Science Autobiography

In APA Style

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Autobiography Part I

A Surprising Journey

Obtaining a vision for the breadth and depth of science has taken years to develop and will continue for the rest of my life. Learning more about the visible and "invisible" world and the inner workings of all types of matter has continued to peak my curiosity over the years. As I reflect not only on science education but also the educational strategies of a high school Chemistry teacher, I have developed a passion for cultivating the same inquisitiveness in others. Surprisingly, teaching science was never my original interest or aim. The wonders of the natural world captivated my attention and compelled me to learn more about the world wherein I live, breathe, and have my being.

In this exposition I hope to accomplish the following: 1) explain how my vision of science education has developed from my early years to my current life as a science educator, 2) explain how my theoretical framework of science education has developed and changed over time with the various life experiences that I have had, and finally, 3) to explain how I employ the theoretical structure on a daily basis while interacting, educating, and learning within my classroom.

Each lover of science has his or her own personal narrative to describe past experiences and present reality. Throughout my journey I have been asking:

- How would I listen to, learn from, approach, and interact with different cultures in the teaching and learning of science?
- What are appropriate academic and personal expectations for students learning science?

My unique story has been shaped by people, events, and circumstances. I could have never expected to be teaching science and studying the best practices within science education. I trust

that as you read my story, your interest will be piqued as you see how science and education have become such a significant part of my life.

Bounding into the Wild

There exists no coincidence why I love science so much and why I pursue the subject with zest and vigor. At an early age, one would find me in the woods during the spring and fall picking huckleberries and teaberries with my grandfather. As a young boy, I would jump at any opportunity to go into *the wild*. Curiosity for the natural world oozed from my pre-adolescent pores. My family would go camping several times a year into remote areas of Pennsylvania. Endless hours of playing in the woods and discovering what was around the next tree or under the next rock satisfied my hunger for learning new things. At the age of eight, I joined the Cub Scouts. A few years later, I enrolled in the next level, Boy Scouts. By my sixteenth birthday, I had achieved the rank of Eagle Scout. Outdoor activities such as camping, hiking, fishing, and hunting were common throughout my teenage years.

Academia: A More Inquisitive Step

Until my middle school years, life outside the classroom offered more intrigue and pleasure than reading, writing, and arithmetic. Influential parents and teachers encouraged me to focus on schoolwork by redirecting my curiosity towards science. By linking academia with my previous outdoor experiences, several high school science teachers pushed me to take honors Physics, Chemistry and Organic Chemistry. Mr. Leuschner, my high school Chemistry teacher, made the abstract information relevant to my previous experiences. Dr. Dively brought science to life with demonstrations and labs that related to the material. Among others, these two educators had high expectations for achievement and were available to explain information when

frustration struck hard. Driven toward success, I gained momentum while attending Advanced Placement courses, which prepared me immensely for college coursework.

At the conclusion of high school, science meant knowing how things worked in *real life applications* and *experiencing* science whenever and wherever possible. As my college years loomed ahead, information and experience formed unforgettable relationships that whetted my appetite for further science education.

Follow Your Heart (and Mind)

With my college admissions interview at hand, I had no idea which major to pursue. One particular teacher, Mr. Leuschner, believed in my chemistry abilities before I ever realized that I was gifted in the sciences. Although I was a driven student in all subjects, he focused me toward the love of science, specifically Chemistry. He openly recognized my achievements in Chemistry class. One such achievement was the *Top Chemistry Student* award, given to the senior who displays the very best academic achievement. I was excited that someone pursued me as a student by identifying my strengths. Heading into my undergraduate studies, I majored in Chemistry. The thrill of studying science would need to stretch deep and wide over the coming collegiate years.

The Road Less Traveled

Other interests besides the sciences grabbed my attention in college. One interest was an off-campus ministry that involved teaching young inner city boys at a detention center. Each week I was encouraged to teach a mini “life-lesson”. Having never taught in a formal setting, these first few sessions scared me. Their cultural language and experiences were very different than my own. I was also scared being in front of a crowd, managing people, time, and content.

