DOCUMENT RESUME

ED 443 707 SE 063 898

AUTHOR	Bennett, Julie McLean
TITLE	Students Learning Science through Collaborative Discussions on Current Events in Science.
PUB DATE	1999-00-00
NOTE	19p.; Paper presented at the Annual Meeting of the National Association for Research in Science Teaching (Boston, MA, March 28-31, 1999).
PUB TYPE	Reports - Research (143) -- Speeches/Meeting Papers (150)
EDRS PRICE	MF01/PC01 Plus Postage.
DESCRIPTORS	*Constructivism (Learning); Current Events; Epistemology; Experiential Learning; Graduate Study; Higher Education; Primary Education; *Science and Society; Sciences; Social Sciences; Student Attitudes; *Teacher Role; Technology
IDENTIFIERS	Conceptual Change; Science Technology and Society Courses

ABSTRACT

After participating in a graduate level Science, Technology, and Society course, a third grade teacher utilized constructivist approaches with her students to foster life-long learning. The focus of this paper is how students searched for patterns while participating in collaborative discussions focused on current events in science. The tools in both the graduate level and elementary school classrooms included student-selected newspaper and magazine articles on science topics, follow-up internet searches, and current event summaries. After students presented their learning, collaborative classroom discussions took place with students looking for patterns in their learning while they recorded reflections in their science journals. The teacher used qualitative research methods in an attempt to reveal students' construction of knowledge and to solidify her own role as facilitator in the learning process. Results suggest that students view learning as more valuable when the teacher seeks out students' ideas. The students' experiences and interests drive the lessons with students seeking resources and information to solve real world problems. These practices are instrumental in cultivating learning that extends beyond the classroom walls. (Contains 32 references.) (Author/YDS)

Students Learning Science through Collaborative Discussions on Current Events in Science

Julie McLean Bennett

Department of Curriculum & Instruction

Florida State University

Tallahassee, FL 32306-3032

and

William Lehman Elementary School

10990 Southwest 113 Place

Miami, FL 33176

bennej@wmlehman.dade.k12.fl.us

This paper was presented at the annual meeting of the National Association for Research in Science Teaching in Boston, MA on 31 March 1999.

Abstract

After participating in a graduate level *Science, Technology and Society* course, a third grade teacher utilized constructivist approaches with her students to foster life-long learning. The focus of this paper is how students searched for patterns while participating in collaborative discussions focused on current events in science. The tools in both the graduate level and elementary school classrooms included student-selected newspaper and magazine articles on science topics, follow-up internet searches, and current event summaries. After students presented their learning, collaborative classroom discussions took place with students looking for patterns in their learning while they recorded reflections in their science journals. The teacher used qualitative research methods in an attempt to reveal studentsí construction of knowledge and to solidify her own role as facilitator in the learning process. Results suggest that students view learning as more valuable when the teacher seeks out studentsí ideas. The studentsí experiences and interests drive the lessons with students seeking resources and information to solve real world problems. These practices are instrumental in cultivating learning that extends beyond the classroom walls.

Introduction

What we want is to see the child in pursuit of knowledge,

and not knowledge in pursuit of the child.

-George Bernard Shaw

The purpose of this study was to address the following questions:

-How do students talk about science?

-What questions do the students have about the world around them?

-If given the opportunity for class discussions on science current events, will a productive discourse occur?

-What patterns or themes emerge as the students co-construct knowledge?

-What can be learned from these collaborative discussions about the way students think about science?

"Talk" is at the heart of this endeavor. The research began with overcoming my own fear of talking with fellow graduate students in my *Science, Technology & Society* class. Each Tuesday, armed with the *Science Times* section of the *New York Times* , the class gathered for discussions on the vast array of topics that appeared on the written pages before us. Before the first class, I doubted that I was qualified to participate in such scientific discussions. I believed that I possessed no prior experience or knowledge to share on some of the topics. As the first discussion developed, I quickly realized the true "power of talk." The power came from being able to collectively "talk science" in ways that connected to our own first-hand experiences and to our lives outside of that classroom. Building on each otherís questions and emerging theories we evolved from a community of individual learners into a discourse community (Tobin, 1993). After participating in this summer course, I realized that I had the necessary tools to facilitate similar talks in my own third grade classroom by using current events to integrate science and language arts.

Rationale

Learning science can sometimes be a frustrating process if children are asked to accept what they are told about how the world works without considering how the new information may fit into their prior knowledge and experiences. Conflict can arise when, in some instances, new knowledge does not match what is currently believed. According to Bonnie Shapiro:

When we teach science, we are asking learners to accept something more than

scientifically verified ideas. We are asking them to accept initiation into a particular way of

seeing and explaining the world and to step around their own meanings and personal

understandings of phenomena into a world of publicly accepted ideas (1994, p. xiii).

