A Journey Through Inquiry

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Introduction

My first recollection of cheating was when I wore blonde hair in pony tails and had freckles spattered across my nose. I was in first grade. We sat in rows, raised our hands to answer the teacher's questions, and rarely talked to our peers, except at lunch or recess. I remember the teacher handed an assignment to a fellow student and me. We must have been absent on the same day and needed to make up the work. I also recall the anxiety I felt because I did not have a clue as to what any of the answers were or how to figure them out. As my head hung low, I glanced over to the nearby student only to see him easily filling in the bubbles. I felt the only way I could save myself was to copy him. Surely he must have understood what I did not.

The next memory of me making a conscious decision to cheat was in third grade. This memory is more vivid, and I remember the teacher standing in front of the room lecturing to the class. There was no discussion between the students or the instructor, only the teacher verbally telling us what was expected of us. She handed out the assignment we were to do independently. That particular paper required short written answers, and I was clueless as to how I could possibly answer any of the questions. Once again, my eyes found a well written paper of a nearby neighbor. I was saved from the humiliation of handing in an incomplete paper and the teacher suspecting that I did not understand the concept.

While in high school my grades ranged from As to Bs. I was a pro, at cheating that is. My best friend and I sat near *the smartest* kids in class, copied their answers on to small pieces of paper, and tossed them to each other. I also found that if I knew the

students who took the same course, prior to my class, they could be of assistance. Innocently I asked them what was on the test and how they figured out the answers. Most did not have a problem revealing the answers while filling me in with explanations of how they smartly came up with them. I boldly took tests with my notebook lying out in plain sight containing notes or answers to the test. After all, who would dare take that risk?

By the time I started my associates degree, I was 22, had served in the Navy four and a half years, and had my first son. I was going to become a teacher. Just as I had passed my classes before, I continued. One of my friends had all of the exams for the Western Civics class I took. Plagiarize was my middle name when it came to research. My history professor alternated tests from year to year, and those would seem to randomly fall into my lap. One of my biggest breaks came when I was studying in my car. A classmate of mine came out of the college with a final exam he had copied. We spent the whole next day working to figure out the answers and the following day memorizing them.

One might think all the time and effort put into cheating could have easily been put toward studying and understanding the concepts taught. I absolutely agree. In hindsight, I realize I am not an auditory learner. Whenever an instructor taught with multisensory strategies I did not feel the need to cheat, yet when a teacher taught in an auditory fashion I used the one strategy I knew best, memorization. Finally, if the content was too abstract or the quantity of learning too large, I resorted to cheating.

Once I began my bachelor's degree, my cheating came to a halt. The courses I took focused on many theories of child development and the notable theorists: Piaget, Freud, Erikson, Maslow, and Vygotsky. I gained an understanding of how people think. I studied the physical, cognitive, and social development of children. Most importantly, I became educated in how people learn through multisensory instruction and how to teach to all the senses. I absorbed the information like a sponge. I used the content intended to instruct me how to become a teacher to teach myself how to learn. And even when my professors lectured, I used a variety of newly learned strategies to retain knowledge of content. I was no longer a cheater.

In 2001, I graduated from Virginia Wesleyan with an elementary teaching degree at the age of 34. By then I was the mother of three and my husband had one year to retire from the Navy. My college career had been a bumpy road with the birth of two more children putting my education on hold due to financial reasons. My youngest had just finished the first grade. Nevertheless, I was ready to make a difference in the world of teaching. I was certain my education was top notch, but it was the years of cheating that had given me the drive to be the best teacher I could be. I would do everything in my power to ensure students would never yearn to cheat.

I taught for eight years before beginning my Master of Arts in Teaching (MAT) in Integrated Natural Science (INS) at Colorado College (CC). My first year of teaching was a shock. I thought my personal experiences and work ethic would land me as a top notch teacher, only to find out the experiences I learned teaching a classroom of students trumped the educational classes I took. All my hopes and dreams of being *Teacher of the Year* flew out the window when I recognized it would take teaching a lesson several

times before I learned how to teach the lesson effectively for the diversity of all learners. Standards, benchmarks, leveled reading groups, math manipulatives, behavior management, and other components of teaching contributed to the real world of teaching being nothing but a fog the first year.

As the years passed the fog slowly lifted, and as clarity came I sought ways to improve my teaching. It seemed the more clear I was of my daily instruction, the more aware I was of how it needed to be improved. To better myself, my tenured peers became of great assistance, and I also took a variety of educational methodology classes given by the district. I integrated a variety of teaching strategies such as cooperative grouping, collaboration, and student notebooks for all subjects. I asked the *fat questions* of who, what, when, where, why, and how. I taught to all the senses and worked hard for my students to feel safe to ask questions and take risks. After writing lessons for the district, I truly felt I was at my peak of teaching. That was until I began my MAT in INS program.

Disequilibrium

Piaget stated, "Intellectual growth involves three fundamental processes: assimilation, accommodation, and equilibration. Assimilation involves the incorporation of new events into preexisting cognitive structures. Accommodation means existing structures change to accommodate to the new information… Equilibration involves the person striking a balance between himself and the environment, between assimilation and accomodation… For Piaget, equilibration is the major factor in explaining why some

children advance more quickly in the development of logical intelligence than do others" (http://www.sk.com.br/sk-piage.html).

I never experienced a teacher or professor *intentionally* putting me in a state of disequilibrium until my first summer in the INS program, Chemistry of Fire: Members of the class introduced themselves to each other, the professor had us prepare a science notebook, and we followed by answering a question in our science notebooks. She did not start the lesson with an anticipatory set, she did not model the concept or give input, and she did not give us any guidance. My head was spinning. Had not this *professor* ever heard of Madeline Hunter?

It did not stop there. Scientific explorations followed in the first couple of hours. Students were given permission to use most, if not all, the science tools in the room. Little did I know that most of the students in my class were middle or high school ***science*** teachers. When she gave the go to explore, the room exploded in organized chaos of students using burners, beakers, flames, scales, aluminum foil, and tools I had never used or seen in my life. People collected data, made charts, and talked real science. Students explained, the professor elaborated, and I, well I held in tears of dismay. Thus, disequilibrium.

The design of inquiry is intended to pre-assess background knowledge, engage students through questioning, offer explorations, and guide students to use their minds to think and elaborate, yet I did not recognize it. The entire summer consisted of me learning to find a balance and struggling to assimilate and accommodate the information. Throughout the course I did not accept this lack of equilibrium as a useful tool in

teaching until I personally experienced the gains I achieved in my learning from the level I began at the beginning of Chemistry of Fire and where I ended. I am convinced the struggle to gain knowledge through inquiry invited me to obtain a greater understanding of all concepts entailed in the course. I believed my students could make larger gains by replacing the anticipatory set and guided practice with the engagement phase and allow more explorations for students to have hands on discovery. Slowly my mind was shifting from believing it was necessary to *always* model and guide students through new concepts to the notion of students taking on more accountability through their own desire to learn.

I started the new school year with the enthusiasm of incorporating a variety of the phases of inquiry into my content lessons. The biggest change I made was to begin lessons with questions. I was prepared. All my students had notebooks for science, math, reading, writing, and social studies. I began, as my summer professor had, by asking a question. I wrote it on the board and told my class they had five minutes to write all they knew about the question. The excitement of inquiry was beaming on my face, until the majority of the class sat there staring at their notebooks and a few of my first graders began to tear up. Well, I wanted disequilibrium and I got it. I am not sure why it never came to mind that many first graders lack the ability to write a sentence, especially after a summer break following kindergarten.

After a few attempts of trying to have students answer questions in notebooks, I knew I had no choice but to modify notebook writing during the engage phase and change it to students verbally telling the answers to their questions to me and their peers.

Once again I came across yet another hiccup, the students' difficulty verbalizing their thoughts. My intention was for students to experience disequilibrium, but it seemed at every turn it was *I* who needed to find balance. Ultimately, I had no choice but to go back to using a more structured format to guide students to effectively verbalize their thoughts and write. Once students made enough progress, they were able to begin answering questions in their notebooks as I had initially proposed. Not so surprisingly, I observed students going through the same stages I went through in the beginning of my first summer of INS: doubt, fear, and tears, which led to perseverance, confidence, and risk taking.

I initially believed the more I used questioning in my lessons, the more students would become used to this style of teaching. Many students lived up to my belief, but I felt it was negatively affecting two-thirds of my class due to the immaturity that comes with such a young class. To overcome the emotional stress, I created a cue in an effort to relieve student' anxiety and still allow me to use disequilibrium to positively teach. Now, I begin by stating to the class that I am going to ask them a question about something that I may not have ever taught them and that they may not be sure if they know the answer. I then explain to them it is important to write or say what they think even if they are not sure it is correct because it will get their brain to start thinking. I found this cue to be successful with easing their stress. Just as carpenters use scaffolding to aid in building a structure, I was able to "make it easier for learners to undertake the task successfully and thus expand the possible learning activities and experiences increasing the rate at which learning may be achieved" (http://www.educ.utas.edu.au/users/ilwebb/Research/

scaffolding.htm).

