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Teacher Research

Revised Analytic Memo

You See, But You Do Not Observe:

Focusing Third Graders' Scientific Observation-Making

This year during my internship, I taught most of the science throughout the year. Students were always excited about the different experiments that we were doing, and were very engaged with the lessons. What really surprised me were their observations. The majority of students were able to describe what they were seeing, but their observations were unfocused. In one experiment, we were testing the density of hot and cold water in comparison with it's density at room temperature. Students were asked what they saw, and most of their observations did not connect to the waters being denser or less dense than one another. Students noticed that there were bubbles at the top of the water, or that one cup had the ladle a little higher than another cup did. While these were accurate observations, they had nothing to do with the density experiment we were doing. I wanted to know what I could do to help my students make more productive observations. There is a strong connection between the observations we make and the conclusions we are able to make, and I wanted to help my students to realize this connection.

Initially I was trying to see how my actions could help my students make more productive observations. I initially put my research process together feeling that certain aspects of the process would help students with their observations. As the process of researching continued, however, my focus shifted away from these aspects. Also,

through my literary research, I was better able to categorize “productive observations” as “transitional observations” (a transition between everyday observations and scientific observations), and inferences. This led to my question becoming, “In what ways can I support the transition from students’ everyday observations to more scientific observations and inferences?”

I wanted to see what I was doing as the teacher to facilitate student observation making, what observations my students were making, and what conclusions my students then made from each experiment as a whole. For my research, I collected information from three specific lessons. I chose these lessons because these were the lessons that I had video and audio data for both the introduction and the experiment. The first of these lessons, done on April 26, looked at how the salinity of a water solution affects the density of the solution. Students tested four different solutions with different levels of salinity to see how salinity affected the density of the solutions. The second lesson, done on April 27, looked at how the temperature of water affects the density of the water. We had already looked at the density of hot and cold water compared with that of room temperature water, and this lesson looked at what happens when these two different waters are mixed together. This lesson, unlike the other two lessons, was a whole class experiment done by the teachers where all the students could see from their seats. The third lesson, done on May 17, looked at how blubber helps a whale survive under water. The students tested the coldness of a bucket of ice water with their bare hands, their hand in a plastic bag, and their hand in a “blubber glove.”

To see what I was doing to facilitate student observations, I looked at my lesson plans and the introductions to my lessons. I looked at both to see what I had planned to

do in each lesson, and then to see what actually occurred. The lesson plans were a combination of already written experiments and lessons, and my own additions and changes. To capture the introductions of my lessons, I videotaped myself introducing the lesson to my students. Since this research was all about student observations, it was very important to collect what students were saying during the experiments. To collect this, I used both audio and video taping. In my first lesson, I had placed a tape recorder at each table, but only one of these tape recorders worked. In the second lesson, since it was a whole class experiment, I videoed the whole class, and in the third lesson I was able to video tape each of the three groups individually as they did the experiment with me.

From this data, I first had to classify what I was looking for in the student's observations. I used my literary research to help me with this classification. In looking for literature related to my research question, I used the Brandeis database to search for different articles relating to the subject of student observations during science experiments. I wanted to see how other teachers taught observing to their students, and then also what they noticed about their students' observations. I used two of my literary resources to help with this classification.

In the article "From Everyday to Scientific Observation: How Children Learn to Observe the Biologists World," (Eberbach, and Crowley, 2009) the authors discussed the difference between the type of observations that students are generally able to make, everyday observations, and the type of observations that scientists make, scientific observations. Observations are so much more complicated than we as teachers make them out to be. "Go observe," is not a simple command. This article made me think about what I was really looking for when I was looking for focused observations. My students were making observations at the beginning of the year, but as Eberbach and

Crowley refer to them, they are everyday observations. They were making irrelevant observations to the experiments we were doing, and they were not using what they had seen then to make conclusions. I was looking more for what they defined as observing like expert biologists, who notice the relevant ignoring what is not relevant to the experiment.