I am intrigued by the meanings and personal understandings that my students bring into the classroom. In this study I wanted to discover what ideas my students already had about science and how they communicated them to each other. The broad question to be answered at the start of this research was "How do children talk about science?".

The Study

All students in the class were asked to choose a current event on any topic relating to science. The intent of having the student self-select an article was to allow the teacher to move away from the traditional positivist role of "provider of information" and become the "provider of opportunities" for students to gather their own information (Anderson, 1996). This practice allowed curriculum to become more of a collaborative effort between the teacher and students.

After reading a current event from a newspaper article, magazine article, or internet site students were asked to prepare a short presentation which included three facts restated in their own words as well as their opinion of the entire article (see Appendixes A and B). On an assigned day, each student was asked to present his/her learning to the class. While students listened to the presentation, they recorded their thoughts and feelings in their own "wonder journals." Students were asked to record reflections by answering two questions: 1) What did I learn (from the presentation)? and 2) What do I wonder about? (questions for further study). Students were asked to share excerpts from their journals as the teacher facilitated a class discussion based on studentsí ideas and wonderings. These journals provided "an opportunity to access and assess changes in childrenís understandings and thinking, identify misconceptions, and provide a more complete picture of childrenís understandings of science phenomena" (Shepardson & Britsch, 1997, p. 13).

Because learning depends on the shared experiences of students, peers, and the teacher, we held collaborative discussions which were centered around the studentsí reflections from their journals (Schulte, 1996). These collaborative discussions allowed the students to talk about their ideas, develop them logically and reach some understanding of the process of science and the way real scientists work (Simpson, 1997). These discussions became known as science talks, which the children anticipated eagerly.

During science talks the students were able to learn from other students, recognize contradictions between their own and other studentsí perspectives, and construct new understandings by internalizing problem solving strategies that were created together jointly (Webb, Troper, & Fall, 1995). By encouraging students to share thoughts, ideas, and questions freely with each other, without teacher direction or interference, the languages of the child and of science melded together to create a scientific discourse. Children were able to "talk science" in ways that connected to their own experiences, to each otherís learning, and to their lives outside of school (Tobin, 1993). On several occasions, students were motivated by a specific science talk to conduct follow-up internet searches on the topic in order to clarify questions that resulted from the talk. This independent research was then brought back and shared with the entire class.

These presentations and science talks were videotaped and transcribed. After a series of science talks had occurred, the transcripts were analyzed in an effort to identify repeating patterns occurring throughout the science talks. After recording my interpretations of patterns, they were shared with the whole group to see if all stakeholdersí views had been accurately recorded and interpreted (Guba & Lincoln, 1989).

Theoretical Framework

All too often science teaching can create harmful attitudes toward science by contributing to the "mystique of science" (Lemke, 1993, p. 129). According to Lemke, the "styles of discourse in which teachers normally presented the thematic relations of a science topic, and which they themselves had picked up in their own training in science, are dehumanized and dogmatic" (1989, p. 33). In most classrooms, science is not portrayed as something "that real people do"; moreover, "the ëhumannessí of science disappears from view" as the "language of people doing, saying, and deciding" is replaced with " the languages of ëit is...í íí(Lemke, 1989, p. 33). According to Easley, elementary science teachers often "unconsciously imitate the authoritarian approach of scientists when they teach" (1990, p. 62). Easley notes that teachers attempt to "overcome the conceptual confusion of most of their students by leaning on authority, striving to give error-free lectures and exacting examinations" (1990, p. 62).

The way we speak about science in the classroom can result in the alienation of students. Knowledge needs to be co-constructed through interactions in which students and the teacher communicate verbally using a shared language (Tobin, 1993). Allowing students to use scientific language for themselves will allow them to "gain a stronger identity as scientific thinkers" and to "value their role as thinkers and knowers" (Gallas, 1994, p. 77). Teachers can improve instruction by "promoting pupilsí creative and critical thinking about their environment and sensitively studying ways to promote that kind of thinking in all the children in their classrooms" (Easley, 1990, p. 63). Collaborative discussions, known as science talks, allow opportunities for students to take an active role in their own learning. Students "begin to bring their world of experience to the classroom in the form of personal narratives and important questions, realizing as they do that what they observe, wonder, and imagine has importance in a science classroom" (Gallas, 1995, p. 3). Learning is facilitated through discourse as students "talk science" in ways that connect to their personal experiences, studies, and lives outside of school (Tobin, 1993).

When students enter into a dialogue together on important science issues in todayís society, they realize that they have much to offer and learn from each otherís experiences. Taking a *Science, Technology, and Society* approach, using current events as a springboard can help students to become scientifically literate by encouraging their ability to read about, comprehend, and express an opinion on scientific matters while continuing to develop an understanding of science concepts (Driver & Leach, 1993).

