bugs that was weird. They looked like beetle and with black shells on it's back. With the deer they where beautiful with the baby and the dots on there back. And seeing them prance off in the distance just pure beauty. Anyway just being there I got to know more about people on my team. But what I learned is the creatures dig or smell the air. really cool and amazing also that nature is pretty when you get past the nats or whatever bug you don't like

Chart EA

Reflection learning additional info.

learning lesson

Figure 10

10/13/04

Merrill Creek

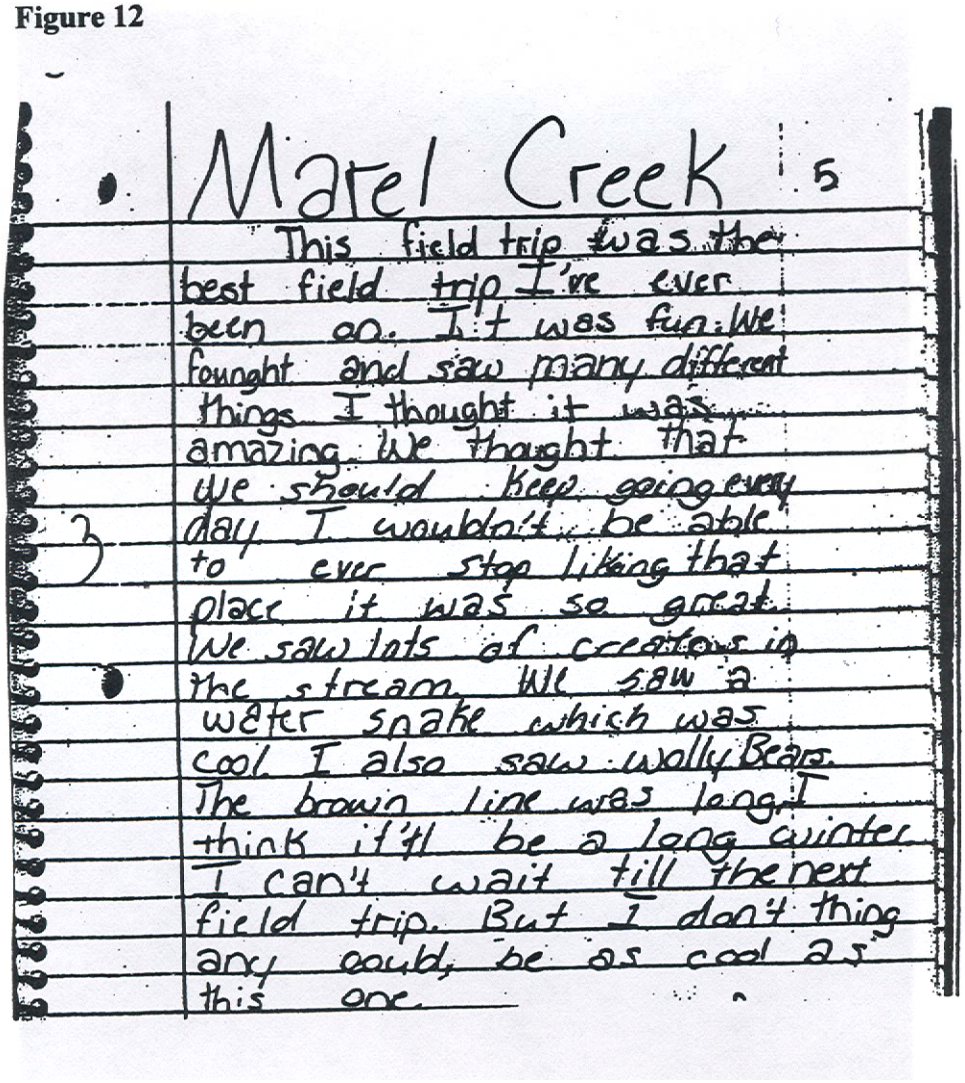
Merrill Creek was cool we saw so many neat things. I caught this bug. It looked like this... * we didnt idenfy it, because we had the sheets, but they didnt say what it was. Meghan P. and I walked in the creek, are shoes were soaking wet but, we had fun. Then after the creek we went back to "Home Base." we went a different way and we ended up on this road. So we walked on the side of it when we got back we ate our lunch outside After that it was time to go. So I went home with my dad because he came along with us

Figure 11

Merill Creek

The field trip was fun and we got to see a lot of different animals. When we were fishing with the nets I caught two waterbugs. I don't understand how they float like that. When we were hiking we saw some strange things. Like the baby animals skull in a pile of rocks. I feel bad for the group that goes on Thursday they're probaly going to get soaked.

Figure 12



Marel Creek 5

This field trip was the best field trip I've ever been on. It was fun. We founght and saw many different things I thought it was amazing. We thaught that we should keep going every day I wouldn't be able to ever stop liking that place it was so great. We saw lots of creatures in the stream. We saw a water snake which was cool. I also saw wolly Bears. The brown line was long. I think it'll be a long winter. I can't wait till the next field trip. But I don't thing any could be as cool as this one.

The next journal entry included another trip to the environmental center to observe fall. Students were eager to begin. I reminded them to observe plants, animals, air, soil, and whatever was different from the last time we were there. I returned their observation sheets to them. Their summer observations made in September were on the same sheet, to assist them in making their fall observations. The journal prompt simply asked them to make observations of fall and to compare these observations with the summer observations taken six weeks previously.

Most students rushed again to the pond. I told them to touch the water to compare temperature. Several students dipped their hands in and commented on how cold it was. I pointed out the Dogwood tree, which was covered in beautiful red leaves, and most wrote this down. I pointed out what was left of the Virginia creeper, the vine that was so lush last time, now barely visible with berries and a few brilliant burgundy leaves. A few students remained at the pond, while several others moved back to the pile of rocks where a chipmunk had just dashed. They pulled some of the rocks off of the pile while several students told them to stop. I agreed, and the rocks were left in place. We discussed where the chipmunk was going. We had previously noted the rocks as a possible snake habitat. Now this idea was being challenged.

Several girls were cold and not interacting as much as I thought all would. They were not dressed appropriately. They had completed their observations, and

when I looked at their sheet, they had circled almost everything. I went over it and told them to elaborate on some of the observations and only circle what the majority of the environment looked like. With that, a yell from Joe brought all students to one area of the environmental center. “Hey look what I found!”

Outside of the environmental fence, a dead squirrel lay between the fence of our center and the neighbor’s fence.

“Cool, a dead squirrel.”

“Let me see, should we bury it?

“How do you think it died?”

“It fell.”

“Maybe a hawk killed it.”

“It might of got shocked from the electric line.”

We continued for a minute or two, most ventured over to see the squirrel, even the girls who moments ago were screaming at the discovery. It was still chilly, and with so many not prepared, we returned to the classroom. These journal entries seemed very weak in detail and most students wrote very little. It had been a cold day and perhaps this had dampened their abilities to collect enough data to actually write about. I was a little surprised, though, that only a few included a dead squirrel that we had discovered, since at the time, this surprise had dominated our visit. I must note, however, that we had made our observations a few weeks before Thanksgiving break, and I did not collect the

journals until after the break. Many may not have written in it right away and may well have forgotten much of what they had seen. Students had been successful at hypothesizing the demise of the squirrel while we had been in the environmental center. We had seen squirrels running across the electric line during our last visit and obviously, Suzanne remembered this and made the connection with the dead squirrel.

The final journal entry was given more as a means of reviewing and reflecting for an upcoming test on the first four biomes. Since we live in the deciduous forest biome and we had taken a field trip to Merrill Creek Reservoir, which included a deciduous forest, I asked students to reflect and write about the deciduous forest. I specifically asked them to include their own experiences with the deciduous forest, which if nothing else included their field trip to Merrill Creek.