The article then explains that there should be a transition level between what I was seeing in my students and what I felt were more sophisticated observations. Even though children's observations are not initially scientific, there are actions that the teachers can take to help students make the transition from everyday to scientific observation. At first this had me worried that developmentally students were not capable of making expert scientific observations, but Eberbach and Crowley continue to state that in the proper contexts students can begin to transition to more sophisticated observations. In my research I am now looking to see where students are making these transitional observations instead of just everyday observations, and looking to see what context they made in. I am focusing on what I did to allow for these transitional observations to be made, specifically my usage of a focusing question and predictions, and a printed procedure for the students.

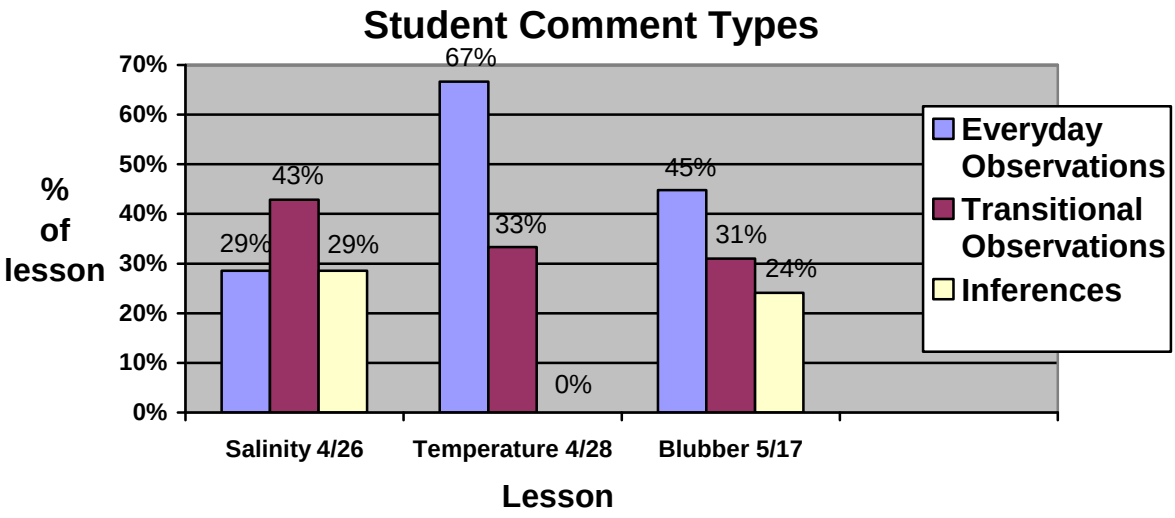
From another article I looked at, "Learning to Observe and Infer" I realized that I was not only looking for students making observations, but inferences. (Hanuscin and Park Rogers, 2008) Inferences are when the observer puts his observation together with prior knowledge, as well as other observations he made during the experiment. I wanted my students not only to observe what they were seeing, but to make connections between what they are seeing and what they know.

Using these three terms, then went to my data. I looked for the everyday observations, which I considered to be the observations that were not fully connected to