The predominate school of thought that shaped this research was constructivism. Constructivists believe that in order to understand how learning occurs in the classroom, we must first consider what experiences the learner brings with him/her (Brooks & Brooks, 1993; Tobin & Tippins, 1993; von Glasersfeld, 1996). These experiences are often referred to as prior constructions. According to von Glasersfeld, "whatever things we know, we know only insofar as we have constructed them as relatively viable permanent entities in our conceptual world" (1996, p. 19). A general constructivist belief is that each time a child is to learn something new, he/she must construct it through prior experiences, knowledge, and beliefs which already hold meaning for him/her.

In contrast to this philosophy is the objectivist view of knowledge. Objectivists seek to transmit knowledge from experts to students because their knowledge is closer to reality than the studentsí knowledge (Davis, 1993). While the traditional objectivist teacher views students as "blank slates" that need to be filled with information, the constructivist teacher views students as thinkers with emerging theories about the world (Anderson, 1996).

There is also a vast difference in the objectivist and constructivist view of the learnerís role. Constructivists view the students as active learners. These active learners make sense of the world by constructing meanings and linking new information with past experience (Thijs, 1992). In a classroom where objectivism is used as a referent, the students wait for the teacher to present information and correct answers and then they are given opportunities to memorize facts and practice these right answers. Students are placed in the role of passive receivers while the teachers are left to measure observable behavior rather than true conceptual change or understanding (Schulte, 1996). As described by Saunders (in Clough & Clark, 1994), in a classroom where constructivism is used as a referent you would see:

cognitive activities such as thinking out loud, developing alternative explanations,

interpreting data, participating in cognitive conflict (constructive argumentation about

phenomena under study), development of alternative hypothesis, the design of further

experiments to test alternative hypothesis, and the selection of plausible hypothesis

from among competing explanations (p. 47).

All of these activities allow the teacher insight into the studentsí thinking and facilitate the accommodation of new ideas, or conceptual change.

Guba & Lincoln instruct us to ask "What is there that can be known?" and "What is the relationship of the knower and the known?" in order to better understand what the learner brings into the learning situation (1989, p. 88). A combined effort of a constructivist approach to listening set within a fourth generation evaluation framework was used in this research in an effort to create more than just a study of current events in science. I sought to understand the "individual pursuit of meaning during the experience of learning science" (Shapiro, 1994, p. 202) in my own classroom.

Due to the active listening involved in exploring the learnersí constructions, most of the data are in the form of videotaped class discussions and studentsí wonder journals. This qualitative research does not attempt to measure the amount of learning related to the presentations but rather delves into how that learning is taking place through the use of class science talks. The most effective way to report on this kind of qualitative data is by sharing the stories that developed throughout the course of the study. This is best achieved through a narrative report.

Erickson defends that qualitative research is more appropriate than clinical trial studies for educational research because studies that can be replicated (much like a cookie cutter), are not particularly helpful due to the uniqueness of individual school climates. Instead, the narrative case study is ideal because it thickly describes observations. This allows the reader to then pick and choose how the situation the author describes is similar or different than his or her own situation (1992). The need for qualitative data is made necessary by the desire to identify the nuances of subjective understanding that motivated participants, and by the need to identify and understand change over time (Erickson, 1998).

Setting

Data for this action research were collected within a third grade classroom at William Lehman Elementary School. Located in the heart of a middle class community called Sabal Chase in Miami, Florida, this state-of-the-art facility sits on 8.11 acres. The school is designed to hold a capacity of 885 students. The student population consists of 1,000 students from a variety of ethnic backgrounds. The school-wide ethnic makeup is approximately 45% Hispanic, 10% Black, 40% White, and 5% other. My classroom reflects this diversity with 12 Hispanic, 9 White, 6 Black, and 1 Asian students. There are 16 males and 12 females in my third grade homeroom.

William Lehman Elementary was designed to allow children to receive technology-infused, hands-on, instruction in all subjects. Classrooms are focused around learning centers to assist learning and to foster the independence and responsibility of the student (Gold & Deiros, 1994). Because of these learning centers teachers spend less time as deliverers of knowledge and more time as coaches. This helps to create a constructivist environment as students are more directly involved in learning, making choices as they move through a center rotation (Anderson, 1996).

The curriculum responsibility is divided between teams of two teachers throughout the school. One teacher is responsible for teaching mathematics, science, and social studies for two grade levels. The other teacher in the team teaches a two-hour block of reading and language arts for two grade levels. I am a reading and language arts teacher for second and third grades. By assisting the students in developing the strategies they need to comprehend nonfiction, content-related readings through the use of writing and oral language, this research is correlated with my personal goal to integrate science learning with reading and language arts.