I was a little disappointed with these entries as well since most students simply repeated what they had recorded in their notes from the previous week. Many were word-for-word from my overhead transparency. They did do part of what I had asked, write about the deciduous forest, but none shared a personal experience. I suppose since my intention was to get them to become more familiar with the deciduous forest as preparation for the upcoming exam, that I should be satisfied with that. However, it does not seem to qualify as reflection, if it is merely copying my words. I decided that I would need to rephrase my prompt to

ask about an experience they had with plants and or animals of the deciduous forest. Further reflection might occur as they have more intimate contact with nature. Many did pull material from some of our reading. I had told them earlier that questions from our reading materials might show up on the test, so this was encouraging for me to see.

Small Group Work

In addition to journal writing, much of my research revolved around groups and social discourse. I was hoping students would be assisting one another in learning and understanding the material. The first lesson where I included small groups was for an introduction to common lab equipment. I had placed samples of most of the equipment- beaker, test tube, petri dish etc.-into a bin and had given each group a bin. They were instructed to compare the contents with a handout they have also received. After identifying the piece of equipment, I instructed them to discuss with their group what the purpose of each piece might be and to brainstorm and make suggestions on a separate piece of paper to later compare with the rest of the class. I changed this lesson from a lecture and demonstration lesson to this small group lesson in an attempt to encourage more social dialogue among the groups, enhancing student-directed learning (Marinopoulos & Stavidou, 2002).

I observed students using many different senses - touching, listening, talking - while completing this assignment. Dialogue amount varied from group to

group, but all took part in some discussion about the lab equipment. Many had used some of the pieces before and shared their experiences. I observed nearly every student trying on the goggles. I also observed less dialogue once a worksheet was given to them to complete. I see now that there were limited open-ended questions and too many knowledge questions on the worksheet, and this may have impeded vocal discourse.

During the microscope labs, students worked independently, but within a group of four. Every student used his or her own microscope and was given an assortment of specimens to look at over the course of several weeks. These specimens varied and ranged from objects like pennies, pollen, newsprint, negatives, sponges, sugar, and salt crystals, to animals, including ticks, fleas, mites, and microorganisms like parameciums, volvox, hydra, and spirogyra. Students also looked at blood cells, skin cells and onion cells with slides they created. These were very hands-on, authentic-learning activities where student-directed learning was in full swing.

The students worked at their tables, some working independently, others staying together with each and every specimen. These labs gave students the opportunity to talk with each other and discuss specimens, as well as the correct use of the microscope. They shared microscopes often, wanting to see as much as possible within the time allowed. What stood out for me when reflecting on this dialogue in my field log was the excitement and energy that was conveyed. I tried

to capture that excitement and energy in the following poem, comprised entirely of student quotes taken during the microscopic labs (see Figure 13).

Figure 13

The Mircoscope

“Look,
its so
cool”
“Ooh,
look,
look,
look!”
“Did you look at
the wood yet?”
“Its so awesome.”
“Its so
bumpy.”
“I see
things
moving,
come
look at
this.”
“Some
one
come
here
and see
this.”
“My hand looks like a skinny skeleton.”
“The sugar looks like pieces of jewelry.”
“Are those bugs real? They look plastic.”
“Look, its transparent, I can see eggs.”
“Look! There’s Abraham Lincoln in the back of the penny!”

"Imagine if you were a paramecium and you were on a slide."

"Its all these little things you would never notice with the naked eye."

Students were sharing microscopes, eager to show one another what they had found. I also noticed a great deal of peer tutoring developing in most of the groups. Simple directions were repeated by students, not me;

"Mine is bigger. Switch to high power."

"Mae, go like this with the focus knob."

"You're too far away, get closer."

"Here, let me show you something."

I had only three students come to me during their first day with the binocular scopes and two on the second day. All other assistance was successfully provided by the other students.

When students began using the compound microscope, a more difficult scope to use, I had seven questions for assistance. By the end of the week, I had none. I kept instructing the students to seek help from one another first before coming to me. Students began to do this once those individuals were identified who were having success with their microscopes. Eventually, they were back to sharing their microscopes, especially with the live pond specimens, which moved, making them more difficult to focus on, and their size, making them more difficult to find.

Students worked often in small groups during the microscope unit and labs. At the end of the unit, I gave students a review sheet to complete. This

review was for the entire unit and included a great deal of material. I told them they could work alone on the review sheet, with a partner or with a small group of not more than five. Two students, Ian and Jane, chose to work alone. Several students paired up, Alan and Joe, Edgar and Royce, and Kit and Shannon. These students worked quietly together. This often included one of the students reading the question, offering a possible answer, verification of the answer by one or both of the students, and then writing it down. Of the three paired groups, Alan and Joe posed the least number of questions to each other and seem very passive in interacting and verifying answers. They received an 88% and a 94%, respectively, on the unit test. In contrast, Edgar and Royce verified nearly every question and both did very well on the unit test with a 93% and a100% respectively. Kit and Shannon fell somewhere in-between with the amount of discussion and received a 98% and a 100% respectively on the unit test. These two were both quiet and studious during class. It appeared the interaction and discussions may have increased performance, at least for the boys involved in paired groups.

The rest of the class had moved into small groups of three to five. Erin, Maria and Sarah worked at a table together, Beth, Joy, and Suzanne were at another table, and Kathy, Katrina, Melanie, and Mae were grouped at a back table. I noticed that in this last group, Kathy mostly waited for her group, which all seemed a little lost, to come up with the answer and then just wrote the answer down. “You guys keep going and I haven’t finished yet!” Kathy bemoaned to

her group. This group, in general, engaged very little in discussion about the questions. One member would offer an answer, usually Melanie, and everyone else assumed it to be correct and wrote it down. All four girls scored just below average on the unit test.

In contrast, Beth's group was very talkative, all pertaining to the review sheet. Joy and Beth practically debated each question. Suzanne was also very much involved and they each verified every answer before writing it down on the review sheet. I noticed this group on several occasions, huddled closer together than other groups. They were very close physically, with one of the girls even sitting on the edge of the table to get even closer. They were obviously comfortable with one another. Suzanne and Joy did very well on the unit test, 98%, 90% respectively, with Beth receiving an 81%. All three seem to consistently score high on unit tests, however, discussion could also have been a contributing factor.

In the third group, Erin pretty much directed everyone, correcting answers that were put forth by other members. "No, electron microscope is viruses and bacteria, compound microscope is microorganisms and small specimens." For the most part, however, all three were contributing to the completion of the review, checking answers by looking back in their notes, but little real dialogue occurred during the review. Test scores, however, for these three were below average.

Jane and Ian, the two working alone, both scored well, 100% and 95% respectively. These two have consistently been my highest performers since the beginning of the year. They are both quiet and studious and I'm not sure whether this says more about their personalities than it does about group work, but it is something to consider none-the-less. Eventually, both students would work in small groups when given choice. Jane even expressed a preference to working in groups when asked on a survey.

Students gained additional time working in groups during the scientific method unit. This unit started with identifying the seven steps of the scientific method. The second step included gathering information about a problem. I had students working together in groups of their choosing to gather information on a problem I had given them and five stations in which to find the various information. The stations included a magazine, the internet, an encyclopedia, dictionary, and seed catalog. I recorded a great deal of dialogue in my field log during this lesson, however, I noticed that this dialogue was not always focused on the activity. I had been allowing students to choose their own group to work with because I wanted them to become comfortable with their group. I was now beginning to wonder if this was always such a good idea.

The activity itself took several days to complete and was chaotic and noisy. All did manage to complete the questions and were competent at gathering information in all areas. They did socialize a good deal as well, as the topic was

about parakeets and many had stories to share. I had to continually circulate and question groups at each station to make sure students stayed focused and to keep students at the computer from searching other websites that were not necessary.

After completing the steps of the scientific method, I had a series of labs demonstrating the seven steps for students to complete with a partner. At each table were pairs of two teams, so discussion about the labs was allowed, and encouraged, to take place. For each lab, a paragraph was given at the top, which students were supposed to read and extract from it the first two steps: the problem and the information gathered. From this information, students were to develop their hypothesis and then collect the materials needed and perform the lab to test their hypothesis, collect data, analyze the data, and come up with a conclusion.