My involvement with the ministry continued throughout the four years of undergraduate school and became the jumping off point into my teaching career.

A second interest arose during each of the four summers during college. I had the opportunity to be a wilderness camp counselor. Not only was I in charge of ten young boys throughout each two week camping period, but there were also teaching responsibilities in eleven different instructional areas (canoeing, swimming, archery, etc.). Managing ten year-old, energetic children as a camp counselor and teaching kids to love the outdoors was such an odd combination. I was an outdoors teacher who loved science! By combining my love for science and the outdoors with a budding interest in instructing pre-adolescents and teenagers, my worlds were colliding.

My greatest period of growth in leadership, management skills, and instructional improvement occurred during the four years at Grove City College. I could have never orchestrated an intermingling of such varied interests in my life-long passionate pursuit of science and science education. Science, no longer a set of mere facts, became a component of understanding the world at large. In combination with my love for the outdoors, teaching provided an avenue to express my passion for science. Though an unlikely and unexpected road for me to travel, the desire to be a "science educator" meshed well with my other gifts.

Hit the Ground Running

After realizing that I did not want to work in a laboratory focusing on individual (and impersonal) science inquiries, I quickly added science education to my degree during my junior year at Grove City College. This shift in life was huge. I was encouraged through the teaching experiences I had with the off-campus ministry and the wilderness camp. Another influential teacher pushed me in the direction of teaching science to inner city students. Dr. Mackey

became such an integral part of my life during my senior year of undergraduate school. Similar to Mr. Leuschner, he believed in my abilities, specifically to teach urban youth even when I did not realize I was gifted or interested in this area. After several field experiences in the inner city schools of Pittsburgh, I asked myself, "Why should I be teaching science to urban students?" I was skeptical that I could reach students who had grown up so differently from my suburban, "outdoor" experience. How could they relate to a teacher who had seen rabbits, deer, and other wild animals up close when they rarely had the opportunity to even visit the city zoo? What would bridge the teaching and learning of science? Many questions churned in my mind as I started the second semester of my senior year.

Dr. Mackey provided me with an opportunity teach for a semester in inner city Pittsburgh while finishing up my college coursework. He encouraged me to get into the classroom to gain confidence and experience. Though I was teaching an SAT preparatory course instead of science, I grew in my ability to write curriculum, instruct teenagers, and manage a classroom.

A Promising Career Path

Following the Pittsburgh inner city work, my student teaching experience consisted of teaching two very different types of students. An eighth grade Physical Science class and an eleventh grade Chemistry class provided opportunities for me to share my passion for science on a very practical level. The students were from a rural area and had experienced a drastically different world than the inner city students I taught previously. Initially, I presumed that once they were engaged in the material the students would be highly interested in learning every scientific detail. Unlike the eleventh grade class, the eighth graders were enthusiastic and had a sense of curiosity. It was harder to motivate the older students, and I often felt as though I needed to impress them with the science content in order to gain their attention. Some of the

students responded but most appeared to just go through the motions of science class, doing whatever it took to secure a good grade. I assumed students would grow to love science like I had, but reality struck close to home as I realized not every student has an innate love of science. After student teaching for a semester, I looked forward to the day when I could manage the entirety of my own classroom.

My love for science education drove me to Center City Philadelphia. A newly formed public charter school hired me as one of their very first Chemistry teachers. I was responsible for teaching both physical forensic science and general chemistry. The students grew up in a very different environment than I had: barely any trees or wildlife, few opportunities to be outdoors, and hardly any shared experiences similar to my own. Situated in the heart of the city, many students traveled from North, South, East and West Philadelphia to attend school. My teaching began mid-year, a starting point which resulted in a rough transition for this new teacher. As I discovered who I was as an educator, my developing teaching philosophy included the idea of "Giver of Knowledge." I imparted science knowledge as though it oozed from my skin. Surely students would partake of the wealth of knowledge that overflowed in my lectures and instruction! I thought that the students would automatically care about science because I cared about science, yet this was most certainly not always the case. I was passionate about teaching science and did my best to survive those first five months. Classroom management was a challenge, and relationship building was practically nonexistent. I tried to teach the basic facts about science, struggling to relate to students who seemed so very different than me, or were they?