Methodology

Data Sources

The methods used to conduct this research were varied but focused heavily on active listening through the use of the hermeneutic dialectic circle (Guba & Lincoln, 1989). This circle involved identifying stakeholders, determining the claims, concerns, and issues of everyone involved, and sharing an open discourse together. After this occurred, it was then necessary to check with members to ensure that they were accurately recorded and work to reach a shared construction (Guba & Lincoln, 1989).

To gain a better understanding of emerging patterns in science talks, I needed an accurate method to track viewpoints so that I would be able to assess changes over time. I kept a personal research journal to record my thoughts and beliefs about the study before as well as during the research process.

I explained the purpose of my study and the procedures involved to the class and in written letters to both the students and parents. Those who expressed a willingness to participate in the process returned a signed consent form. After each science talk, the discussion was transcribed and analyzed. I also made my own notes in brackets on the transcript as I typed to record any patterns or changing ideas as they appeared.

Data Analysis

Through the collection of data I learned that students see various patterns through their prior experiences and connections. From their observations of the natural world they drew facts learned from nonfiction and fiction books, web sites, CD-ROMs, movies, and television shows to help clarify and build upon learning during science talks. Together they sorted through this information about the world much like a scientist collects data and then searches for patterns. The students then developed, challenged, and refined theories together to explain those patterns.

The discussion of an article titled "Plutoís an Oddball But Still a Planet" (Zabarenko, 1999) illuminates how students used prior knowledge to discover patterns.

Jason: What is a nomer [*sic*]? It says astro but then it says nomer [*sic*]? What is that? Iím

breaking it up and I know what astro means, but what is nomer [*sic*]? Is it about the astro?

What does nomer [*sic*] mean? What does that word mean?

Teacher: Can you find the sentence? Can you read it?

David (presenter): ...(reading) *It could however, get a celestial social security number that puts*

it in a league with asteroids and comets, ***astronomers*** *said.* [David reads a sentence using the

word astronomers from the article.]

Jason: Astronomers are probably like astronauts that arenít in space but that study the

same.

Jason was able to combine context clues with prior knowledge about astronauts to discover the meaning of an unknown word. He was not afraid to admit to the group that he did not know what the word meant. When the presenter was unable to answer his question, he persisted and connected prior knowledge to a new situation to gain understanding.

During a science talk launched from an article about an ancient rock carving of a giraffe ("A Desert Discovery," 1998) students saw a pattern and related the carvings in the Sahara Desert to the Tequesta Indian archaeological site recently discovered in their own city.

> Jason: I donít understand... are they going to put the museum on top of it? Or are they going to pick it up? Because like in Miami, like downtown, they found this...I donít know what it was...it was like this carving and...
>
> Jay: Tequesta...
>
> Jason: On the Today show... (louder) Um, I heard this thing about, itís something in Miami, they were trying to dig it up, but the archaeologists are trying to keep the bulldozers away because they are trying to study it and...
>
> Jay: That is what I did mine on! (Looks over at teacher excitedly.)
>
> Jason:...and they have to take caution...I mean precautions if they dig it out. Are they going to take dig it out in Africa? Are they going to dig it out to put it in another museum, or are they going to cover the museum on top of it?

Students were able to see patterns between the archaeology site in the Sahara Desert and the Tequesta site in Miami. Jay later presented his article on the Tequesta site (Nazareno, 1999) and led a science talk about it. Issues of preservation of the sites and concerns regarding relocation of artifacts arose in both science talks. Archaeology proved to be a topic of high interest to the students as another related science talk soon followed.

After sharing an article about fossilized dinosaur eggs ("Dino Babies," 1999) students sought to discover the cause of the extinction of the dinosaurs. Emerging theories were shaped by patterns in an attempt to justify or refute the role of climate changes leading to extinction.

Jason: I think it was the climate or something...like how hot it was or cold cause in the desert...

David: Iíve got a book about it.

Jason: ... it is supposed to be hot...

Jay: Maybe the volcanoes did it.

Jason: ... but in the desert at night it is freezing.

Jay: The volcanoes? [He is looking directly at the teacher waiting for her to tell him whether his volcano theory is right or wrong.]

Jason: Yeah but if it was a volcano, the eggs would crack.

Alfonso: Yes, yes it will. ëCause itíll crack.

Krystal (presenter): Um I donít think that the dinosaurs died because it was so hot because when they lived a long time ago there might have been all these trees and water there and then things happened.

Jason: Dinosaurs eggs are supposed to be warm. So I think it was because it was cold, you know how it is really cold in the desert at night? Because arenít eggs supposed to be warm?

Later in the same science talk, students debate the issue of climate further.