The first lab, I distributed the lab and attempted to give little directions. As I roamed around the room however, I noticed most students had the problem wrong and felt we needed to stop and review step one together before moving on. The next two steps of the lab we walked through together as I was now unsure of their independent ability. By the time they were actually completing the lab, I did notice a great deal of peer tutoring, or at least peer-reminding, going on.

> Mike, noticing Ike has placed all of the paper towel strip into the cup of water, corrects Ike, “Your doing it wrong, only put the end in, not the whole paper.”

Maria reminds Kathy as well, “No, don’t dip the whole thing in the water, just the ends.” As Diane goes to move on to the next color she checks first with her group, “Can we go to the next one?”

“Yes” answers Katrina, “but you have to write down your results first.”

Diane then wants to know, “What color are you doing next?”

I noticed a great deal of peer checking prior to moving on to the next color or to check to see if they were on the right track.

Erin, assuring her group that has stopped to compare results before going on, “Yes, that’s what I put, there’s yellow and green.”

Melanie, checking with Maria, “Is that pink or red?”

Royce checking with Ian, “Is this done yet?”

I also noticed a lot of comparing of results. Especially from the following group, who compared each color as they completed it.

Beth tells the group, “I see red, orange and yellow in there.”

“Mine too,” replies Jane.

“Mine has more red in it,” Suzanne notices.

Joy is thrilled with one outcome, “Oh look, there’s blue in the brown, I didn’t guess that!”

True reflection was taking place as each girl not only evaluated their own data, but compared that data with their group.

During the second lab, I had initially thought students would be able to complete it without my help. But watching for merely two minutes, I felt that I needed to intervene. Students seemed unable to begin, or if they did, started the experiment without doing the first three steps and following the directions for the set-up of the lab. So I stopped them and gave them the following directives:
"Turn the test tubes upright first and place them in order from A-F." Once all groups had completed this, I continued,
"Now look at the paragraph and read this to find out the problem and what information is given about the problem." (Steps one and two of the scientific method.)

I roamed around the room while students were doing the above, and all but one or two groups had missed both the problem and the information given. I redirected their attention to the board and we read the paragraph together and completed the first two steps together. Once completed, I instructed them to come up with a hypothesis, and start their lab. Once this was done, students were able to work through the lab successfully in pairs. I did collect and grade this lab. The class average for the graded lab was a 96.5%.

Initially, I was upset with what appeared to me to be a lack of independence on my students' part. After all, we had spent over a week reviewing each step. I had included several hands-on activities that were used to clearly demonstrate each of the first three steps of the scientific method. Why did these

students seem to have so much difficulty completing them on their own? However, now it appears that my simple dissection of the lab into direct and distinct steps was essential for all students to run through the lab smoothly.

Small Group Project

After completing the three labs, students were ready to create their own scientific method experiment. I chose to include a small group project for several reasons. In my research, I had investigated the use of including constructivist techniques, which encourage more student-directed learning. These techniques often included small group work with an open-ended direction for students to develop and create to show understanding (Applefield, Huber, & Moallem, 2000; Beston, Fellows, & Culver, 2001).

The project I designed followed the seven steps of the scientific method to solve a problem that students would pose, research about, and then develop an experiment to help solve the problem. Students would follow the seven steps of the scientific method and would present their findings orally, with a visual component summarizing the experiment and the results. In this small group project, students chose their own groups. I reminded them to choose wisely as this would be a long-term project in which the group would have to work cooperatively to complete. They were very excited about the project and quickly selected groups of 4-5 students.

I then gave them a worksheet that had brainstorming questions to help them get started. I also had project books to help with ideas to use. We talked about limitations (materials that would be unavailable, time restraints, etc.) and I tried to get them to first write down what materials they would be able to get before they started thinking about an experiment. Very few completed this part of the worksheet, something that would later prove to be a burden for me since many experiments included materials that proved a little more difficult for me to find. For the most part, students simply looked through the books and used experiments already well designed. I would try to get them to modify these experiments a little so the outcome would be a surprise. They worked very well for the entire forty-minute period. Most were able to complete the brainstorming worksheet in the time allotted.

Maria's group got on the internet rather quickly to aid them in ideas. They were all engaged and found several sites for science projects. They spent the entire period looking at these science sites looking for ideas.

Edgar's group was talking a great deal but spent most of the period being silly, coming up with very silly ideas and then giggling about them.

Erin's group worked very well at their desk, using the library and project books that were provided. They found an experiment they all liked very quickly and had a list of materials completed before the end of class.

Mike's group was very quiet, and I was a little concerned. Mike and Ike teamed up with Kit and Shannon. All but Ike are very quiet to begin with and I again wondered if letting them choose their own group was such a good idea.

On the second day of working on the project, All groups were engaged, most had their problem developed and were on the computers gathering information about their problem. One group was even developing their hypothesis.

Edgar's group was not getting much done. They were doing a lot of laughing. When I questioned them, they admitted they were stumped. They needed to do some more brainstorming, so I directed them back to the handout from Friday that had brainstorming questions and ideas.

Maria's group, which included Kathy, Katrina, Mae and Melissa, found information on the computer that contradicted their original hypothesis so they rewrote their problem. They knew they wanted to do a mouse in a maze, but they weren't sure what question they would try to answer. Like most, they put the cart before the horse and had to back up and brainstorm for a question to answer.

Ike, Kit, Shannon, and Mike were working extremely well together. They had chosen an experiment from one of the books and were working out the logistics of completing it. Ike offered, "I'll bring I the vinegar." Kit, being logical, suggests "Let's do this outside, the cork might shoot off pretty far." Mike replies, "There will probably be snow on the ground by then. Maybe we should think of

somewhere else just in case." The entire group seemed caught up in the project, which was a rare sight for me to see with Kit, Shannon and Mike, who were usually very quiet and passive in class. This was also one of the first times I had observed Ike so excited in my class. "Let see if we can do this Monday." Ike told his group, even though they were nowhere close to being ready to conduct the experiment.

Ike was not the only one excited. All of the students seemed excited and were actually getting way ahead of themselves. They wanted to do the experiment, but didn't want to collect information on the problem or come up with a hypothesis. I told them they will need to completely write out the procedure prior to completing the experiment. Some start on this once I reminded them I will need it, and a materials list. I reminded them to start bringing in materials if they planed on doing the experiment here. I also suggested that they do the experiment at home at one group member's house. This did not seem to be something that anyone wants to do. They all were planning on doing it here with me after school or during 12th period.

As soon as students started coming in on the following day, I told them we would be working in our groups and to rearrange the tables to accommodate the larger groups of 5. Ike noticed the change in the room as soon as he walked in the door, "All right, we're in our groups again."

Students found their group and got busy right away. All five groups were engaged in dialogue. Many seemed to have picked up exactly where they left off. “Now we need to start our list.” “I have two mirrors we can use.”

One group seemed so into what they were doing that several of the girls were actually sitting on the table. Sue was kneeling on her chair so that her body was across the table and Jane was lying across it. Because of her size, this seemed the only way she could see what was going on. Diane and Ann were seated close together as well, hovering over as Erin recorded the question and hypothesis for the group.

I noticed leaders emerging. Suzanne, Joy, and Beth are, unfortunately, in the same group and are all leaders, with Joy and Beth doing most of the orchestrating. Joe was the apparent leader in his group, however Edgar was also offering suggestions and keeping the group “grounded.” I was surprised, and delighted, to see some new leaders emerging from a group of well behaved, quiet girls. I had assumed that Sue or Erin would be the leader, but instead both Diane and Jane seemed to be giving directions and telling the others what to do and write. Shannon, normally so quiet, seemed to be taking the lead in her group, although perhaps by default. She asked her group, “When are we going to meet to do the experiment?” Ike reminded them, “Everyone has basketball practice after school. Let’s just bring the stuff in tomorrow and do it soon.”