On the Brink of Change

A shift occurred in my thinking after one and a half years of teaching. I wondered, "Why should they care about science? Why should the science material I am teaching matter to them?" I questioned what science education should really be about. I questioned whether these students were really that different than me? Deciding that instead of trying to make them scientists, my goal of science education would be to encourage my students to be more interested with the visible world. Just as I had experienced the natural world as a young boy, I desired my students to become more scientifically literate of the world at large. I re-examined how I became interested in science and remembered that my love stemmed from curiosity. Instead of assuming that my students would love science, I piqued their curiosity; much like the influential people in my life had done so magnificently. Science education became more than learning mere facts. The discipline now involved the stirring of students' innate curiosity about everyday life.

A second shift occurred after attending a Process Oriented Guided Inquiry Learning (POGIL) workshop in the summer of my first full year of teaching. The workshop took place at Franklin and Marshal College and included how to write curriculum and compel students to actively think about science. Inquiry learning was very different from the way my students were currently gaining knowledge in my classroom. I changed the structure of my class, including fewer lectures and more inquiry-based assignments. With this newly found style of instruction, I could envision students truly *experiencing* science education. Labs, demonstrations, and inquiry-based worksheets related to real world problems became standard procedures in my classroom.

As I devised inquiry lessons, a quote from a recent professional development guided my thinking: "The person who does the work does the learning." The change in my classroom continued as the emphasis switched from teacher-oriented learning to student-oriented activities

and learning. Students assumed more of the responsibility of science education. Surprisingly, students responded positively to the increased workload and expectations. Both their desire to learn science and their curiosity about the world around them increased dramatically. As an added bonus, I left school each day refreshed by the thought that students were completing the assigned work, learning science, and having fun in the process. Never one to settle for less, I have continued to ask myself what else I could do to improve science education in the classroom.

Autobiography Part II

The Context of Content

Since the beginning of my journey as a science teacher, I have had the opportunity to reflect on my practice in various ways. My experiences in the classroom provided insight that lead to an alteration in my mode of science format and presentation. The shift from lecture style learning to inquiry learning dramatically changed science education within my classroom. From strictly pedagogy to new methods of presentation, I quickly came to realize that learning science greatly depends upon the intrigue of the material and the practicality and applicability to life. When teaching bored teenagers, context dictates the acquisition of content.

A Keen Observer

Observing professional educators interact with students and science material provides effective ways to learn more about science education. For two months in the fall of 2007, I had the privilege of serving as a cooperating teacher. I learned to analyze teaching routines, classroom structures, and pedagogical tools as I explained and described my own pedagogy. I slowly released responsibility to the student teacher by increasing her teaching load from zero to three classes. This experience became quite involved due to the commitment I had made to the student teacher: to educating an aspiring professional within my classroom. After a few days of

observing the student teacher, I noticed the tremendous hurdles of student/teacher interactions in science education. As a result of my observations, I implemented the use of video and conversational analysis to aid in our understanding of classroom interactions. I did not expect to spend most of the student teacher instructional time on student/teacher interactions. For students to grasp science content, I need to first address the poor teacher/student interactions in the classroom.

I could relate to the student teacher's struggles; she and I had much in common. She grew up in a rural part of northern Pennsylvania, while I spent the first twenty years of my life close to the Blue Mountains of Central Pennsylvania. She had not been exposed to many different cultures just as I had never experienced an inner city environment until college. With a limited exposure to other social and cultural backgrounds, she struggled to relate to the students on a personal level. Day after day, I sat on the side as a watchful observer. I took notes on her interaction with the students and their responses to both the science material and her practice, style, and comport. I struggled to let her lead the class, especially in light of the conflicting classroom interactions. Spending an hour each day to coach her on positive social interactions, I provided her with opportunities to learn to value social and cultural capital. By the end of the two months, the student teacher had significantly more positive interactions with the students, and learning within the classroom improved. She grew to realize (and appreciate) the importance of positive students/teacher relationships in the acquisition of new material. I grew equally as much, learning that science education was so much more than a particular presentation of content.