Jason: Oooh! Thereís two theories.

Teacher: Tell us.

Jason: Well the first theory is Ice Age, the second theory is...the volcano, I think, no...yeah volcanoes. (He sounds unsure.)

David: A comet.

Jason: Oh yeah! It was a comet, youíre right. I read that.

Donnie: What is the Ice Age?

Jason: The Ice Age is like when itís totally frozen like thereís no, no, no...

Allison: Like Pluto? [former science talk topic]

Jason: ...no heat or anything...it was snow...Like Antarctica ok? So frozen that there was no water...

Keith: Mrs. Bennett, remember the story we read about the Ice Age and the girl?

Teacher: What was the second theory? Jay, did you know something about the second theory?

Letís listen as Jay shares his idea.

Jay: It taught me that, itís like CD-ROM of dinosaurs and it says that there was a comet that hit the dinosaurs.

Teacher: So then what happened, the comet killed the dinosaurs?

Jay: Cold places turned into hot and hot places turned into cold.

Jason: Because I think it was because you know how dinosaur eggs, well any eggs really, are supposed to be kept warm? Well I think it was because like the Ice Age it got cold and then they all died and stuff...

Teacher: But how would that explain how the adult dinosaurs died?

Jason: ...or like the comet that it was so hot you know?

Katie: But if it was hot, it would keep them alive.

Jason: I know but **so** hot that it...

Donnie: Burned them?

Teacher: It was just fire?

Jason: They just died.

Prior knowledge gained from nonfiction books, stories, and CD-ROMs helped the science talk move forward. The students gained confidence in their answers as they pulled in learning from outside sources and worked together to make the pieces of the puzzle of extinction come together.

As I searched the transcripts of the science talks I noticed interesting patterns in studentsí behavior and approaches to science learning. In early science talks, students relied heavily on the presenter to answer all of their questions. As I stepped into the role of facilitator to allow the students to share their experiences with each other without my interference the students quickly placed the presenter into the role of disseminator by directing all questions to him/her. This occurred even when the question could not be answered with facts from the article. The first science talk based on the article "Whatís Going On With the Frogs?" (Call, 1998) was about research concerning environmental factors contributing to frog abnormalities in Florida. The group was directing every question to the presenter even after repeated reminders to share personal ideas to try to answer questions as a group.

> Teacher: Boys and girls, this part of the discussion doesnít just have to be for asking Sabrina questions. Some of you might have some information that you know about it that you can share with the group or just some ideas about what you think might be causing this. You can just ask the question in general and anyone who has an idea or thought on it can share.

Even when desired behaviors were modeled by the teacher and they were reminded to share their own ideas, the students continued to depend upon the presenter to provide answers in early science talks. Deeply embedded views of teachers as disseminators of information were thus transferred to the presenter during class discussions when they discovered that the teacher was not providing answers.

Early on, students also struggled with the notion that some answers may not be found in the article. The nature of their questions revealed the belief that there is a correct answer to each question about science. This was evident during one science talk when, after the presenter read the entire article to the group, several students repeatedly asked a question, which was clearly not addressed in the article, directly to the presenter. After the same question was voiced repeatedly, the presenter began to make up answers in an attempt to satisfy the group.

"Final form" science, as Gallas (1995, p. 102) described it, has been wrongly handed down to our students. This was evident as they struggled with science talks related to topics of ongoing scientific discovery. Students were accustomed to learning science as a history lesson because they usually have only studied discoveries that have already been made. When faced with current events that lacked closure such as cures, inventions, or environmental solutions, the students expressed frustration. This occurred during the science talk on "Whatís Going on With the Frogs?" (Call, 1998).

Katie: When the frogs...when the frogs start behaving sort of abnormal, is there something

that can help them not be abnormal?

Alfonso: (hand raised) So...

Sabrina (presenter) : You mean invented? No, the scientists are still trying to find something

to help them.

Alfonso: (hand raised) So... (exasperated at not being able to get his question out.)

Allison: Do they stay like that all their life?

Unknown: They stay like that their whole life?

Samantha: Do they have to take a medicine? (pauses) So once they are deformed they canít

help them?

Sabrina (presenter): No.

Similar patterns were found at the beginning of the discussion related to "Tracking a Killer" (Kowalski, 1999) which detailed a mysterious disease killing healthy young adults in the Four Corners region of the American Southwest.

Samantha: Is there a medicine that can help stop spread the disease?

Allison: Is there a medicine for them to get better?