Maria's group was sitting very quietly on this third day of working on the project. I noticed Kathy, surprisingly the apparent leader, was absent. I told them to at least get started in developing a problem they would like to do and start gathering information about it. They had come up with a problem but were not sure about the experiment since no one had a maze and their attempt to buy one had failed. They went on the internet to see about making one.

Ian, Royce, Alan and Edgar were laughing over silly ideas. Joe was absent and without him, the rest of the group seemed like a ship afloat with no anchor. I sat at their table and discussed the problem. It was vague and they definitely needed some help in developing a good problem to experiment on. They agreed they needed specific information about fresh water fish that would be good to use in a fish tank and Alan volunteered to get a book from the library. I told them to list behaviors they would anticipate seeing and to define what they meant by interacting. This seemed to get them back on track and with this clear goal, they managed to work fairly well for the remainder of the period.

All groups did manage to complete the project successfully. Following are samples of the finished visual part of the assignment showing overall understanding of the seven steps of the scientific method (see Figures 14,15,16, & 17).

Figure 14

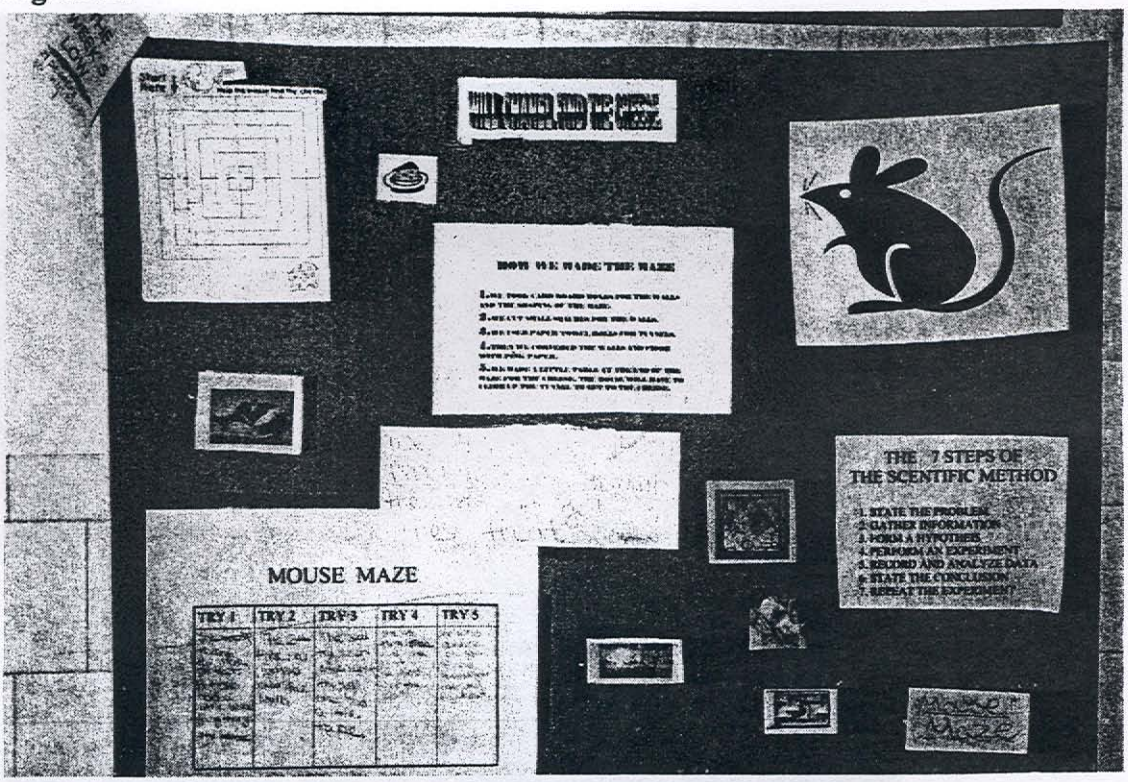


Figure 15

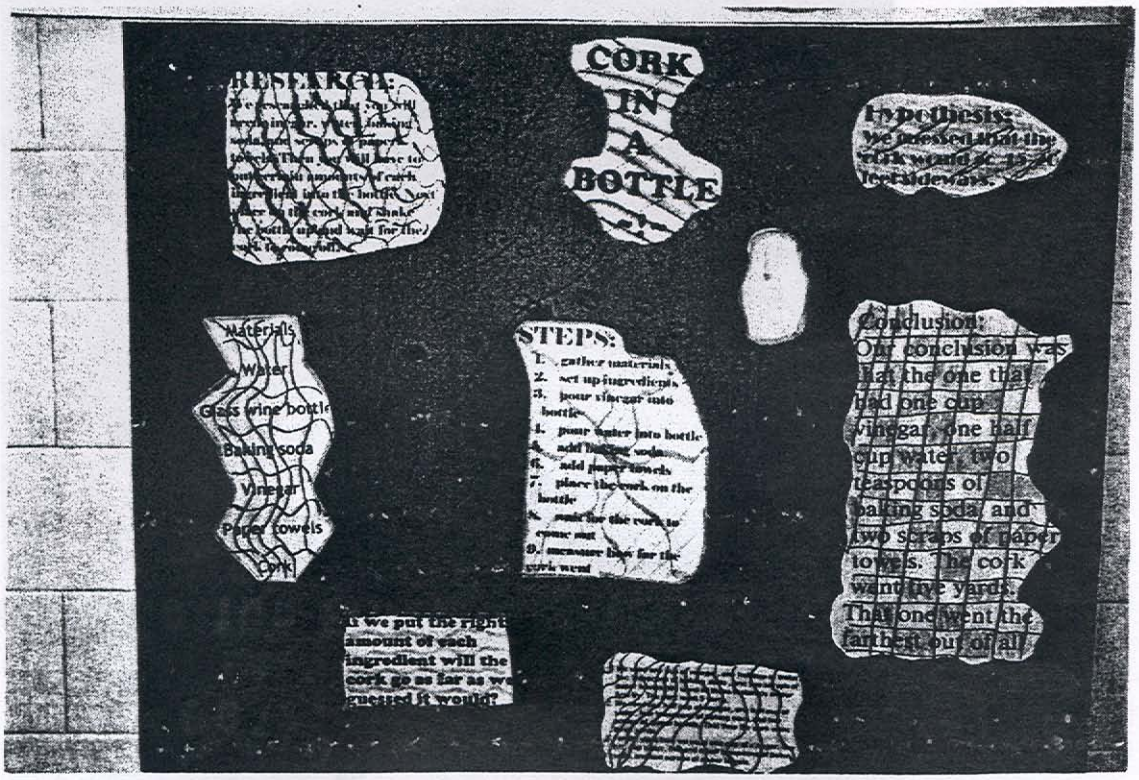


Figure 16

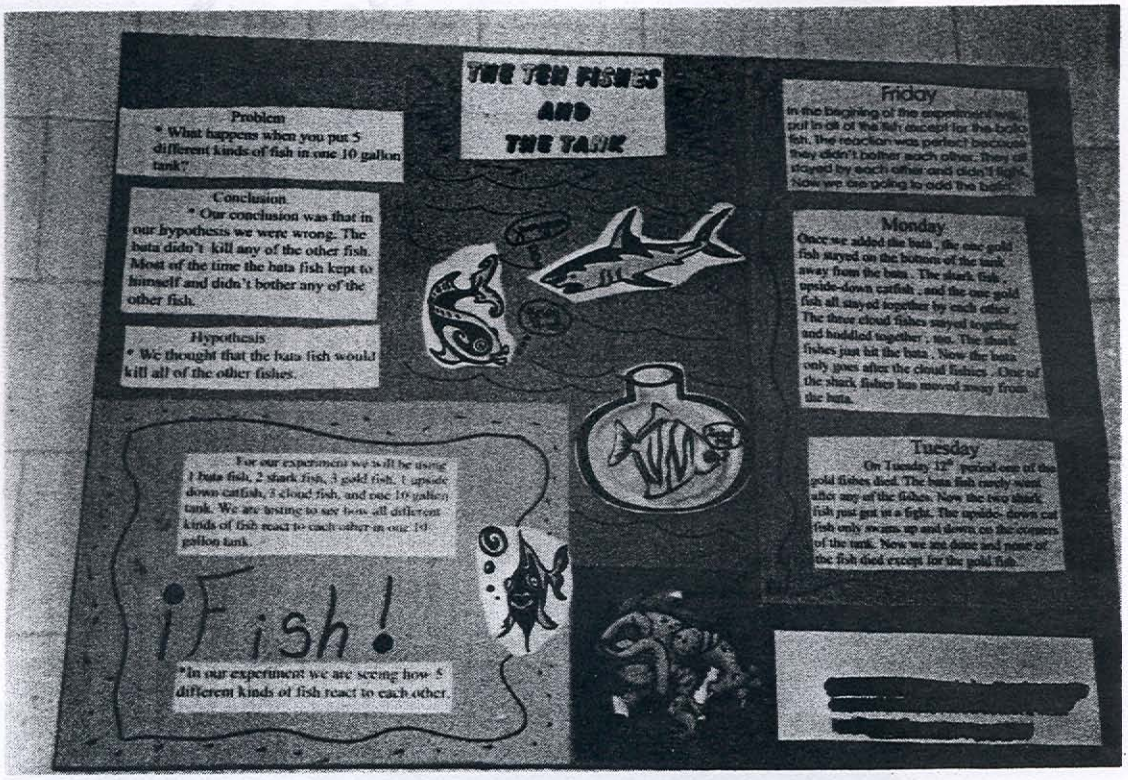
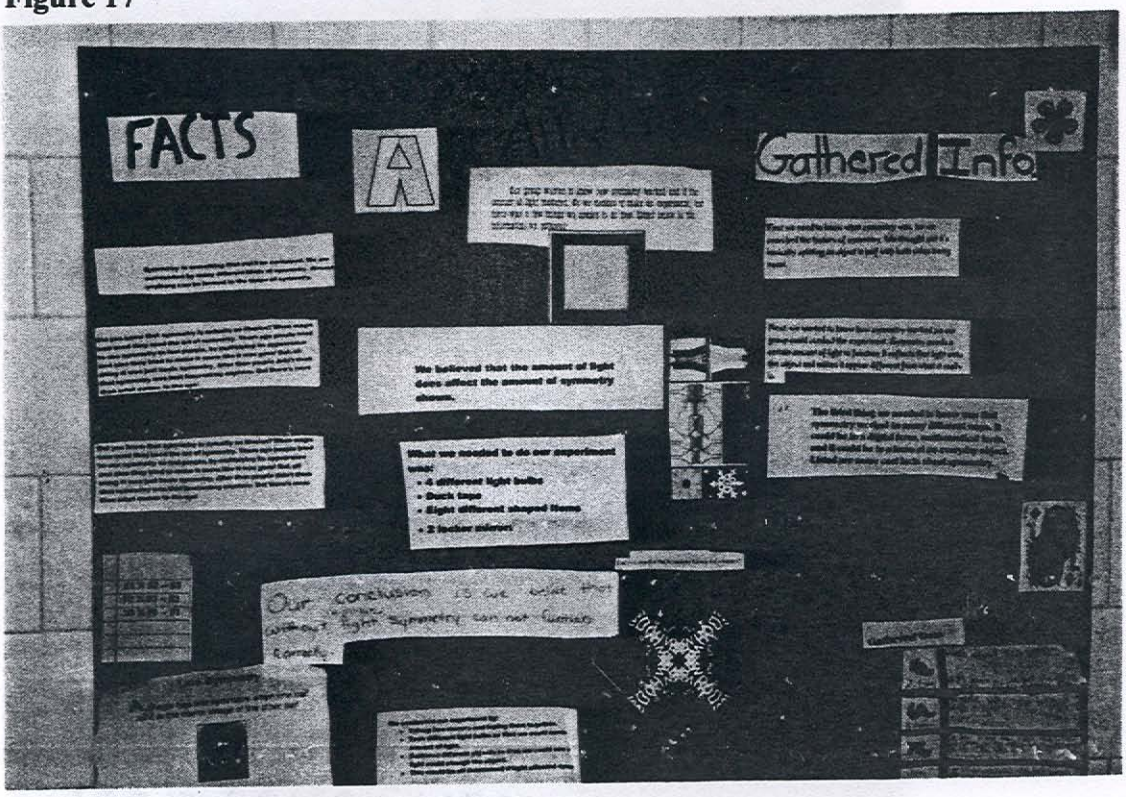


Figure 17



I wrote the following pastiche to show not only my frustration but also the students' enthusiasm in working on the small group project.

Figure 18

<u>Project Pastiche</u>

Ms. Conway, did you bring in the light bulbs?

Ms. Conway, we're ready to shoot off the cork, where should we go?

What do you mean you need a tank? The water must sit for 24 hrs. before putting in a fish!

I thought you were going to bring in the mirrors! Maybe Ms. Conway can get some.

Can we just boil the water on the hot plate? Let's use the jars themselves.

Put newspaper on the floor first to catch any vinegar or baking soda.

I think one of our fish is dead. Should we still include him in our study?

Oh No! Quick get a rag!

Is anyone hurt? OK, back away. I'll get a dustpan!!

Ms. Conway, the bell's going to ring.

Pop! Wow, did you see how far it went!

No, do not come back during study hall, We'll work on it next week…..

RESULTS