One of my favorite subjects to use disequilibrium has to be math. During our whiteboard time, when students write their answers on a 9x12 dry erase lap board and show their work, students work to figure problems. They anxiously wait for the cue to show their boards, looking at their peers and me while pointing to their boards with big grins on their faces. When they show their boards, I point to who has the correct answer or state who may be close. Students feel at ease because they know I follow by doing a one to two minute example of how to solve the problem and then quickly write another similar problem on the board. The students work to find balance and pay close attention as they know they will only get a small glimpse of how to work the math problem. As seen by their persistence to work challenging problems, students are invested. They are delighted when accomplishing their mathematical task. Due to the brain power needed to figure the problems versus following a memorized algorithm, true learning occurs at a more rapid pace.

Since my first experience of learning through disequilibrium, I have encouraged my teaching peers to have their students attempt an inquiry-based approach. I have not had much positive response from the more experienced teachers, yet teachers new to the field have come to me interested. I have been talking with the principal regarding some changes toward inquiry- based learning. Perhaps I will play a more active role in supporting other teachers once new standards become active.

2009 Modular Refinement

Just as I had experienced disequilibrium in my first MAT summer course, I experienced a lack of balance again while creating my first modular refinement. I spent a large part of the summer engrossed by the difference in the 5E lesson plan compared to lessons I had created in the past. The 5E model begins with an engagement phase, accessing the learners' prior knowledge and promoting curiosity. The exploration phase follows providing students with experiences exploring questions and possibilities. Explanations come next giving students' opportunities to demonstrate their understanding of the concept and teachers directly introduce the concept. Students develop broader understanding when challenged in the elaboration phase. Evaluations of what students have learned conclude the phases (Biological Sciences Curriculum Study (BSCS), 1980s, n.p.).

I had used the Madeline Hunter lesson model and worked for my school district the prior two summers creating lessons using the Backwards Design lesson model (Wiggins and McTighe, 2005, p. 22). Throughout the summer course, I consistently found myself attempting to recognize the 5E phases of teaching/learning while the professor instructed the class. I was intrigued by the different style of teaching as the student accountability in the 5E model surpassed the other lesson models I had used. The Backward Design model was led by the teacher, lacked explorations, and somewhat mimicked the Hunter lessons. According to Craig A. Berg and Michael P. Clough, the Hunter "…model supports only the teaching of low-level facts that require only recall of information and low-level skills…" (Berg and Clough, 1990, n.p.). I was also impressed

by the professor's ease in teaching using inquiry methods. I questioned if I could teach as well as the professor I had witnessed.

When it came time to generate a modular refinement, I chose to produce extension lessons to the FOSS Science and Liquids Science Kit. I did this in an effort to practice making inquiry lessons based on the 5E model. Just like when I struggled to become comfortable with Hunter's model and the Backwards Design model, I knew it would take great effort to adjust to a new lesson format. I also believed the struggle to understand how to make inquiry lessons through the 5E model by BSCS would result in increasing my understanding of the pedagogy of inquiry and consequently make me a better teacher.

Researching the background of the Full Option Science System (FOSS) science kit, I learned my school district provides a variety of kits geared toward various grade levels and abilities. The solids and liquids kit, provided for first graders, focused on the introductory experiences regarding solids and liquids. Students explore differences between solids and liquids: comparing sizes of particles, various types of liquids, and mixtures of both solids and liquids (FOSS, 1995, p. 6).

The FOSS science kit provided comprehensive lessons and investigations that follow the Colorado Academic Standards (CAS) stating that physical science for first grade students includes, "Solids and liquids have unique properties. They each can be sorted/classified by their unique properties (shape, size, texture, color, etc) (Colorado Department of Education, Colorado Academic Standards, p. 28).

Although the science kit did follow the Colorado Academic Standards (CAS), I noticed the kit neglected to provide an appropriate bridge between the physical states of matter for solids and liquids. The *Benchmarks for Scientific Literacy* states students "…should become familiar with the freezing of water and melting of ice (with no change in weight), the disappearance of wetness, and the appearance of water on cold surfaces" (American Association for Advancement of Science (AAAS), 1993, p.67).

The extension lessons I made focused on providing the bridge in understanding that solids and liquids often undergo physical changes but remain the same substance. The lessons were designed using the BSCS 5E model and included all learning phases. Extension lessons began with students exploring solids changing into liquids, continued by adding heat or removing cold temperature to increase melting speed, and ended with liquids transforming again into solid form by decreasing heat temperature. One such lesson began with the engagement phase when students were asked if a solid ice cube could become a liquid and if so, how? After students wrote their ideas in their notebooks, they rotated through center activities exploring possible methods of ice melting. One center included rubbing ice between their hands, and another center entailed students using an eye dropper to compare dropping cold and warm water on ice cubes. Once students rotated through all their centers, they shared the data accumulated through their exploration and worked together as a whole group to arrive at explanations for the melting of ice. Conceptual understanding was applied later to an ice cream experiment and was used as a formative assessment to evaluate students' progress, providing information needed to adjust teaching and learning.

This modular refinement experience did give me the practice I needed to gain a better understanding of creating lessons using the 5Es, but it was also far from perfect. Some of the scientific terminology I used could lead to misconceptions. There were also additions or changes that were suggested by the professor to improve the lessons, such as using age appropriate vocabulary and including more opportunities for students to explain their learning. The professor also noted I reversed two phases of *every* lesson beginning with the exploration phase versus the engagement phase. I believe one of the best ways I or other students learn is by correcting mistakes. Learning from my mistakes increased my confidence in writing inquiry lessons and gave me the opportunity to refine aspects of personal science knowledge.

One of my professors offered very useful advice for the upcoming school year. He did not recommend modifying all of my lessons, but suggested trying different phases of inquiry to get comfortable. This advice took the pressure off of changing all that I knew and gave me the go ahead to experiment with my teaching throughout the school year. On a daily basis I tried different elements of inquiry. Unlike before, I did not answer all of my students' questions. I responded with questions. I gave my students more opportunities to explore and then added choices. My students began to explain their learning and eventually I figured ways to chart their information for better understanding. I modified the way my students used science notebooks. I pre-assessed students to gather their background knowledge and gave formative assessments to evaluate students' progress to guide my instruction. Units ended with summative assessments to evaluate the growth of students' learned knowledge. My first attempts of inquiry were not perfect, but as I practiced I got more comfortable and became a better teacher.

2010 Action Research

When I was first assigned to do an action research I immediately thought of the modular refinement I did using the FOSS science kit. When reflecting how important a strong base of science concepts is, I decided to, unknowingly to the science teacher, challenge the science teacher's focus on state standards. I thought it would be interesting to focus on physical science standards as a topic because I had a background of these standards from my (previous) modular refinement, but even more because the school where I teach used the same science kit. I had also taught the Solids and Liquids FOSS Science Kit numerous times until science kits were taken out of the classroom and science was placed into the specials rotation with music and gym. The science teacher in my school had just completed the Solids and Liquids FOSS Science Kit, and I pondered about how well my students actually understood the concepts of solids and liquids. I also questioned if I added a variety of inquiry lessons with more learner self-direction if my students' level of understanding would increase. Because the end of the school year was near and I had limited time, I decided I would do a short review of liquids and put the central focus on solids. The lessons for the action research incorporated some backtracking of basic concepts, additional explorations, and a variety of inquiry methods I learned throughout my masters courses. None of the lessons from my modular refinement were used.

My action research project began with the research question, "When students are taught using scientific inquiry, do they acquire higher level thinking abilities and understanding of subject matter when there is more learner self-direction and less

direction from teachers or materials?" I chose that question because of all the inquiry I have learned, it is what I struggled with most. The idea of releasing control to students and allowing them to create their own questions and experiments is far different from the style of teaching to which I was accustomed.

I began by researching the first grade science state standards and the first grade FOSS Solids and Liquids Kit, identifying the standards the FOSS kit focused on. The standards entailed: Solids have unique properties that characterize them. The evidence outcomes are: students can identify the similarities and differences of two or more groups of solids and also classify solids based on their properties. Students will justify the choice based on evidence (CDE, 2009). Once I knew the state objectives, I turned to the science kit's teacher manual to analyze whether the lessons effectively taught the state standards. Ultimately I found the manual's focus was properties.