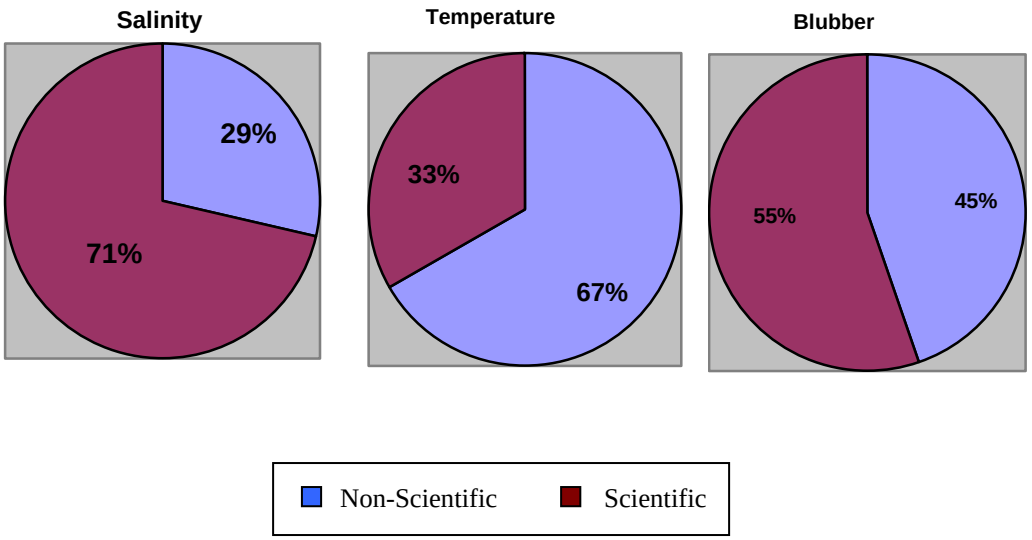
the experiment we were doing, transitional observations, those that were focused on the experiment we were doing, and inferences, those that had students making connections. I listened through each of the audio and video recordings of the experiments, and entered the student comments into a database. For each entry I recorded which lesson it was in, the student who made the comment (when identifiable), the comment type (everyday observations, transitional observations, and inferences), as well as the comment made. Comments such as, “That’s bright red,” and “That looks so cool,” were classified as everyday observations, since they were not directly connected with the experiment. Comments such as “The red is much more dense,” and, “It’s warmer,” were classified as transitional observations, since they were focused and connected with the experiment. Comments such as “This is like a swim suit for when you go scuba diving,” and, “The opposite colors all sank,” were classified as inferences, since students had to make connections with what they were observing with what they had already observed, or already knew.

From this database, I was then able to see how many of each different comment type students said during each lesson. Since I was looking at the first lesson, which was only one group, the second lesson, which was the whole class together, and the third lesson, which was three individual groups recorded separately, I felt the numbers would be more useful as percentages rather than totals of each type of comment. With these numbers I was able to put together the following

graph:



From here I was able to visually see the different amounts of each of the comment types. From here I again divided the comment types, but this time into only two categories, non-scientific and scientific. The everyday observations I classified as non-scientific, whereas the higher level transitional observations and inferences I classified as scientific. From these new classifications I put together these following graphs to help me look at my data:



From here, I returned to my lesson plans and my videotaped introductions to see what could cause the different amounts of non-scientific and scientific comments made in each experiment. For each lesson I made a list of the different components of the introduction:

Salinity	Temperature	Blubber
• Background information • Focusing question- What type of water is denser, water with a higher salinity, (saltier water), or water with a lower salinity, (less salty water)? • Predictions • Small Group work/discussion • Printed out procedure • Specific jobs • Complexity of the challenge	• Focusing question- What do you think will happen? • Predictions • Whole class	• Background information • Focusing question- How does blubber help whales survive in the cold water? • Predictions • Individual task/ group discussion afterwards • Printed out procedure

• multi-step where they needed to put things together		

From these lists, I was then able to compare the lessons and find out their similarities and differences . The three main parts of the lessons that I felt had the most effect on the students' comments were the type of focus question, whether the kids were working in small groups or as a whole class, and the complexity of the experiment.

While each lesson had a focus question, there was a difference between the focus questions in the salinity and blubber experiments, and that of the temperature experiment. In both the salinity and the blubber experiments, the focus questions were very descriptive. The new terminology from the experiment was in the focus question itself. On the other hand, the focus question in the temperature experiment simply asked students to "notice what was happening." While they were given a general idea of what we were looking at, they were not told what they should be looking for. With the more specific focus question, the students were able to discuss what was happening in terms of what the experiment was actually about. When they were just asked to notice "what happened," however, they had trouble knowing what they were supposed to be focusing on. Instead, they noticed everything that was happening, without focus, and had trouble understanding what the focus of their observations was supposed to be. Simply put, they had trouble making the realization themselves that their observations should be connected to what was relevant to the experiment, instead they relied on a specific, almost leading question to make observations which were relevant to the material.