During the recording of data in my field log, I continued to code my field log identifying behaviors and outcomes exhibited by students. These included connections being made by students as well as when student dialogue and peer tutoring was taking place in the lesson. I was also looking for areas in which scaffolding or teacher assistance was required to see what was lacking or causing students trouble. Immediately I saw several codes emerging more often than others. These included social dialogue, small group learning, peer teaching, and connections. The first three were areas I was concentrating on in my study so these were the strategies that I was trying to incorporate in the first place. The connections code showed me that perhaps these methods were working.

I was concentrating on group work for several reasons. First, I felt the network of peers would help students develop a little independence from me, a step from totally teacher dependent to totally student-driven. And second, I felt that working in groups increased the opportunities for students to partake in dialogue. This dialogue, I hoped, would help students sort out questions and ideas that would aid in their own learning of a given topic. Since my social dialogue code is by far the most often used code in my field log, I felt this group work did indeed enhance student dialogue. I was thrilled to see this. I had noted early in my study my concern because less dialogue was taking place than I had anticipated. I then noticed later entries with far more social dialogue codes in

them. Perhaps, as some studies suggest (Hudson, 2002; Marinopoulos & Stavidou, 2002; Peters & Alderton, 2003; Vermette & Foote, 2001), students need practice to become competent and comfortable within their group. Did I feel their dialogue and conversations were always "on-task?" Probably not, but the ability to communicate and build a community with a group you can trust was also important, and I do feel that did happen in most of my group situations.

I recorded an increasing amount of verbal expressions during small group activities as the students continued to work together. Debate and discussion seemed to increase in all groups as the students had more practice and was observed more often with the use of short answer questions than with the knowledge based fill-in-the-blank questions, reflecting similar results found by Peters and Alderton (2003).

Clearly, the development of dialogue within a group is contingent on group members, and even when groups are conducive to dialogue, dialogue takes time to develop, as relationships develop between members. Because of this, I had allowed my students to choose their own groups, hoping they would indeed choose students who they liked, trusted, and felt comfortable with. I also wanted them to have time to develop good group dynamics so I wanted them to work, for the most part, with the same group each time we did group work. The downside of this was that each group did not always include a leader or member who was proficient enough to steer the conversation and debate in the right direction.