I also used the table 2-6, Essential Features of Classroom Inquiry and Their Variation to classify if the kit's lessons would be categorized as more or less learner self-directed. (National Research Council (NRC), 2000, p.29) (Appendix). The level of inquiry typically fell in the teacher-directed categories. Because the science manual was more teacher-directed and my class had just finished the Solids and Liquids Kit in the science lab with the science teacher, I believed through modification of the manual's lessons I could make a comparative analysis using the pre and post-assessment.

To ensure I was teaching to the state standards, I created lessons to fill in where the instruction was lacking. I modified lessons to include more learner self direction. Students were given opportunities to pose their own questions and decide on their own

experiments. They were given opportunities to share evidence and make conclusions based on data. Once the lessons were taught, students were given a post-assessment to compare to the pre-assessment. 27% of the students were proficient on the pre-assessment and 100% of the students were proficient on the post-assessment.

Initially I concluded when students are taught using scientific inquiry with more learner self-direction, they do acquire higher level thinking abilities and understanding of subject matter. Now I do not believe that the research supported my conclusion. First of all, I do not know if the science teacher and I taught the exact same lessons with the only difference being the amount of teacher or student direction. Next, I added lessons based on the state standards. Basically students were given additional lessons I created to fill in any missing gaps based on the standards. Finally, prior to the science teacher's instruction the students had not been exposed to the kit. When I began my higher level version of instruction, they had already been exposed to the kit and had acquired background knowledge of solids and liquids. My research was flawed making the results inconclusive.

Even though I now believe my action research was flawed, I learned a lot. When students are given the opportunity to make their own choices, they are excited to learn. They immediately wiggle in their seats, attempt to whisper or sign their choice to peers, and often do not pay much attention to the teacher. From this I have learned to give choices last when voicing procedures. I have also learned it is difficult to do an effective action research due to all of the variables that can come into play when experimenting with real life situations. Teachers, students, and instructional practice is far more difficult to research than a study in a controlled lab.

2010 Action Research, State Standards

After my action research, I realized teachers who are not properly taught how to create lessons beginning with standards put their students at a disadvantage. I am fortunate to have started college on the cusp of when standards and benchmarks became the central focus for lesson planning. In college I was taught that all lessons are derived from standards. Once receiving an educational degree at Virginia Wesleyan College and hired at a primary school in Virginia, I observed some teachers struggle with change. It became apparent that many teachers who had taught for years often had thematic units that entailed a variety of standards, but the focus was on apples, whales, or perhaps a rain forest. Standards were hit and missed and often derived from whether or not a worksheet had an illustration that went with the occurring theme. What seemed an easy modification of using themes to increase interest when teaching the standards, tenured teachers struggled with the change and fought it. After my first year of teaching and moving to Colorado, I experienced what seemed to be a step back in time. Standards and benchmarks were published, but not enforced…yet. By my second year teaching here, I began to see the change in administration enforcing the central focus of standards. Once again I witnessed competent teachers struggle with the change as I became a leader in modeling what I knew as to be the only way to create effective standard-based lessons by the way I learned in college.

All of my past and current lessons begin with standards, but I have learned additional ways to map the standards through explorations done within a number of MAT courses. The *Atlas of Science Literacy* contains a variety of webs that pace the appropriate scientific knowledge students should obtain according to grade level

(American Association for the Advancement of Science (AAAS) and the National Science Teachers Association (NSTA), 2001, p. 59). This gave greater insight to the background knowledge needed for students to move forward in learning science, and gave me greater understanding about how scientific concepts build on each other.

Looking back at the action research I did using the FOSS Solids and Liquids Kit, the implementation of state standards played a vital role when making lessons with more learner self-direction. Because the common theme of the state standards is *properties*, it was imperative students truly understand the concept of what a property is for them to apply it to solids. I began by investigating the Solids and Liquids FOSS Science Kit and found the first investigation/exploration had students describing solids using properties and the second investigation entailed students sorting solid objects in a variety of ways based on their properties. I felt the investigations were premature when considering the lack of background knowledge many students might have of what a property actually is. I decided students would benefit from a variety of explorations that focused on using the senses to identify properties.

According to state standards, students should be able to identify similarities and differences of two or more groups of solids. The FOSS Kit did have one investigation where students sorted solids, but when I gave an assessment that required students to write similarities and differences, they failed miserably. I attribute this failure to lack of experience in verbalizing or writing the observations. I believe one opportunity to sort objects is not enough to master the concept. I chose to add an exploration that required groups of two or three to write how properties of two chosen solids were similar and different, and then verbally explain their data by reporting out to the class. I believe this

method of inquiry creates more accountability of learning on the student's part, when all partners do what is required of them. When personally taking part in group activities in the MAT program where we had to report out, I was more involved because I did not want my group to look like idiots, and it also tugged on the competitive edge of me wanting to possibly have a better product than other groups. My students surprised me with the group report strategy because overall students were very excited to share their findings and most often wanted to be the reporter. Some groups also pre-planned what each student would report out.

The most important conclusion solidified what I have always believed since beginning of my career when standards were first being enforced. Manuals, in any content area or kits for that matter, are not the end all be all. To be an effective teacher, one must begin by researching the standards, and not trust a manual made by a company as always the best or only resource. The FOSS Solids and Liquids Science Kit provides a variety of inquiry-based explorations and is a wonderful tool to guide instruction, but teachers should not take the explorations for granted when considering the standards. When researching Table 2-6, Essential Features of Classroom Inquiry and Their Variations, most of the kit's explorations were at the more structured level of inquiry (NRC, 2000, p.29). Altering lessons and giving students more choices and opportunities for exploring, increased their background of experiences. Had I not challenged them at a higher level of inquiry forcing them to be more accountable for their learning, they would not have made the growth needed to reach a level of proficiency. Teachers must put in the effort to improve lessons and locate additional resources when manuals do not entail all that is needed to teach standards effectively. Interestingly, since having this teaching

experience, the FOSS Science kits have been revamped in an effort to be aligned closer to the standards.

2010 Action Research, Explorations

Unlike teaching to the standards, allowing students to explore with more self-direction has been my greatest struggle. I have always been a fan of hands-on learning. I recall sitting in the classroom acting as if I understood the teacher lecture, only to find my eyes wandering once a worksheet was handed out. I have since learned ways to combat this happening to other children by means of inquiry. Although initially I went through a state of shock when beginning my MAT courses, forever my style of teaching has changed to support all students by having them invest in their own learning through instruction of all of the inquiry phases. Now I have replaced what I consider spoon fed information, with opportunities to explore given questions.

Early in my teaching career, I learned the proper way to teach began with an anticipatory set that led into modeling a skill or concept. It now seems the reason for the anticipatory set was to get the students excited and maintain their interest through the modeling part of the lesson. I have always modeled the concept to be learned and controlled all aspects of the lesson. *Prior to taking my INS courses*, I chose to modify the FOSS science lessons as I believed all lessons should be modeled first. An example of how controlling I was is when I taught the Solids and Liquids Science Kit, the same kit I eventually would do my action research on. One exploration lesson involved students using a variety of solids to create a structure. The structure was to be built with the

objective of having the greatest height possible. Through hands on experience and exploring, students were supposed to figure out how to successfully create this structure. Instead of allowing students to explore and learn through the experience, prior to the exploration phase I modeled how to make a base and ways to use the aluminum foil to gain height. I additionally robbed my students of thinking by modeling how to classify similarities and differences of liquids and solids prior to students discovering them on their own. I believed I had improved the kits when in actuality I had removed the strength of teaching through inquiry. I lacked the knowledge of the reasoning of what made inquiry such a valuable tool in teaching.

Once I began learning the pedagogy of inquiry, I knew I had made pivotal mistakes with the modifications I made to the FOSS science kits. Although I could not change what I had previously taught, I now knew a purpose behind the way the explorations were written to be taught. I was then able to experience teaching the Foss science kit with new eyes and compare the learning to how I had modified the lessons. Perhaps the biggest impact I observed was the level of investment students had in making their own discoveries. Yet in hindsight, another discovery I made my own transition from beginning teaching with less learner self-direction to modifying lessons to having students take on more self-direction in creating their own experiments, exploring, collecting data, and making sense of evidence in order to explain what they had learned (NRC, 2000, p.29).

The crest of my belief in teaching through inquiry came by meeting my worst teaching fear of all: letting go of control and handing it over to students. This happened when teaching the final exploration in the Solids and Liquids FOSS Science Kit. I

believed for me to fully experience teaching through inquiry, I needed to modify the kit's lesson and allow the students to arrive at their own experiments of identifying what is a solid. First, one must understand that if I were to lay a variety of solids and liquids on a table, students could point out the objects that were solids and the objects that were liquids, but could they state why a solid was a solid? From prior discussions I already knew students could report that a liquid takes the shape of its container.