The "Tracking a Killer" (Kowalski, 1999) science talk transcript also showed that the group had grown more comfortable with the nature of science talks. After initially worrying about the unknown origins of the disease and lack of a cure, the group was able to develop theories collectively that addressed the contributing factors of this mysterious disease. It appeared to be a turning point as they evolved into experienced "science talkers" who viewed themselves as scientists. The students began to brainstorm more ideas as a group. The questions were directed less often to the presenter. Furthermore, the studentsí questions indicated the use of higher order thinking skills. They began to understand that science is ongoing and that it is acceptable to not know the answers to some science questions because they need to continue to be explored. True discourse occurred as they struggled with difficult theories together as a group during this science talk.

Alfonso: In which place does it live?

Keith: In the Four Corners section, Alfonso (pointing to the map pulled down).

Donnie: Why did it happen?

Tonika (presenter): The more rain, the more the mice eat the grass and then they start to spread the disease.

Donnie: How did the mouse get the disease...eating the grass?

Jason: Like was there some kind of pesticide in the grass, or was it picked up later?

Samantha: Did the scientist ever think of like getting rid of the grass that may have the pesticide in it?

Allison: (referring to her wonder journal) How did the deer mouse get it?

Tonika (presenter): When they ate the grass, what happened was that when more deer mice were born, there were more to give diseases to the people.

Vincent: How did the hurricane pick it up though?

Jason: Vincent asked why, how did the hurricane get it, but the hurricane did not get it. It rained and then it made the grass grow and then the more the mice ate it, the more they had like they duplicated.

Teacher: What weather condition was mentioned in the article?

Sabrina & Jason: El Niño!

Teacher: Ok, what did it say about El Niño? Sabrina?

Sabrina: It said that El Niño was going to bring a lot of rain...and the grass was going to grow...and that would bring more mice after the next rain season.

Samantha: But why does it only stay in that part...

Donnie: That is what I was going to ask!

Samantha: But why does it, the disease, only stay in that in that part of the world, and doesnít come on the other side? Is it because the like deer mouse isnít on that other side, or is it because of something else?

Teacher: Letís talk about it with the group.

Katie: On the map they have like little pin-marks of where the disease has been like because of the deer mice...

Samantha: I know, but why doesnít it go in other parts of the country?

Katie: ...itís been like in Utah, Arizona, New Mexico, Colorado...

Jason: Well it depends on...

Raymond: Is it gonna get to spread?

Keith: Is it gonna spread?

Jeannie: That may be their habitat.

Teacher: Whose habitat?

Jeannie: The deer mice.

Teacher: Oh. So that is a possibility. What do you think about that theory?

Jay: Maybe itís because they canít be near the ocean, like they canít swim.

Teacher: So again we are talking about the deer mice and their habitat. What about the change in their habitat?

Jeannie: Well the wet weather is different.

Teacher: The weather, the wet weather..so perhaps that is why it is happening in the area.

Students approached this topic as a mystery to be solved and worked together to develop some initial theories. When ideas seemed to be off track, as was the case when a student confused El Niño with a hurricane, group members provided clarification and the flow of the science talk continued. It was exciting to see this group of young scientists sharing in the co-construction of learning on a difficult science topic.

As they gained more experience in listening to otherís theories and constructions, they were able to discern differing viewpoints arising within the group as well as from the key players mentioned in the articles. In time they were able to think beyond the viewpoint presented and search for differing opinions. These thinking skills are evidenced during a science talk about an article on global warming (Stevens, 1999) from *The New York Times* web site.

Teacher: What could possibly be a reason that some people might not join in, and just stop

doing this?

Katia: They donít want to lose their money.

Teacher: Who doesnít want to lose their money?

Katia: The people.. (several people talking at once)

Teacher: What people?

Jeannie: The companies that put their smoke in the air...

David: The factories...

Jason: The factory people...

Alfonso (presenter): The companies that donít want to waste money..

Jason: They want to invest money. The factories...they are making like a lot of money...

Krystal: The big companies...like the orange juice companies...

As they discussed the article together they decided that the companies that burn the most fossil fuels would be opposed to legislation designed to protect the environment. Students examined the many ways that science is interwoven with important issues in society. By incorporating science current events into the classroom curriculum, meaningful discussions and debates can help bring about new understandings of their world and society around them.

Findings

Men can do jointly what they cannot do singly; and the union of minds and hands, the concentration of their power, becomes almost omnipotent.

- Daniel Webster

The goal of this research was to better understand how my students talk about science. Through their presentations on science current events and the science talks that followed, I was able to hear my studentsí constructions, questions, and emerging theories about the nature of science. More importantly, they were able to hear each otherís private views and assist each other in learning in a format that was more effective than teacher-led discussions.

By forcing myself to stand back and listen, rather than deliver information, I was able to "focus on the issues of language" and begin uncovering my studentsí understandings of the study of science (Gallas, 1995). It was evident that students used meanings of familiar words as a scaffold to build up new understandings. Scientific vocabulary was not an impediment but rather a tool to help students relate prior and new science ideas. Through science talks they were able to make learning unique and relevant to their lives. The students took ownership of learning much in the same way they took ownership of the selection of topics. Technology was seen as a tool to gain more information about relevant issues in their world. Those who found new resources of scientific knowledge shared them with the entire group.