Eventually however, all groups succeeded to some extent, the lowest grade in the group project was a 83%, so leaders did eventually emerge.

I did see peer-tutoring going on throughout the study. I began noticing this peer tutoring taking place every time we had group work or labs or activities. I was thrilled to see this happening so much more as I continued to observe. I felt this was a very important code in student-directed learning since the two are so closely linked. Observing peer tutoring in action, and seeing the importance for it in individual students in particular, convinced me of its importance. Every time it is listed in my field log, we were completing a hands-on activity where my attention was often divided between twenty-four other students. Because of this, I was less available to each individual group of students at any one time. Peer tutoring thus developed naturally with some students and filled in the gaps for many others.

One such student who was observed demonstrated peer tutoring often was Suzanne. Suzanne is studious and academically one of the best students on the entire team. She is friendly and is often chosen for a partner by many of the students when given the choice. She is often seen assisting another student at her table who is often absent and relies on Suzanne to "catch her up." This student struggles academically, but does better, I am convinced, because of Suzanne's help. It is this type of student who can offer so much, especially to her peers, during group and partner work. She is often one of the first to make connections

and pose answers based on past experiences and reflective practices. These are excellent traits to model to other students who are not as proficient in these areas.

Perhaps Vygotsky put it best with his reflection on peer tutoring, “what children can do with the assistance of others might be in some sense even more indicative of their mental development than what they can do alone” (1978, p. 85). “Using imitation, children are capable of doing much more in collective activity or under the guidance of adults” (p.116). With only one adult present in the classroom, this scaffolding device falls on the shoulders of the more capable students with great success. Student learning is taking place in both students as verbal communication enhances student understanding. I also believe most students enjoy small group activities because of the verbal exchanges that inevitably take place. In the first student survey, twenty students out of twenty-two stated they preferred working in groups. Most cited completing the assignment more quickly as one of the reasons; many others cited the ability to get help on something you are unsure about.

“If you are having trouble with a problem the rest of the group will help you.”

“If you don’t know an answer, you can get help from your group.” Still others cited the ability to talk and discuss the question with their peers as an important reason for working in groups;

“You can share your ideas with others.”

"You have more people to help explain things."

"It helps you understand it much better and talking it over."

One student even commented on the ability to get to know others in her group better and the importance of listening:

"You get to listen to other people's opinion and you get to know that person better."

I saw first hand my students' enthusiasm when they were "allowed" to discuss and talk with each other. I, too, am social, so this vocal discourse was not disturbing for me. I have found however, that because my students have been able to "indulge" in social dialogue more often, they have become more effective and less noisy than one might expect. Perhaps it is just that students see it as more of a regular part of class now, since we work so often in small groups. We also did many activities in which discussion was encouraged. Either way, I enjoyed the social dialogue and knew that discussion was essential to my teaching and could not imagine any other way of doing it. The students seem to enjoy the stories I told, and enjoyed telling their own and hearing those of their classmates.

Initially, group discussions were minimal in the small groups, even when students selected their own groups. I found that student dialogue may not always occur naturally but can be promoted through small group activities and guided practice, which proved to promote more student dialogue and discussions over time. I also feel that this increased student dialogue and the sharing of stories that

my students engaged in helped to develop a climate of cooperation in the classroom. Students worked well together, regardless of the group they ended up in. I encountered very few, if any, personality conflicts this year in this class as a result, I believe, of their close interpersonal contact. They seemed to have enjoyed getting to know one another better and helping each other out. This alone has made the action research so very valuable, regardless of the other benefits I felt were gained.

The challenge with utilizing social dialogue and discussion is to keep students on track. I found by roaming through the room and stopping at each group to “eavesdrop,” I could more accurately assess when students were on task and when they were not, redirecting groups when needed. This seemed to work well for me. I also found, at times, I needed to select groups rather than always letting students decide. It depended on the activity and the expected outcome I was trying to achieve.

The connections code was also a code I had used more than others. I was trying to observe when connections were taking place to see if a pattern was developing. Four occurred during microscope labs, and the other four while we were out in the environmental center or at Merrill Creek. All of these activities constituted “authentic learning” as well so I feel I can safely associate these two together. It certainly makes sense and follows much of the research I have read

(Dewey 1997; Marinopoulos & Stavidou, 2002). No other place in my field log had I recorded connections being made other than in the student journal entries.

Some of these connections were made in the environmental center. One student wrote, after noticing the squirrel climbing the wall that, “they must have good claws.” Upon noticing the thick black stripe of a wholly-bear caterpillar, a student predicted a long winter. In the journal entries following the microscope labs, one student noticed the similarity between the planarians we were looking at and the leeches she was familiar with and decided, “they must be related.” Another student noted the same thing, saying she had seen planarian in the creek near her house and thought they were small leeches. “Now I know what they really are.”

The student reflection was such a big part of my study, but an area that proved difficult to witness. I do have pieces of student work from their journals that showed reflection was taking place by individual students. Four of these entries were following the field trip to Merrill Creek. Several students were wondering how water bugs float. One wondered what the reservoir and creek would look like in winter. Erin discovered that fawns are covered in dots, by viewing it up close. During the fall observations in the environmental center, Joe noticed that “the grass was frail, like it didn’t have that green lush it usually has.” Another student wondered about the bugs that might crawl on her while she was watching television at night, following our video on microorganisms. Certainly

they had spent some time reflecting on the various activities which was, after all, the purpose of the journal. I had expected to see more of these connections and evidence of reflection, but part of this could be attributed to the lack of writing experiences I gave for the students. There were only six entries assigned, spaced out over about three months. For some, this was also their first try at keeping a journal. I have seen consistent improvement in student journal entries and feel that practice and comfort over time will enhance all students' writing and reflecting over time. More consistency on my part would probably enhance these improvements even more quickly.

The overall assessment average for the scientific method project was the highest of all but one of the unit test assessment averages (see Table 1). With an average of 89%, this was the students' second to highest score for the semester, since projects are weighted equal to tests. The lowest grade was Ike's 83%, who was graded less by his peers for his overall contribution to the group. The two groups that received 91% and a 96% were by far the two groups that consistently worked well together and seemed to engage in the most dialogue, Jane's group and Suzanne's group.

Table 1

ASSESSMENT	CLASS AVERAGE	NUMBER OF SMALL GROUP ACTIVITIES
Microscope Unit	**91%**	**10**
Scientific Method Unit	**72%**	**5**
Scientific Method Project	**89%**	**Entire Project 3 days in class, 4-5 days on their own**
Biome Unit	**69%**	**2**

The only unit test with a higher average was the microscope unit. It is interesting to note that the microscope unit included ten days of hands-on activities; all of these were labs in which students worked individually, but were encouraged to work with their group as well and shared microscopes often. The average for this unit test was a 90.5%, by far the highest average. It was one of the longest units as well, with a great deal of new vocabulary words. The scientific method unit test average was only a 72.3% even though five days were spent on hands-on group activities, again mostly labs. In addition, students had been taught the scientific method numerous times before, as it is part of the fourth and fifth grade curriculum. The biome unit test, which included limited group activities, was the lowest average with a 69%. These unit tests and project averages implied that small group hands-on activities could indeed enrich student understanding. I firmly believe that the interaction the students were able to partake in contributed

to their academic success. I have often thought how I could change the biome unit to include more interaction, and it seems clear to me now that this is something I will need to work on to increase student success in the future.

In the scientific method project, better development of the experiment prior to performing it independently was something that needed to be done. Clearly the students enjoyed the opportunity to try something they wanted to do, but this excitement often meant that students were not well prepared to perform the experiment when the time came. I definitely needed some sort of checklist for each group, developed around their experiment to initiate more independence by the students. This would have allowed my student groups to continue more independently and to fully complete each step before going on. I did provide them with a rubric (see Appendix E), that both they and I had created, and thought this would act as their checklist but it was not specific enough for each individual group. Because of this, I found the time and organization required by me to be overwhelming and was glad only two of my five classes were participating in this small group project.