I began by asking the students what a solid was. A number of my students answered with, "I don't know," but many did list properties of solids. I challenged those who listed properties and had volunteers report a property that made their solid a solid by showing them a solid that lacked the property that they stated. If a student said a solid is flexible, I showed the class a rock and restated my question, "What is a solid?" If a student said a solid is hard, I showed them a cotton ball and asked my question again.

After discussing the dilemma with my students, they decided they should do some experiments to obtain the answer of what makes a solid a solid. It was necessary to model the thinking process of constructing an experiment since the class had never done anything like this before. I also modeled how to fill out a data sheet. Once I modeled my experiment, I told the class they would break into groups and write three ideas for their own experiments. This task was much greater than I thought. Many of the students just sat there in their groups speechless. While many were afraid to take risks, others raised hands to get a feel for boundaries. In hind sight how would they know how to come up with an experiment to determine what a solid was? This was my first time trying this experiment thing too. So…I took a deep breath and began asking questions to scaffold the students. It appeared once a group was confident with one experimental idea they

could easily come up with more. This process took so much time all I could do was collect their ideas for that day.

When the class was gone for the day, I considered deciding on one of the experiments by myself because I was so overwhelmed. Fortunately the next morning when I awakened and my head was clear, I decided I would list the safe experiments on the board and still allow my students to choose their experiment. I had all the materials needed for all of the experiments, and I provided a variety of solids from which to choose. Once the groups decided on their experiment, they gathered their materials and began. Of course every group chose the same experiment of putting their solid in water. I did not observe any students who were not invested in their experiment. I did need to ensure they were using their data sheets, and only one team was unsuccessful documenting their findings. As the experimenting ensued, I leisurely walked around the room asking students about their findings and scaffolding when needed.

The following day we came together to consolidate the data and make note of any similarities in the data that was gathered. As I wrote the groups' data on the board, I was able to guide students to a common similarity that numerous students had noted. "The solids had maintained their shape." The Kleenex tissues led to another discussion because they were squished by the students to get the water out. I did the experiment again in front of the class to show that if they gently unfolded the tissue after being squished, it could still take on its original shape. The discussion with the tissue initiated another discussion of how many solids' shapes can change if an outside force comes into contact. Students observed volunteers breaking crayons, crinkling paper, etc. We held a short discussion of heat coming in contact with solids. Although ideas and discussions

were swarming around the room, I felt I was still able to redirect the students' focus on the concept of solids maintaining their shape. Students made wonderful growth in their understanding of the concepts of solids when I assessed students' growth at a later date. The pre-assessment scored 27% of the students to be proficient and the post-assessment scored 100% of the students proficient.

From teaching all levels of exploration, the greater the learner self-direction, the greater the personal investment is. Most importantly I modified my teaching from *always* modeling to student discovery through explorations. Teachers need to have a balance of instruction. Some skills are best introduced with modeled teacher instruction, but explorations can play an integral part in teaching even after a concept has been modeled. Phases of inquiry should be placed in lessons where they best fit for optimal instruction. I have taken part in a variety of discussions, with my teaching peers, of this style of teaching and have often witnessed many scoff at the notion of letting go of "modeling" lessons and replacing some modeling with exploring. I do believe the conversations have had an impact on some as seen by their willingness to observe or discuss it.

Explanations

Some of the more powerful moments of inquiry are when "learners formulate explanations from evidence" as per table 2-6, Essential Features of Classroom Inquiry and Their Variations (NRC, 2000, p.29).

Prior to when I began my masters classes I had students explain their thinking, but not to the level for which I now hold them accountable. Basically the lowest level of explaining I had my students do was turn to a peer and repeat *my* explanation of

something, such as, “Turn to your partner and tell them a compound word is two words put together to make a new word.” When looking back at this so called teaching, it actually seems quite embarrassing. I expected them to recite my words versus synthesizing what they learned to make their own sense of it. Some examples of students formulating explanations and using evidence, prior to me taking any of my master’s classes, are when I had my second graders using a reading series called Junior Great Books. The series is used for students who are higher level readers who need to be challenged. After students read the story of the week, we entered a discussion circle where I posed a question to begin and students answered the question using evidence from the story to support their position/answer. From an initial discussion, other students were encouraged to use more evidence from the book to provide additional support or to also dispute the response/s. When students are first exposed to this type of discussion many sit idle, but through encouragement and modeling seven year olds can be surprisingly effective in proving points of conversation once they become proficient in locating evidence in the text to support their position/answer. By no means is this an easy task to teach, but once a couple of students get the gist of it, others grow from peer modeling.

Some of the best examples of using evidence to formulate explanations were in the INS classes: Chemistry of Fire, The Chemistry of Smell, and Matter into Mountains. As my knowledge of the BSCS 5E Instructional Model improved through class experiences, I began to recognize it more easily in a variety of activities used to teach the pedagogy of inquiry. Some of the simpler activities may have looked like an independent response in the science notebook using data from an experiment or a reading article.

Other examples of explanations from evidence I have experienced when taking my masters classes include cooperative grouping where groups of students were given a task, gathered evidence, and shared the data in a whole group setting to be analyzed along with all of the other group's evidence. Student data could be displayed in a variety of ways such as using poster boards, document cameras, lists, etc. Sometimes the data/evidence was verbally reported out to the instructor and color coded under categories through discussion and explanation. From this point the teacher could facilitate or scaffold a discussion where groups explained their outcomes and arrive at conclusions using the evidence. These discussions/explanations led to a better understanding of concepts and gave us a better picture of big ideas. The lessons were intentionally used by the instructors as an inquiry model to promote learning. Better yet, they gave teachers' experiences of good teaching to pass on to their own students.

Not until toward the end of my Smells class can I say that I fully recognized the inquiry teaching strategy of learners formulating explanations from evidence. Perhaps there is so much to learn when in it comes to inquiry that it begins like a fog and slowly the fog dissipates to where strategic inquiry teaching becomes more and more clear to those learning from it. I also believe experiencing this as a student opened my eyes and mind to the usefulness of this strategy. When my colleagues and I were teamed to explain information to others, I had to know and understand what I, or my group, was going to say or I risked looking foolish. Accountability was held high for I knew I might be asked questions to support our group's conclusions. In addition, when other groups shared information, I was comparing our groups work to others, looking for inconsistencies. When inconsistencies were noted, it clearly made a bigger imprint on my thinking.

Although when an activity was clearly nearing a close, I was still invested in my learning. I know from my learning experiences that it is a powerful teaching tool and will continue to seek out additional experiences for my own students to derive their own explanations using evidence on a more common basis.

I have now moved on to teaching third grade for the first time. I consider myself to be very fortunate to have started my INS degree while teaching first grade and then looping up to second grade, only to find myself still progressively teaching by now instructing third graders. I have witnessed the progression of how students at different age and/or grade levels are able to use their evidence and formulate explanations. From the first grade years where the majority of student explanations remained verbal due to the need of practicing of how to put their thoughts in words, and where I created the charts and graphic organizers. In second grade the verbal rehearsals continued, but students began charting their data to support their explanations. Currently teaching third grade, students can effectively display or orally reveal their evidence, but the challenge still comes in the actual formulation of explanations to a level of summarizing what has been learned from data collected. There is great range in the ability of students, possibly due to the number of experiences they have had in verbalizing their thinking combined with student cognitive ability.

At first I had to force myself to teach using this type of inquiry or as some say, *take the first step*, but guiding students to explain their thinking has given them an upper edge. Now that I have used this approach to teaching with a variety of grades, I have been fortunate to model this to other teachers through the Induction Program. The Induction Program is a program used to help beginner teachers become competent and effective

professionals in the teaching field. With state testing headed in the direction of using evidence to explain answers to questions, the explanation phase is critical in providing students with the practice needed to be successful.

Questioning

I have always used questioning as a teaching tool. The level of my questioning has evolved through the years beginning with the lowest level of questions where students answer by recalling information and answering in one to two words. Now I have students use higher levels of thinking to synthesize their thoughts and relay their ideas by explaining their answers using data to support their responses to questions.

When beginning my first INS class, Chemistry of Fire, my experience with questioning was confusing, as questions were asked before lessons were taught. Without having reference to the BSCS 5E Model, I initially misunderstood this questioning to be an anticipatory set such as in the Madeline Hunter Model. After exploring the style of inquiry teaching, I recognize questioning can have a variety of goals that go beyond catching a student's attention. Asking questions before a lesson lends itself to a formative assessment for teachers to learn the amount of accurate background information students have about content as well as learned misconceptions. Another useful tool for written responses to questioning is encouraging students to refer back to their science notebooks to reflect on where their journey of learning began and to add their new knowledge.