Exciting and challenging discussions could take place because students were no longer functioning in isolation. During science talks, students heard that others sometimes held similar beliefs. They posed questions and sought clarification on key concepts related to the topics being discussed. They tried to apply prior knowledge and made an effort to combine several beliefs from the group to support emerging new theories.

After completing several science talks there was evidence that new patterns of behavior had emerged. Students became more skilled in facilitating their own talks as indicated by the decrease in teacher interjections on the transcripts from the science talks. Students became aware of the need to involve more of the learners in the group. This was seen when "big talkers" allowed "less active" talkers to participate more (Gallas, 1995, p. 90). In the initial talks, several students "funneled" their questions through a "big talker". Later, those students gained their own voice and felt confident enough to pose their own questions directly to the group. It was also noted that the number of discipline disruptions within this grouping of students decreased significantly. This pleasant change came about, I believe, as students felt more empowered, responsible, and involved in their own learning (Davis, 1993).

Important information was revealed about how students viewed the role of the teacher. Their initial reliance on the presenter was a result of how they were previously taught science. Initially, they did not approach the science talk circle to share beliefs. They desired to be given information. When it was revealed that the teacher would not provide answers to the group, they assumed that the presenter would be the expert. While the presenter did select and introduce the topic, students eventually realized that no one student alone possessed enough knowledge for the group to depend upon. The presenter could facilitate knowledge but could not transmit understanding to the group. Learning, it was later discovered, would have to be co-constructed through their discussions.

When students are free to choose the topic for discovery the teacher must relinquish control and allow the students to determine the scope of their discovery. It became clear that the way to involve students in their own learning is to step back and allow their interests, ideas, theories and opinions drive the lessons. The high level questioning and argumentation seen in later science talks illuminated the end reward of allowing time for discourse on science within the classroom.

Ongoing scientific discoveries are baffling to young children who are accustomed to studying science in the past tense. The students sought closure on issues during science talks where there were no definitive findings. This can be attributed to their experiences with teachers who introduced science as existing in a "final form." Memorizing facts and concepts fit into this "final form" science because these techniques ease the delivery of information. Because of the way knowledge was delivered in the past to these students, they have come to believe that science is absolute. It was difficult for them to understand that the answer to a scientific problem may not be revealed at the end of the article. This may have also contributed to their belief that the presenter knows the answer because they assumed that the answer was revealed in the article.

It was also found that as the students became more experienced science talkers, the questions posed by students were discussed more in depth. I needed to allow for more time for this scientific discourse to occur. By allowing more time for the students to talk about their experiences, the level of co-participation increased as they tested each otherís understandings and were more sensitive to their roles as learners and teachers within their group setting (Tobin, 1993). Although the allotted time for science talks needed to be extended, I found the students to be on-task and communicating meaningful and personal thoughts with each other regarding in-class learning as well as extra extensions with discoveries beyond school learning.

Another benefit from this discourse was that students were found to be more receptive to giving and receiving help within the group. I found that, consistent with research, my students made a "consistent effort to clarify and organize material in new ways, recognize and resolve inconsistencies, develop new perspectives, and construct more elaborate conceptualizations than they would when learning by themselves" (Webb, Troper, & Fall, 1995, p. 406).

The use of student wonder journals was an effective tool for monitoring growth of studentsí constructions and theories. Not every child could voice each question listed in their journal so inevitably, there were ideas and theories not discussed that I might have missed. The journals assisted in helping me to know individuals who were struggling with important constructions. Student science journals became an effective means of communicating learning for the students (Abbas & Gilmer, 1997). As they became more comfortable, they shared their knowledge in the form of pictures and labeled diagrams. These pictures combined with writings that reflected new learning and feelings about that learning, became a valuable tool that communicated growth.

The more students communicate about science, the stronger scientists they will become. They learn to seek patterns in everything they see and describe and analyze these patterns to bring about more complete and valid theories about their world. After recognizing otherís theories they expressed opinions freely about those theories shared. Students were able to combine theories through careful listening and analyzing. Their ability to recognize bias within scientific issues was strengthened through these science talks. These skills lay the foundation for all future science learning. They will be prepared and motivated to participate in future learning communities.

Quality Criteria

In order to make this study credible and sound, efforts were made to ensure that quality criteria as outlined by Guba & Lincoln were conducted (1989).