In addition to coding and looking at the themes emerging from my field log and student work, I used an analysis of figurative language used by the students and myself to get a better idea of underlying problems or concerns. Many entries include language that showed my frustration at students' inability to perform tasks more independently. Often I was making them take on this

responsibility whether they wanted to or not. It seemed I felt that they were either not willing or not able to make this transition from teacher-directed to student-directed lessons easily, since the words I used were strong, and often negative. I did notice however, that any time I had a more student-directed lesson that went well, at least by my perception, I saw more positive language being used.

Perhaps with more clear and distinct directions, students will have a better chance of completing labs and activities more independently, thereby reducing my frustration. For projects, a better checklist with clear and specific goals should be included to again, reduce the strain on me. Asking for more parent involvement would have also made the small group projects run more efficiently.

I found myself conveying frustration, at times, with my students' inability to question, discuss, debate and determine an answer when working. They were still checking with me to see if they were correct or writing down whatever the first person suggested was right. Very little dialogue concerning the correct answer was seen, at least in most of the groups. This did improve over time and when more open-ended questions were used by me to facilitate discussion.

I also saw evidence of my frustration in the lack of student involvement in general. I noticed this in both student-directed and teacher-directed lessons. This worried me because for students to do well in student-directed activities, they need to be involved in their group and the group-making decisions. Hopefully,

with time and practice, students will feel more confident to speak up and question one another.

I wanted my students to achieve goals that had been identified by them, by me and/or by the district. I wanted them to achieve these goals so much – probably more than many of them wanted for themselves. Perhaps if I let up a little, this motivation will become intrinsic as students start to direct their own course of study and develop that excitement on their own. I believe that is the heart of student-directed learning.

REFLECTION FOR FUTURE STUDY

I feel by far the most successful part of my study was seeing the benefits of small group work. The amount of peer-tutoring that naturally occurred enhanced student learning and the overall community of the classroom. I truly felt the climate of this class was made as positive as it was by the bonds that naturally developed during these group activities. I did feel that choice was not always the best option for small groups, and have since started assigning partners and groups more often because of it. Early in the year however, I felt it may have helped some students to work with a student of their choice as they got to know other classmates better.

Spencer Kagan (1994), an authority on cooperative learning, offered several options when establishing groups. His preferred choice, for most activities, was the ranking method. For this method, students are ranked from the highest to the lowest achievers. Groups are then formed by placing one high achiever and one low achiever, along with two-three middle achieving students together. (He suggests that groups should never be less than four students.) This method is intended to keep each group balanced.

Another way offered by Kagan (1994) was the sociometric approach. Here students pick 2-3 students they would like to work with and then groups are formed insuring at least one of the chosen students are included for each child.

The last suggestion made by Kagan, and the least supported method, was the random assignment of groups. Here students pick a number and partners or groups are assigned according to the numbers. I did use this method on several occasions as well, but only for impromptu discussions or debates and not for any long term projects or assignments.

Of the three methods discussed by Kagan, I feel the sociometric approach is one I will tend to utilize more in the future, based on my desired outcomes of establishing trust. With this method, I can have some control over making sure groups are balanced, but still allow for some aspect of choice.

I could encourage more student dialogue by being more specific perhaps about outcomes I wish to see. I may have to develop a type of “exit slip” where groups need to show evidence of what was discussed during the activity. Making them responsible for actually contributing as well might better enhance verbal communication. Perhaps all group names placed on the exit slip with whatever contributions were made - whether they be questions posed, answers explained, or reflection of material - might help to promote equal contribution of group members, which was mentioned by many in the survey to be a problem with working in groups.

I felt I could use this group dialogue and sharing more in the biome unit. I tried it to encourage this when students recorded notes this year. Instead of an overhead transparency for students to copy, I placed copies of my notes at the

tables, and students copied them at their seats. I told them to discuss the climate, plants, and animals with their groups, clarifying those that students were unsure about. I included pictures as well for students to use and pass around, again, hoping to instigate discussion. However, very little discussion took place. Students seem to rush through copying their notes and then talked about anything other than science. Once all students were finished, I would go over plants and animals briefly to clarify any misunderstandings. Making each group member ask one question about the biome - its climate or plants and animals - and write it down for a group exit slip might be one way to encourage more involvement.

With the journal writing and reading, the question of time became a problem for me. I often felt my students were not getting the full benefit of the journal writing because we didn't have time to go back and discuss what they had written. I had also intended to allow for group discussions before and after the journal writing, which did not happen as often as I had hoped for. I also did not have time to comment and create a dialogue between the students and myself to the extent that I had envisioned. These are all areas I would like to work to incorporate into the journal writing experience.

One idea I had for addressing this problem was having students, either in pairs or small groups, read one another's journal entries. Since most of the journal prompts were content based, I do not believe students would object to this suggestion. And if given the choice of whom to collaborate with, they would

enjoy sharing their stories and summaries of the activities with one another. This would free up time for me and would allow me to assign more prompts to increase writing and reflecting by my students.

I was also unable to include all of the journal entries I had intended. It seemed very difficult to include the writing as much as I had hoped. This made students feel a little lax about the journal writing in general. And since two or three entries counted as one ten point homework assignment, there seemed to be less motivation about getting it done. In fact several students completed only one or two entries the entire semester, and one student did none of them and had a grade of incomplete.

Although I had some difficulties in utilizing group projects in my classroom, from the students'standpoint, it was clearly the best part of the study. They loved the truly student-directed nature of the project, with research and discussion included to come up with a problem that they were interested in. The three or four weeks that students were completing their group experiments was hectic for me but were the weeks that my students were most excited about. In the future, to avoid the overload of responsibilities onto me, I will need to ask for assistance from parents and to include an individualized checklist ensuring successful completion of each step prior to moving on. This might also help in ensuring equal division of labor, as many students cited the lack of this in their group during the project activities. (Part of the rubric however did address this

problem with a group member report card filled out by each individual who graded the rest of their group. This grade was factored into the overall project grade so not every group member received the same grade.)

I was hoping that the incorporation of many of these ideas and activities would result in me talking less and students more, which would allow me to facilitate and observe, assessing student achievement more accurately. This is exactly what happened. I was able to conference more one-on-one within the groups, allowing me to get to know individual students better. I think student-directed lessons are more refreshing and rewarding overall, which helped in keeping my teaching fresh and more enjoyable for me, and in turn, more successful for my students.

I believe my students also gained much from this study and the incorporation of these activities. They had less note-taking, which most of my students already loathed. In addition, students were able to engage in dialogue more, something my students seem to naturally love. They were given time to reflect, record, and analyze activities and articles to enhance their understanding of major concepts, increasing their understanding. Consequently, I was better able to assess their understanding, allowing me to decide whether further instruction was needed. All in all, I will continue to utilize these student-directed activities in my classroom, and look for additional lessons that I can enhance by following these same practices.

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APPENDIXES

Appendix A: Small Group Project Rubric

Rubric for Written Portion and Oral Presentation for the Scientific Method Group Project

For Written Portion: (10 pts. Total)

1. Problem stated in question form (1)
2. Information collected (1)
   - Just include information that helped you design your experiment
3. Hypothesis stated (1)
4. Experiment explained (2)
   - Include material list
   - Include procedure in a step format
   - Include pictures if you have them of your group performing the experiment
5. Data collected (2)
   - Include observations in a table or graph or paragraph
   - Include pictures of results if you have them
   - Include final product if there is one
6. Conclusion (1)
   - Conclusion should be a statement that answers the question posed in the problem portion.
7. If you were able to repeat the experiment, include these results as well.

**Neatness will also be included in the grade of the written portion. (2)

Oral Portion (10 pts. Total)

All steps above will be required in the oral presentation. Each step will be worth one pt. Explanation of the experiment and the Data collected will be 2pts. each. Overall preparedness of the group presentation will be 2 pts.