Possibly the greatest variation of how questioning is used through inquiry can be exemplified through the Matter Into Mountains course. As written in *Inquiry and the National Science Education Satndards,* "In the classroom, a question robust and fruitful enough to drive an inquiry generates a need to know in students, stimulating additional questions of 'how' and 'why' a phenomenon occurs…The teacher plays a critical role in guiding the identification of questions, particularly when they come from students" (National Research Council (NRC), 2000, p. 24). The professor leading the course modeled questioning throughout all of the phases of the 5E Instructional Model (BSCS, 1980s, n.p.). As my colleagues and I asked questions pertaining to rocks or formations, he responded with questions forcing us into a state of disequilibrium. We struggled to look through our science notebooks for data to answer our questions on our own. He used great restraint when scaffolding. My colleagues and I were encouraged to use our own minds, making a larger imprint in the memory and improving individual problem solving abilities.

Understanding the impact of inquiry questioning has taken my instruction to a higher level. In prior times when students asked questions, I answered them. Now I challenge their thinking by responding with questions that guide students to form their own answers. Teaching elementary students gives me the opportunity to teach all content areas and apply inquiry questioning throughout the day. A combination of verbal and written questioning throughout the day keeps students' interest high and motivates them. An example of this happened at the beginning of this school year while teaching third graders. We were reading a story with a focus on categorizing animals. As the story progressed, we noticed a spider in an illustration. Students began to debate if a spider

was an animal or not. Somewhere in the discussion, I was asked what the spider was, and I responded with a question, "What makes an animal, an animal?" Students had a variety of answers to this question and continued to look toward me for some sense of approval to their responses, highly invested in discovering if their definition was correct. To their dismay I never confirmed or denied any. I encouraged them to talk to their family about it. To my surprise, many students came back to school the next day after researching the question on the computer. The discussion was up for debate again, this time with students using information obtained by outside resources. The spider debate has continued throughout the year and currently into the fourth quarter of school.

When teaching reading, I often use inquiry questioning to get students' minds focused on main ideas of stories, predictions of upcoming events, or meaning of vocabulary. Questioning engages students to the point where they are impatient and begin exploring the story often before I am ready. In many instances, they should read along with me and discover the story as it unfolds. In addition, my students' level of interest continues to be sparked when teaching reading skills such as contractions, compound words, nouns, verbs, etc. When I used to teach these skills by modeling, students' eyes rolled to the back of their heads. One example of how I changed my lessons to include inquiry is I have them copy a couple of contractions and the words that combine them off of the board into their notebooks; I then ask them to work with a partner or individually to explore similarities and differences to see if they can explain how the words compare to each other. We often share our ideas and then explore the skill. During small group reading instruction I use questioning to the highest level. While students read, or after they have finished reading a chapter in their books, they are

directed to pose questions they have to their peers in the reading group. Students can be seen searching through their texts to find answers, often the child who asked the question will end up answering it.

Math is made up of rules and algorithms. Questioning mostly consists of what it would take to get the correct answer. The math series our school uses, *Everyday Math*, does promote more questioning. The publisher supports the theory that there is more than one way to answer a math question, often encouraging students to ask new questions to similar math problems. I must admit that most of the math I have taught has been based from teacher material versus student questioning. This could be improved by using a strategy I saw modeled in the Chemistry of Fire class. A poster was hung on or near the board that was titled something like: Questions I Have About Fire. As college students progressed through the course, they were encouraged to write questions about the science content on the poster. The questions were either discussed in class or supported with resources for students to find answers on their own. I plan to adopt this learning/teaching tool as it will provide the students with the opportunity to ask their own questions and take part in guiding future instruction.

Inquiry questioning works well when it comes to teaching students writing. In the beginning of the school year, I discovered I could ask students a question in a whole group setting and collect their answers on the board. I use a variety of graphic organizers to assist in organizing their thoughts. Collecting and posting their ideas helped support those who lacked background knowledge. As students heard and saw others' ideas, it triggered a ripple effect of students coming up with more ideas to the questions.

Ultimately when it came time to write, students focused on the writing skill versus thinking of ideas to write about. Once the class became more efficient in answering questions in their notebooks, I encouraged students to add other students' answers to their own notebooks if they agreed it was good information.

I have attempted to let loose of my need to control by giving students more opportunities to select among questions. I now give my students an assortment of writing prompts to answer versus when I used to post only one. I want to improve my instruction as I know if I allowed them to lead the lesson by having them state their own questions, investment of learning would reach a new peak. During the INS courses, my professor was very encouraging when stating how important it is to gradually add phases of inquiry to my instruction. The next step in improving my instruction is to have students voice/write their questions or concerns and allot time for student guided lessons.

Student Engagement

For others to engage in my spoken words has been important all my life. It only makes sense for people to want others to be engaged when one is speaking. From as early as I can remember, I wanted my voice heard and I wanted others to show a high level of engagement through eye contact and body language of interest.

As early as my elementary years I dreamed of being on stage where all could be entertained by my ideas and/or performances. From elementary age through college, I was in a variety school and church performances where all could be engaged by me. The

notion of teaching a class of 25 was exhilarating to the performer in me, as I knew students would learn more in my class than others because I could entertain them and keep their attention. For years I used theatrics and comedy to teach concepts. My students watched, laughed, and focused on *me*. As I would learn in INS program, the instructional focus on the teacher was wrong.

In addition to my theatrical teaching, I spent hours creating hands-on lessons that integrated thematic units based on holidays or social studies and science concepts. Students were engaged simply by the presentation of what was to come because they knew it would be fun. Once again, I was wrong.

My definition of student engagement when teaching whole group could be defined simply as students making eye contact and sitting still. After whole group instruction, most lessons included cooperative grouping such as Think-Pair-Share, "a three step cooperative structure. During the first step individuals think silently about a question posed by the instructor. Individuals pair up during the second step and exchange thoughts. In the third step, the pairs share their responses with other pairs, other teams, or the entire group" (http://edtech.kennesaw.edu/intech/cooperativelearning.htm). I also used Jigsaw, "…the class is broken into groups of approximately five students and each group member is assigned some unique material to learn and then teach to his group members. To help in the learning, students across the class working on the same sub-section, get together to decide what is important and how to teach it. After practice in these 'expert' groups the original groups reform and students teach each other" (http://edtech.kennesaw.edu/intech/cooperativelearning.htm). Students talked throughout the majority of lesson because teachers know that students should talk more than the

teacher. Student work was disguised in thematic crafts that often took on an art-like form. Cutting, gluing, and creating kept students interested in learning and gave them plenty of time to talk. Engagement, so I thought.

Every year when school ended, I used the summer to focus on an area of my teaching that could be improved based on the data I had collected throughout the year. I researched Best Practices and planned a way to incorporate a sense of flair when teaching the concept so students would be engaged. One summer I worked to improve my spelling program and discovered Bradley Phonics. Since spelling risks being a bore, I added in a variety of mini-cheers students did when a word was spelled correctly. I was confident my style of teaching was better than others because at least my students were engaged.

Following the summer of 2010, the MAT professors required us to make a video of our teaching. I wanted to get a good view of my students' behavior because being second graders at that time, they seemed quite wiggly and I questioned their engagement. What I watched on the video has forever changed my perception of engagement.

As I viewed the video, there I was at the front of the room entertaining. And there sat my students, surprisingly still for a group of seven and eight years old. After all, they were being entertained. When I asked the class questions, students raised their hands and when I cued for more students to participate more raised their hands. One or two kids were called on and the lesson continued. I watched the video spellbound. They were engaged, but not with the type of engagement that leads to true learning. My students were no different than a dart board. It was hit and miss with who was truly learning because it lacked student discussion and interaction of the concept at hand.

Most of my students had good behavior, yet sat there like bumps on a pickle. They had learned that as long as they sat still they were not held accountable for their learning. In addition, when viewing my students as they collaborated I witnessed them talking. They talked about their favorite television shows, who they played with over the weekend, what food they had in their lunch box, etc. They were not discussing the concept at hand, thus, lack of engagement. My teaching style had to change.

I now know students do not have to be entertained to be engaged. Engagement is an active effort taken by students to use their brain to think and learn through investigation, exploration, discussions, and sharing. I have discovered children need to be taught how to think about their thinking, metacognition. It is my job to teach them to be aware if they understand what is being taught or recognize if they are confused.

My initial focus related to the students with the least amount of engagement, the well behaved ones that did not raise their hands. For all I knew they were zoning out. I needed to find a way to ensure they were engaged and more importantly accountable. In the beginning of the school year, during a staff meeting, my teaching peers and I were shown a video of Power Teaching. Power Teaching is a fast paced style of teaching that most often entails the teacher stating a concept, students repeating what was stated, and then turning to a partner and repeating what was said. In addition, the use of student hand motions is encouraged to invite kinesthetic learning (http://www.youtube.com/watch?v=

eBeWEgvGm2Y). I recognized this style of teaching could rein in the students who normally were not willing to participate and those with the quieter personalities. Initially those students seemed to be more apprehensive and less willing to take part in activities

with their partners, but as time passed and partner work continued they eventually became accustomed to conversing with one another and taking on more of an equal partnership.