Prolonged Engagement

The presentations and science talks took place throughout the 1998-1999 school year. Due to the need for more discourse time for the group, the length of time for the study of science current events was extended further. This resulted in prolonged engagement, which allowed me to identify the relevant issues and gather sufficient information on studentsí prior constructions, beliefs, and eventually, the emerging patterns that appeared. Prolonged engagement was also necessary in order to establish a relationship of trust within the group during these science talks.

Persistent Observation

By continual analysis of the class wonder journals and science talks, I was able to compare relevant issues that emerged from both sources. A schedule of staggered due dates on the science current event assignments was established in order to allow sufficient time for each presentation. The frequency allowed adequate time for students to select and read articles, prepare for the presentations, as well as for the teacher to transcribe each science talk, and allow for member checks.

Peer Debriefing

Throughout the research two objective colleagues assisted in peer debriefing. They were also actively involved in their own research, which aided in carrying out meaningful discussions regarding these quality criteria. They are familiar with my school setting, which proved helpful in advising me with the emergent design of my research along the way.

Progressive Subjectivity

By making careful observations regarding the nature of science talk in my research journal, I was able to keep an accurate record of the changing constructions of the stakeholders involved. Another helpful technique in monitoring etic, or otherís constructions, was to record my interpretations as I was in the process of transcribing the science talks. These careful notes assisted in keeping track of the emerging patterns over time from all of the participants involved.

Member Checks

Member checks were crucial to ensure that I accurately recorded the stakeholdersí beliefs. After each science talk, I carefully transcribed the discourse that had taken place. The transcripts from a series of science talks were then searched for patterns in thoughts or theories. Member checks decreased the chance that "translation differences" could arise between the question the child thinks was asked and what the researcher interprets the question to be (Johnson & Gott, 1996).

Transferability

By accurately describing the setting, context, and culture in which this study took place, I hope to provide sufficient details to the reader. The reader can then, based on the information given, decide if certain aspects of this study would be applicable to their specific situation in their environment.

Ontological Authenticity

In an effort to observe how my own emic constructions have changed throughout the study, a research journal was kept. Before research began, I documented my beliefs and predictions. This journal served as a diary of my own learning. This allowed an insider view of my changing constructions over time.

Educative Authenticity

Educative authenticity was achieved as I was able to document evidence of growth in my studentsí ability to listen reflectively to each otherís constructions. At the beginning of this study, group interaction in my classroom was strained due to my studentsí lack of ability to respect and listen to differing views. After ample opportunities to interact within a collaborative group, I noticed a dramatic increase in their ability to listen and interact in a scientific discourse. They have also improved in their openness to share their constructions with the entire class. This has enhanced their learning and ability to participate in a learning community (Tobin, 1993).

Catalytic Authenticity

One of the limitations of this study is that I am not able to predict whether the enhanced learning I saw during this study will continue in the future. Changes in my own ability to practice sensitive listening to learn more about how my students learn has been evident and I hope it will be long lasting. It is a vital skill that I will utilize to ascertain studentsí constructions before I begin future instruction. Having a window to peer into student thinking has been paramount to increasing my effectiveness as a teacher and creating a constructivist classroom where students are actively involved in their own learning.

Tactical Authenticity

One of the most rewarding results of this study has been the increased understanding and communication as a learning community was formed within the classroom. Through science talks, the students have been empowered to lead each other to understanding. As a result of this study, I have seen that although students may not be thinking in the same manner, they are using scientific discourse to learn new ideas in ways that are meaningful to them (Shulte, 1996).

Conclusions

Education is not the filling of a pail, but the lighting of a fire.

-William Butler Yeats

This research on science talk has helped me to better understand how my students approach science learning. Active listening is pivotal in understanding what children already know. The knowledge, feelings, and skills with which students come equipped are woven together to form prior constructions. By incorporating studentsí prior experiences and emerging questions about the nature of science, I am involving students directly in developing the learning activities used within the classroom.

Allowing students to choose science articles, which are of interest to them, can provide the spark needed to make learning relevant and meaningful. Through the use of language, the students can lead each other to an understanding far better than I can alone as a "disseminator of information." By sharing observations from their own lives, they truly do "take on the voice and authority of scientists" (Gallas, 1995, p. 3). In time, everyone involved in science talks will become skilled and sensitive listeners.

Learners will construct new meaning by continually trying to make sense of their experiences and thoughts. Through self-selection of science current events and constructivist scientific discourse with peers during science talks, the many patterns that shape the landscape of learning can be seen and shared.

Science talks have increased my studentsí views of themselves as scientists. They are aware that they have valid questions and emerging theories that can be refined through collaborative discourse. Science current events sparked their interest in the world around them. The skills gained from science talks have better equipped all involved for a life-long journey as science learners.

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Organization/Address:
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10990 SW 113 PL, Miami, FL 33176

Telephone: **305-273-2140**
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