In addition, team members will rate each other individually using a 3(worked great), 2 (worked ok), or 1 (worked very little), based on effort and time worked on the project. I will average this number and add it into the total, therefore the total pts. will be 23 pts. and the following grade will apply for the following pts.:

23	100%	21	91%	19	83%	17	74%
22	96%	20	87%	18	78%	16	70%

Appendix B: Observation Sheet

Observation Date: _____

Lesson: _____

Who	Action	Interpretation	Reflection

Appendix C: Small Group Interview

Group Names: _____

1. In completing the microscope labs, did you need more teacher involvement or were you happy to work at your own pace? Explain.

2. Did you think working in your small groups helped you in any way when working with the microscope? How?

3. How could I increase group involvement and discussion?

4. What could be done differently to assist you with these labs?

Appendix D: Student Survey I

Student Survey

Please answer the following questions as honestly as possible. Thank you for your participation. Writing your name on the form is optional but would be more helpful for me.

1. Do you like writing in your journal? Why or why not?

2. Do you prefer working in groups to complete tasks like review sheets and worksheets? Why or why not?

3. What things could be done to help keep you on track when working in groups?

4. In completing the first four biomes, you copied notes at your table with your group rather than completing notes with the teacher using the overhead. Which method do you prefer? What makes this one work better for you? Any suggestions on improving either method?

5. When completing your notes with your group, did your group discuss the notes as you recorded them? Did you ask each other questions concerning the notes to help you understand them better?

Appendix E: Student Survey II
Student Survey

Please answer the following questions as honestly as possible. Thank you for your participation. Writing your name on the form is optional but would be more helpful for me.

1. How did you like working as a group in this project? What are your feelings about working in a small group in general? (What do you like about it, what don't you like about it?)

2. What are some of the difficulties your particular small group encountered?

3. What else could be done to insure a more equal participation from everyone?

4. Did you like presenting your results to the class? Why or why not?

5. You were graded on both the written, or poster, as well as the oral presentation. Was this a good thing? Why or why not?

Appendix F: HSIRB Approval Letter

September 17, 2004

Jennifer Conway-Ianacone
PO Box 742
Plumsteadville, PA 18949

conwayj@sd.org

Dear Jennifer Conway-Ianacone,

The Moravian College Human Subjects Internal Review Board approved your proposal: Student directed learning in the middle school environmental science classroom. Given the materials submitted, your proposal received an expedited review. A copy of your proposal will remain with the HSIRB Chair.

Please note the phones numbers you have on your Informed Consents for Dr. Shosh may be incorrect.

Please notes that IV. 13 indicates that the Principal can be contacted re the research; yet the Principals's IC does not include anything about being contacted.

Should any other aspect of your research change or extend past one year of the date of this letter, you must file those changes or extensions with the HSIRB before implementation.

This letter will be e-mailed and snail-md to you. Best of luck with your research.

Jame@rnes

Chair, Human Subjects Internal Review Board
Moravian College
610-861-1672 (voice)
610-861-1657 (FAX)
barnesj @moravian.edu

1200 MAIN STREET • BETHLEHEM,
PENNSYLVANIA 18018-6650 • (610) 861-1300

Appendix G: Parent Letter

September 8, 2004

Dear Parents and Guardians,

As part of my graduate program at Moravian College in Bethlehem, I will be completing an action research project on student-directed learning in the science classroom. I will be developing activities that should encourage more student independent inquiry including journal ' writing, small group discussions and labs, computer technology, a small-group project and a portfolio. These activities will be part of the overall Environmental Science curriculum and will be used in all of my classes. The benefits of the study should be great since students will be taught using diverse instruction and assessment modes, ensuring greater success for more students than one might find in a more traditional setting. For data collection purposes, I will monitor your child's class for student progress utilizing these activities and will include student interviews and surveys, student grades on the various projects, labs and other assessments, as--'" , well as teacher participant observations.

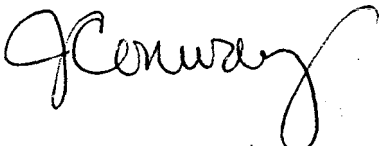
The research study will begin September 1 3,2004 and conclude December 22, 2004. The research will take place during their regularly scheduled sixth grade environmental science class.` Students will be given the option to participate in the study and will not be penalized in any way
if they do not. Students may withdraw from the study at any time. If you or your child chooses not to participate, the strategies used in the classroom will still be in place, but any information pertaining to your child would not be used in my study.

All of the children's names will be kept confidential. Neither your child's name, nor the name of any student, faculty member, or cooperating institution will appear in any written report or publication of the study or its findings. Minor details of the student's writing may be altered
to ensure confidentiality and all of the research material will be secured in a protected location at my home and the data destroyed at the conclusion of the research study..

My faculty sponser is Dr. Joseph Shosh. He can be contacted at Moravian College by phone aor email at jshosh@moravian.edu. PrincipalijIlIlligglJOW has approved my study and may be reached by phone **atemplow**

If you have any questions or concerns about my in-class project, I would be more than happy to talk with you about it. I can be reached at~~ or by e-mail at . If not, please sign and return the second page containing the consent form and return it to school as soon as possible. Thank you so much for your help.

Sincerely,



Ms. Jen Conway
6th grade Environmental Science Teacher

Appendix H: Principal Letter

April 20, 2004

To Whom It May Concern:

I give my consent for Jennifer Conway to conduct an action research study in her classroom. I have reviewed the proposal of the study and understand it is supported by educational literature and is required by Moravian College for the completion of Ms. Conway's master's degree in Education. I understand that consent for the study will be obtained from all students who are participating and that participation is optional and students can withdraw from the study at any time without academic repercussion. I understand that pseudonyms will be used for all participants to protect student identification and the data collected by Ms. Conway, including surveys and interviews completed by the students, will be kept confidentially in Ms. Conway's home and will be destroyed upon completion of the study.

The study will include the incorporation of student-directed learning activities including reading and writing in journals, working in small groups, taking part in small group discussions and debates and completing a small group project. The use of technology will also be utilized and students will be guided in these practices by use of checklists, charts and rubrics. Student experiences will be documented through the use of teacher observations, surveys and interviews. Clarification of analysis of these observations and interviews will be done through student-teacher conferencing.

It is my understanding that any questions regarding this research should be directed to Ms. Conway at _____ or at _____ .
Ms. Conway's college advisor, Dr. Joseph Shosh, can be reached at 610-861014 or at shosh@.moravian.edu to answer questions as well.

Sincerely,

Mr.

Principal,

Appendix I: Journal Prompts

9/13/04 Environmental Center- Summer Observations
Write about your observations of summer that you observed in the environmental center. What does summer look like, smell like, feel like etc. Include details and specifics.

9/15/04 118 Green St. Video Reflection
Reflect upon the micro world that you saw in the video. What new organisms did you discover after watching this video? Were you surprised to discover so many microorganisms in your world? Is this a good thing or a bad thing? Explain.

9/28/04 Binocular Microscope Lab
What kind of detail did the binocular microscope allow you to see in the numerous specimens that we viewed over the past few days. Reflect and write about these specimens. Which were your favorite? Why? Describe and draw some of them.

10/08/04 Pond Organisms
Think about the many pond organisms you observed over the past few days. How did they move? What color were they? Be descriptive. Draw your favorites.

10/20/04 Merrill Creek Reservoir Field Trip
What benefits did you get from the field trip? What did you learn? What did you see? Reflect and write about your experience.

11/12/04 Environmental Center - Fall Observations
Write about your observations of summer that you observed in the environmental center. What does summer look like, smell like, feel like etc. Include details and specifics.

12/10/04 Deciduous Forest
Describe the deciduous forest to someone who has never seen it. Use your summer and fall observations and journal entries to reflect on the changes that occur in this biome due to the changing seasons. Reflect on our trip to Merrill Creek and recall the deciduous forest that we walked through. Include your own experiences with the deciduous forest.