In another effort to raise engagement for students who are lower level learners, they are partnered with students whose abilities are a maximum of one to two levels higher. Students who may be considered high risk due to lack of attention or motivation, now find themselves held accountable. They have no choice but to be engaged as their partners do not waste any time to tell on them out if they lack effort. I have also discovered with this style of teaching it is much easier to identify students who are lacking in effort as their hands are failing to point or scan the text, and their discussion is often minimal.

In addition to Power Teaching, my philosophy of improving my instruction has also been altered due to a film shown during one of my MAT classes. The film struck a chord when a teacher spoke of how every summer she worked to improve her instruction, just as I always had. She went on to explain that her students never showed true investment in their learning until she allowed them to take part in their own learning through choices and explorations. Only when students were given this opportunity did investment pique.

Being the control freak I am, I admit it is very hard for me to allow students to take charge of their learning, but I am getting there. I have integrated a variety of ways students can improve their investment in learning by providing them with a variety of choice activities. One example of this is Vocabulary Choice Boards. Vocabulary

activities for the week are given on individual worksheets that are divided into sections. Each student is required to do three activities making a tic-tac-toe arrangement on their board, or are given a minimum number of must do tasks. During my writing block, I now give students freedom to choose what they want to write about or at least give them a choice between writing prompts. By giving students choices, they are much more interested in the task at hand and have more to write about. Students are much more interested so engagement and investment has risen. Prior to giving students choices, tasks were masked in art-like form, preventing the students from understanding the goal of the lesson. Now they begin with the goal and choose how to prove their understanding of the concept.

In my MAT course when I was told to make a video of myself, I dreaded the notion of seeing myself on camera as I knew I would see things I did not like. Yet, the video has catapulted my teaching to a much higher level. In our district, teachers new to the field or struggling in various areas of teaching come to my classroom throughout the year to observe my teaching and discuss ways to improve their instruction. I hope, through my modeling and discussions, teachers improve and become more efficient. I am confident my teaching style has improved from being the former entertainer of students to an engaged, invested classroom where students take charge of their learning. Utilizing science notebooks is one way students are responsible for their learning.

Notebooks

I had been using the science notebook with primary students for many years before going through the INS program and had always been quite proud of the work my

students did in them. Now that I have taken inquiry-based masters classes, the science notebooks I was once so proud of were far from the full potential of what they could have been.

The professors who taught The Nature of Fire, Chemistry in Science of Smell, and Matter into Mountains II modeled the basic set up of the science notebook, but more importantly they taught me the importance of using the notebook as a tool for learning. Through science instruction, I learned that an effective science notebook embodies an individual's own personal thinking. The notebook entails a time line of thinking, reflection, graphic organizers, sketches, data, disequilibrium, balance, and growth. With practice of my new found knowledge, I researched the positive qualities of my own students' notebooks. I looked for ways to improve the use of the science notebook and how to expand the notebook to all subjects in the elementary setting.

While looking through some of my former student notebooks, I did notice they entailed some positive qualities. Good things I observed were independent labeled sketches and personal connections. The sketches and labeling were done before teaching the content, showing pre-assessments or predictions. The notebooks also contained additional sketches during and after learning occurred. Though this was done well, I now believe the sketches in the notebooks could have been improved because most sketches were colorless and would have been more accurate with the use of color. Another strong characteristic of the student science notebook prior to my MAT classes was the evidence of vocabulary learning. Students drew personal connections to prior background information with the use of their own individual illustrations and written sentences containing the vocabulary word. They also defined the vocabulary in their own words.

Unfortunately these were the only items I noticed to be worthy of what can be considered good in a science notebook.

When looking at one specific notebook that resembled many from throughout the past years, I noticed the front cover was not labeled Science Notebook. It was labeled *Science and Social Studies Notebook.* I am certain this was done in an effort to reduce the number of notebooks students kept in their desk. In hindsight I cannot help but question how many students I confused by something as simple as a label. Science and social studies are clearly two different subjects in my mind, yet in six or seven year olds' minds there is no way they would have this clarity due to the lack of background in both subjects. Now, I would never consider combining two subjects in one notebook. Students need to have a clear perception of what both subjects entail.

In an effort to ensure clarity of subjects, my students now have a number of notebooks in which they work: science, social studies, writing, reading, and math. To keep the notebooks from cluttering up students' desks, all but the writing and math notebooks have a place of easy access located on shelves in the room. The writing and math notebooks are located in each child's desk because they are used more frequently. The reading notebook is used during small group instruction with reading groups and is kept in that area. The subjects of science and social studies are often rotated in an elementary setting. It is not a necessity to keep those specific notebooks in the desk at all times or one may find what was once a science notebook now contains a variety of math problems and past daily paragraph writing due to young students grabbing the first notebook at hand. One may question the importance of where notebooks are located, but

a key to keeping elementary students on track is to teach them the importance of organization.

In addition to the labeling and organization of notebooks in an elementary setting, I could not help but notice that numerous former notebooks were spiral versus composition. Many pages had been torn out, were falling out, and some were missing. This caused the notebook to be confusing because of the disorder of notebook in itself. When comparing the two types of notebooks, it is common sense that composition notebooks are the best choice for a neat, long lasting notebook. The difficulty in obtaining the proper notebooks lies within grade levels putting out a supply list created by the grade level teachers. The teachers must agree on the list. It has been a painstaking debate to get the first grade team to budge with a switch from spirals to composition. The most tenured teacher finally agreed to meet in the middle with the supply list by requesting half spirals and half composition notebooks. When getting ready to roll up to second grade, I was able to easily persuade the team and we had a supply list of all composition notebooks. At the end of the year after teaching second graders, I was informed I would be moving to third grade. The supply lists were already printed. I came into a third grade class with all students providing spirals. I hope to at least meet in the middle again as I did with the first grade team. I will continue to push for composition notebooks if only for the sake of better organization in a notebook where all pages can be maintained to be used as a resource.

For all of the courses I have taken during my MAT experience, all professors provided notebooks for us to use. Throughout the professors' instruction we were encouraged to look back in our notebooks for information previously acquired. It made

sense to use our prior leaning and apply it to our new learning, connecting our thinking. Prior to this observation, once my students finished a lesson in their notebooks, they moved on never looking back at their previous work. My teaching has improved greatly due to this change, and, without a doubt, student learning has been enhanced.

The students in my classroom are now taught to use every notebook as a learning resource. We search through the notebook pages from prior lessons to gather information to help with the job pending. During writing, students refer to the table of contents to locate their prior writing samples and resources. They are encouraged to go back to their prior written paragraphs and stories to revise, extend, and improve them. As students' knowledge of writing grows, they enjoy identifying former written errors and are fast to improve them. This has helped tremendously in the effort to teach a revising or editing eye. Located in the back of the writing notebook are reference materials, such as transition words, strong verbs, samples of imagery, or spelling words. The writing process has been improved because the notebook has become a tool. Students are invested in writing, identifying flaws, and continually developing their pieces of writing.

Prior to me taking various MAT courses, the most obvious mistakes of the science notebook and more embarrassing flaws were the numerous worksheets simply cut out and glued in the notebook. Page after page, worksheets were glued in notebooks with no apparent student predictions, reflections, questioning, or conclusions. There was no evidence of independent thinking about the work covered or discussed….just worksheets. Also when looking back through former students' science notebooks, I recognized evidence of teacher/student discussions that occurred through lists, Venn diagrams, and webs. But most writing appeared to be notes mostly derived from what was teacher led.

With the MAT classes I have taken and what I have seen modeled, I now know a science notebook which merely has worksheets glued in the notebook or only contains teacher led notes is subpar.

Science notebooks represent individuality. The notebooks of my students now entail students' personal predictions, questions, thoughts, and reflections. Students are given time to write their thinking throughout lessons using a standard pencil. After writing their own thoughts, students use colored pencils to show a line of learning. Students share their thinking with peers and use a colored pencil to add any of their partner's ideas. With this teaching strategy, I am able to identify and pre-assess students' knowledge yet allow them to learn from fellow students and add additional information to use as a reference to at a later time. When sharing as a whole group, students continue to insert accurate information but also cross out the inaccurate information. This helps to halt students from learning false information.