In the first and last experiments, students worked in small groups, while during the second of the experiments, they worked as a whole class. The amount that I heard from each student during this second lesson was much less than the amount I heard from them during each of the other two. The small group setting allows for the students to be more hands on with the materials and have more room to voice their observations. Students can not sit back and rely as much on other students' observations when they are working in a group that depends on them for their piece of the experiment. Students who would get lost in the larger class setting have an easier time voicing their observations when working with only a few other students.

The first of the three experiments was more complex than the latter two. In this experiment there were multiple solutions that needed to be compared, requiring different mixtures of two of the solutions. There were many different pieces of the experiment that students needed to carefully put together. Each step of this experiment required students to slow down and focus on what they were doing and what changes each step caused. Precisely because of the complexity of the situation, they had to slow down and focus on each task at hand and what was happening in the experiment. The temperature experiment was extremely simple. All students had to do was see what happened when water of two different temperatures were mixed together. In the blubber experiment, while students had to compare how cold ice water felt through three different insulators, there still was relatively little complexity to this experiment. Each student on their own experienced how cold the water felt in each scenario, and only after everyone had a turn were they able to discuss what they felt. While they knew what topic they were

discussing, the complexity of the experiment left them only talking about whether the water felt warmer or colder.

After looking at my data, my findings, and what I think they meant, I then looked back to the initial lesson where I felt my students were not making scientific observations. During this experiment, the focusing question was very similar to the temperature focusing question in that it asked students nothing more than to notice what was happening. While students worked in pairs for this experiment, after each step of the procedure, the whole class was brought back together to discuss, leaving very little time for students to discuss on a smaller scale. One place where this experiment did differ from my findings was that it was a complex experiment with multiple steps. Even though it was complex, each of the steps was broken down with me leading them through giving students little time to focus from step to step and really notice what was happening.

What I find mainly significant from this research was that what seemed to affect student observations the most was nothing that actually happened while the students were actually doing the experiment. The structure of the experiment is what affected the type of student comments made. In planning ahead for an experiment, I now will have these three aspects of the experiment to focus on to help foster more transitional observation and inference making. I will make sure that my focus questions are specific to the topic we are discussing and use key terms that are important to the experiment. I will also be sure that the students have more opportunities to talk in smaller group settings as they are doing the experiment, to maximize the number of students that are commenting on the experiment, and the number of times each student speaks. I will focus on the complexity of the experiment, making sure that there are multiple steps that the students need to

focus on. I will also try not to simplify the experiment for the students, by not breaking down the steps. While it makes it easier for them to do, it makes it so they are less focused on the experiment, and therefore cannot make as many observations.

From here, there are still further questions I have about science experiments in the third grade classroom. I have now made the distinction between the different types of student comments during experiments, but I wonder how much students need to be aware of these different categories. From here, how best can a teacher make students aware of the distinctions between the categories? From my literary research, I also came upon another article that led me to more questions about these categories. "A Lemon of a Lesson" focuses on how teachers can help students see the importance in careful observation making. (Minogue, 2008) As I saw, and as the other articles stated, this article focused on the fact that observation making is a skill that needs to be honed. Students need help to focus their observations, and the teacher's actions and activities affect students understanding of observations. Students need to have "observation awareness" so that they can understand why they need to make such careful and focused observations. In the lemon lesson, students were able to see the effect of their observations (whether they were or weren't able to find their lemon again in the end). This, however, left me with questions about everyday observations. While I had written everyday observations off as unscientific, and almost not useful, the majority, if not all, of the observations in this experiment are everyday observations, which Minogue values. I now wonder how these everyday observations are valuable to student understanding, and whether they are connected to their transitional observations and inferences. I look forward to looking further into student observations and science experiments as a whole as my teacher career moves forward.

Sources

Eberbach, C. & Crowley, K, E., (2009). "From Everyday to Scientific Observation: How Children Learn to Observe the Biologists World." Review of Educational Research. 79(1),39-68.

Hanuscin, D, & Park Rogers, M. (2008) "Learning to Observe and Infer." Science and Children, 45(6), 56- 57.

Minogue, J., (2008). "A Lemon of a Lesson." *Science and Children.* 45 (6), 25-27.