A feature of the science notebook I would like to improve is self-monitoring rubrics. I witnessed the use of them particularly during the Chemistry of Fire class and Chemistry of Smells class. Being a student who feels comfort in knowing the direction of the teaching objective, the self-monitoring rubric includes a number of learning targets and self assessment columns where the student marks their level of learning at different stages in the instruction. This type of rubric gave me the security of knowing what was needed to master the course and, more importantly, encouraged me to think about where my thinking was during the learning process, and where I needed to progress. Currently, and in the past, I have used rubrics when checking student writing. They have helped me stay consistent when correcting papers and have also given students the information

needed to improve their writing. I see room for improvement after observing the use of a rubric that goes beyond one task and includes the layout of all the content that is to be learned/taught throughout the course. To create a rubric such as this, I need to have a full understanding of the journey of the lessons from beginning to end, including all pre and post assessments. It would help to keep my lessons focused with the results of creating instructions that use time wisely and are less haphazard. The end result of making a self-monitoring rubric goes beyond improving student metacognition; it lends a hand to reducing lost learning time and increased well thought out lessons with clear goals.

Another important use of the science notebook is reflection. Initially when taking MAT courses, I recognized that professors assigned the class to reflect about their learning at various times in each course. I was not new to the power of reflection as I have learned in the teaching field it is often what separates low quality teachers from high quality teachers. I know my teaching has grown due to reflecting on lessons, behavior management, organization, etc. Through my reflection I have modified and improved lessons making me a better teacher. What struck me in my MAT courses was reflecting as a student versus a teacher. As a teacher it seems natural to reflect on what needs improvement, should stay the same, or be modified. But, as a student, reflection is different as it moves into the realm of thinking about thinking. When I first began reflecting about the concepts I learned, I responded in the notebooks with general summarized information. As time progressed, I realized the thoughts going through my mind during instruction were important enough I should write them down. I began leaving the left side of my notebook empty of teacher notes and using it as place for personal reflections of the information on the right side. My reflections included

questions from the instruction, aha moments, and even more importantly, connections of useful teaching tools that could be used in my own instruction. Reflection as a student had transformed me from doing an assignment to an everyday useful tool in monitoring my learning and improving my future teaching.

In the elementary setting, I have also used reflection, but in minimal ways. Typically my lessons conclude with me asking my students if they reached their learning goal or where they currently stand with reaching it. They each show me a thumb up, down, or in between. Now, while teaching third grade, during reading group, students are assigned to write reflections of their reading for every couple of pages read in their assigned reading books. With the exception of the reading groups, student's reflections have not been in writing, and I also have not given them opportunities to document their thinking when thoughts arrive. My plan is to challenge students to do the same as I did in my college courses, use the right side of the notebook for instruction and the left side for ongoing reflection. I believe students can be trained to pause and do mini-reflections. If students begin reflecting about their learning during the elementary level, it should help encourage this habit throughout their learning lives.

2010 Modular Refinement

My second modular refinement was titled, Thinking Skills Integrated in 2nd Grade Life Science. I wanted to produce a unit that would be of high interest to my students, but more importantly raise their thinking skills to a higher level so they could be applied to

all subject areas. To get my desired results, I needed appealing content and lesson plans that challenge my students to engage in metacognition.

When brainstorming engaging topics, I immediately thought of an animal unit I taught yearly. After teaching about animals for numerous years I accumulated numerous teaching materials. My primary students were highly engaged when learning about animals. At this point in my MAT journey, I also recognized the unit I faithfully taught was in actuality no more than a bone yard of worksheets and activities that lacked a central focus, ideally making it the best choice for my unit of improvement. I discovered my modular refinement's unifying concept when researching through the second grade Life Science Standards, "Organisms depend on their habitat's nonliving parts to satisfy their needs, and each plant or animal has different structures or behaviors that serve different functions" (www.cde.state.co.us/scripts/allstandards/COStandards).

I chose to incorporate the 'understanding' level of *Bloom's Revised Taxonomy* in all of the lessons throughout the unit. The verbs used in the understanding level align with the standards across all grade levels and are threaded throughout the curriculum of my district. For example, in first grade, science students should "analyze and interpret data regarding the similarities and differences between parents and offspring" (http://www.cde.state.co.us/scripts/allstandards/COStandards.asp?stid=7&stid2=0&glid2=0). The understanding level entails: "Constructing meaning from oral, written, and graphic messages through interpreting, exemplifying, classifying, summarizing, inferring, comparing, and explaining" (http://projects.coe.uga.edu/epltt/index.php?title=Bloom%27

s_Taxonomy). The standards require teachers to instruct using various levels of Bloom's Taxonomy.

I used the lessons from my second modular refinement the following school year when teaching second graders. Just as with many lessons used the first time, it was necessary to modify minor parts of lessons to make them more effective. Some of the lessons could have been improved with added background information and time for more reflections. I felt great satisfaction in creating a sound unit that I could continue building. Yet with everything positive about the modular refinement, I learned students needed multiple experiences to be proficient in the skills (classifying, comparing, contrasting, explaining, etc.) being taught. I plan to create multiple lessons giving students more experiences to explore these skills prior to using the animal unit. I believe the more experiences they have learning a skill and reflecting, the stronger their background will be.

2011 Action Research

The action research project I did in 2011 focused on self-reflection. Working in the teaching profession, I self-reflect on a daily basis. It has helped me improve my teaching instruction, behavior management, relationships with fellow workers, and more. Every school day I review my lessons, deciding what went well and what did not. From my review, I evaluate what in the lesson should be used again, modified, or discarded. I have also been successful in fostering good relationships with my co-workers because I am in tune to my peers' body language and responses during meetings. Self-reflection boosts

my relationships because I review the positive, negative, or flat discussions. I make certain to reflect on whether their responses were as expected. If not, I work to repair any missteps. I then make a conscience effort to improve my communication. Because self-reflection helped me improve professionally and personally, I believed if I influenced students to cognitively review their work noting what was correct or inaccurate they would score higher in their academic assessments.

My research question asked if students could substantially raise their punctuation and formatting scores when writing a friendly letter and addressing an envelope after self-reflection. I chose letter skills because I had not formally taught letter writing skills yet and felt it would give me a good base with which to start. My lessons did not include self-reflection until after the post assessment of the unit. To start the unit off, students were given the school address to use as their own and given a made up address for the addressee. All students were given a free choice as to the name that would go with the address they were sending the letter to. In addition, they were able to choose from an assortment of prompts when writing the body of the letter.

The research began with a pre-assessment, writing a letter and addressing an envelope. Results were dismal, just as I expected. 21% out of a total of 22 students passed the pretest on envelopes and one percent passed the pretest on the letter portion. Second graders typically have a limited background in letter writing due to their age, and technology replacing hand written letters. The next step was teaching the class how to format a letter and use the correct punctuation that goes along with letters and envelopes. The lessons I created were a variety of inquiry-based lessons. One lesson included students exploring the formatting of letters and envelopes. They were given the parts of a

letter (heading, greeting, body, closure, and signature) cut into individual pieces along with the pieces to be glued on the envelope: address, return address, and a sticker (to be used as a stamp). Their job was to use a model letter and envelope to guide them in gluing their own letter parts onto a piece of paper and envelope. The objective, was not easily obtained and included rich discussions between partners. Overall the unit was sound because when creating an inquiry unit one must know the objective of where the unit begins and ends before making all of the lessons in between.

After witnessing the unit unfold, a post-assessment was given. The class scores for the envelope portion was 93% proficient and the letter portion was 69% proficient. The letter portion of the test did not score as high as the envelope portion because there is more formatting and punctuation involved in the letter. The following day, students were taught one lesson with self-reflection as the focus. The lesson began with students examining a representation of a letter and envelope with correct formatting and punctuation. While examining the letter and envelope, they compared it to their post-test errors. Students then had to write the errors they made in their notebooks and what they would need to do to get it correct the next time. Afterward, students verbalized their data with peers. Subsequently, I gave the class another post-test similar to the prior one and got the following results: 95% of the students were proficient on the envelope portion and 88% were proficient on the letter portion.

I learned many things beyond the confirmation that self-reflection is an effective teaching strategy. Data should be collected and assessed in more than one way. The first action research I did only reported class results, limiting access to individual growth. For my second action research I produced bar graphs for each student giving all observers

information about each student. It was obvious when looking at the graphs certain students continually scored low, revealing learning or motivational issues. It also exposed students who scored high and needed to be challenged. When collecting data for the envelopes and letters, I scored both separately by punctuation and formatting. I failed to give an overall score for the envelopes including both the punctuation and formatting. I did get the breakdown and knew where to put focus for each individual, but a big picture would have been easier to see how the group did over all. A whole group picture would have also been useful in guiding my whole group instruction.

Currently I have two action researches in progress. Once action research entails the reading program our school uses, Open Court Reading. We have been using the program for approximately six years. After every story is an end of story test that is supposed to assess comprehension. According to the reading series, students should be assessed weekly (SRA/McGraw-Hill, 2005, p. 107J). Yet, every year the principal and literacy resource teacher had doubted whether or not to use the assessments. When starting third grade for the first time, the end of story tests came up again. Then, same as before, both of them conversed back and forth whether to use them. Other third grade teachers believed that the assessments were needed to prepare the students for the CSAP test. Working in first and second grade, teachers may have used the end of story tests, but not on a consistent basis. I saw this as an opportunity to put the argument to rest by choosing not to give the end of story test while my two teammates did on a weekly basis. At first I did not believe my students were missing out on much until I began using the practice CSAP booklets in November. The CSAP practice booklets are filled with stories and comprehension questions to be answered by filling in bubbles or writing short answers.

When we were somewhere in the middle of the CSAP booklet and I was conferencing with students, I realized some of my students were having difficulty understanding what the question asked them to do. The same students were not scoring well on the inference questions. At that moment I realized if I had been having my students take the end of story tests, I would have realized earlier who was struggling. I could have identified students' needs for remediation earlier in the year, I missed out on an opportunity and now, perhaps, my state assessment scores will suffer for it. The scores will come out in May. Although I am waiting for the reading scores to come in and be analyzed, I now know the end of story tests should be modeled and given to students in preparation for the state tests. I do not necessarily believe a weekly test is needed, but perhaps one every two to three weeks could be beneficial. If teachers do choose to give the end of story test more frequently, I am certain teachers will identify students who need support earlier in the year.

The other action research I am currently in the middle of is researching the correlations of the practice CSAP books to the Colorado state tests. Unlike my teammates, I had all of my students take the CSAP booklet practice tests as a weekly assessment. They read the stories and took the tests without any support until after they received their scores. Class scores were revealed to each student and we went over strategies and answers together as a group or individually. Whereas my teammates used the booklets to model test taking strategies or to be used as assessments, I chose not to model prior to giving the tests because I had modeled story comprehension in other ways earlier in the year and felt my students needed to explore if they could find the data to

answer the questions themselves. It would also give me the information I needed to focus on my students' problem areas.

I believe I will be able to gather useful information when correlating the booklet scores to the results of the state assessments because the data should also give information on the cutoff point revealing whether scores are advanced, proficient, or below. I reflected on my last action research realizing my scores were broken into two areas, bubble answers and short constructive responses. I know I will need to score booklets as a whole because although state results will somewhat breakdown the scores, all students will be given an overall score for each test (reading, writing, and math).

Leadership

Currently I hold a leadership position mentoring teachers through the district's induction program. The inductees new to the district visit my classroom throughout the year to observe as I teach. I conference with them about instructional or behavioral struggles they are having and offer advice and materials to aid them in their desire to improve. In addition to new teachers in the district, administrators identify low performing teachers who need assistance and have them join the induction teachers' group training. The lessons modeled always entailed best practices, "a method or technique that has consistently shown results superior to those achieved with other means, and that is used as a benchmark" (http://en.wikipedia.org/wiki/Best_practice). Since beginning my INS degree, my classroom atmosphere as a whole has advanced because of the pedagogy of inquiry I have adopted. I give students experiences to explore

questions, combined with a multitude of what I call a bag of tricks modeled from a variety of professors who have taught during my MAT courses. Tricks as simple but as useful as having students switch the color of their pencil when adding information from peers to discriminate between a student's initial background or understanding of a concept. I was first selected to support other teachers because the administrator who heads up the program used to be my first grade teammate and was impressed by my instruction. Now it has grown by word of mouth. I receive emails from various administrators asking if teachers in the field can come to observe.

Another leadership position I will be taking on is raising the rigor of second grade instruction. Typically I teach first grade and loop up to second grade with my students. Knowing both grade levels, I always felt confident of my first grade instruction as I knew how and where to challenge my students to prepare them for the second grade. Yet, when teaching second grade during the second semester I always felt like I was floundering. I talked with the third grade teachers regarding what their grade level students should know when entering third grade, but I never felt certain I was teaching to a higher level or that I focused on all that I should.

Last year when preparing myself for the switch back to first grade, I was informed by the principal I would be moved to third grade. While teaching third grade this year, the doubts of my second grade instruction were confirmed. There were holes in my instruction. We were not informed of the many *specific* requirements of third grade. In prior years, second grade teachers met with the third grade teachers about instruction progression and pacing, it did not compare to the wealth of knowledge I acquired from teaching third grade. Second grade teachers should have been introducing, modeling, and

having students practice numerous skills such as writing summaries, identifying the sequence of a text before or after an event, test strategies, etc. The flaw of the third and second grade discussions in prior years was to be too *general* for the second grade team to guide their instruction. One can only conclude that if this happened to the second grade teaching team, that it is also happening to all other grade levels. Next year I will be going back to second grade to facilitate the changes needed to improve instruction. I am confident our school's state assessment scores will rise once instructional rigor is improved.

A new opportunity of leadership has also been proposed to me due to my INS degree. My school's science teacher will be retiring after next year (2012-2013) and she would like me to replace her. In the elementary setting most teachers teach science with their own class using the FOSS science kits. My school is different. Our school's specials used to be typical of other elementary schools where gym, music, and art were specials that students rotated through every three days. Science was taught in the classrooms by the classroom teachers. My school modified this because the principal found that the majority of teachers were not using the kits with fidelity or chose to omit teaching science because of the time constraint with CSAP tests. To improve the quality and quantity of science being taught in the building, the principal changed the way our building's specials were done. For the last five years art has been taken out of the specials time and placed in the classroom and science has been placed in the specials rotation with a science teacher. Students go to science one to times a week.

Now that the science teacher will be retiring, she would like me to transition into her position. Next year I would team with her for all of the after school science club

programs and begin the process of teaching some of the science classes. I cannot help but have some reservation with the notion of leaving the classroom to only teach science, but perhaps the greatest reason for my reservation is that I question the effectiveness of the science program. For the last five years the percent of students, that go to my elementary school, proficient on Science CSAP has been drastically low: 2007 – 45% proficient, 2008 – 53% proficient, 2009 – 43% proficient, 2010 – 56% proficient, and 2011 – 45% proficient (http://www.gazette.com/Sections/infocenter/csapscores/appSession=80017744 8422596). For our school to have the focus we have on science and to be performing at such a low level is unacceptable. Changes need to be made. I have not voiced my opinion to the science teacher. I did agree to take on the after school clubs with her next year and collaborate with some of the science teaching, voicing my reservation of teaching science when she leaves. While I work with her, I plan on researching the program already in place and looking for gaps that are preventing our school from scoring within the 80% proficient range. Another variable that may assist the science program is the new principal who will start next year. She has an INS degree and was once one of the head administrators for the Foss science kits. Possibly if we work as a team to build the program and guide it into a better direction, our scores will begin to improve. By the end of next year we should know if the program is salvageable or the turn of events that may be needed to improve its overall effectiveness.

I know leaders in the teaching field are important. Within the next ten years I plan to continue my education, improve my instruction, and make a positive impact on other teachers' instruction. Possibly when I am ready for a new challenge, I will move

from teaching elementary students to teaching adults who want to become teachers. Wherever my future lies, teaching is and will remain my passion.

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inquiry-based teaching and learning occurs when students' experiences are described by the left-hand column in Table 2-6. However, students rarely have the abilities to begin here. They first have to learn to ask and evaluate questions that can be investigated, what the difference is between evidence and opinion, how to develop a defensible explanation, and so on. A more structured type of teaching develops students' abilities to inquire. It helps them learn how to determine what counts. The degree to which teachers structure what students do is sometimes referred to as "guided" versus "open" inquiry. (Note that this distinction has roots in the history recounted earlier in the chapter as Schwab's three approaches to "labora-

Table 2-6. Essential Features of Classroom Inquiry and Their Variations

Essential Feature	Variations			
1. Learner engages in scientifically oriented questions	Learner poses a question	Learner selects among questions, poses new questions	Learner sharpens or clarifies question provided by teacher, materials, or other source	Learner engages in question provided by teacher, materials, or other source
2. Learner gives priority to **evidence** in responding to questions	Learner determines what constitutes evidence and collects it	Learner directed to collect certain data	Learner given data and asked to analyze	Learner given data and told how to analyze
3. Learner formulates **explanations** from evidence	Learner formulates explanation after summarizing evidence	Learner guided in process of formulating explanations from evidence	Learner given possible ways to use evidence to formulate explanation	Learner provided with evidence
4. Learner connects explanations to scientific knowledge	Learner independently examines other resources and forms the links to explanations	Learner directed toward areas and sources of scientific knowledge	Learner given possible connections	
5. Learner communicates and justifies explanations	Learner forms reasonable and logical argument to communicate explanations	Learner coached in development of communication	Learner provided broad guidelines to sharpen communication	Learner given steps and procedures for communication
	More ← **Amount of Learner Self-Direction** → **Less**			
	Less ← **Amount of Direction from Teacher or Material** → **More**			