During my time as a cooperating teacher, I observed and learned a few main principles that continue to guide my teaching. First, I learned to actively listen to student concerns, inviting

students into the classroom conversation as oppose to dictating the classroom through teacher authority. Students should experience and appreciate ownership in learning and feel connected to the activities and education within the classroom. Students would not be able to learn effectively without a "listening" teacher. I sought to listen actively through co-generative dialogues or brief one-on-one conversations. Second, I learned to engage students in conversation and dignify their responses, thoughts, and questions. Nearly everyday I witnessed the need for student/teacher involvement that encourages learning by drawing students out of their shells, boredom, self-consciousness, etc. Just like adults, teenage science students thrive on approval and security. This reality became clear when I heard students whisper timid answers under their breath or watched as students hesitated to respond. During these moments of student insecurity, I learned the crucial task of following through with a student's train of thought when I did not understand the question, answer, or cultural difference. Persevering with students and caring for them as individuals undoubtedly builds social and cultural capital. An atmosphere of respect fosters growth. When a student knows that she can fail and yet still have a place in the learning process, the classroom culture offers hope – not shame – to uneasy learners. Students who feel safer are more likely to risk learning challenging science material. Within my classroom, each student/teacher interaction, however grand or minute, became crucial in the process of teaching and learning science.

Third, I learned to be transparent as a teacher. Admitting to wrong answers and a lack of thorough knowledge showed students that I am a life-long learner. This honest dialogue provides a platform for growth on everyone's account, both mine and theirs. Learning together always seems easier! Finally, I started to take less personal offense from student's actions and to communicate clearly about classroom expectations. A teacher may have many unwritten rules

that students never know or follow. In efforts to focus on student learning, I sought to maintain consistent, effective classroom structure based upon clearly defined boundaries rather than wavering emotions. Students saw that many of my classroom decisions were not "personal" and remained steady throughout the semester regardless of how I was feeling on a particular day. The resulting interactions fostered not only learning but also healthy student/teacher relationships. Overall, my watchful eye on classroom interactions proved invaluable. A newly developed concern for a climate of respect has bolstered learning within my classroom and made the whole process more palatable.

A Distinct Vision

The ideas and changes that resulted from having a student teacher in my classroom dealt more with how to interact with students than with how to teach scientific concepts. I was now seeing through new lenses after my role as cooperating teacher. My graduate classes at The University of Pennsylvania provided several different frameworks that could relate to my new view of science education. After the professor presented several frameworks, one in particular made complete sense. Social-cultural theory analyzes student/teacher interactions. Based upon the premise that learning occurs through socialization, this framework explains how relationships play a key role in the learning of science. For the students to be active members in the learning of science there must be a sense of "cultural alignment" within the classroom (Tobin, 2006). Tobin (2006) sums up cultural alignment in the classroom:

> The key implication is the necessity for teachers and students to learn how to interact successfully in ways that produce positive emotional energy, a sense of belonging to the class, and a commitment to shared responsibility for one another's participation. Aligning

> the cultures of teaching and learning offers a possibility that fluent interactions will occur, afford success, and facilitate the learning of science. (p. 219)

Learning science becomes "a cultural production, reproduction, and transformation" within ones classroom (Pitts, 2007). This can occur through the various day to day interactions between students and teachers. As I became more aware of the culture within the class, I realized that social and cultural capital was actually a commodity. Beyond teaching science in an effective pedagogical manner, I began to realize that the teacher plays a vital role in this "cultural alignment" (Tobin, 2006). This role became more and more evident as I initiated positive social interactions.

I now see science education from a different perspective. I consistently asked myself the question, "Am I promoting positive social and cultural interactions with the students?" Sewell (1992) described this fundamental idea of cultural sociology as the dialectical relationship between agency and structure. Agency is the ability to enact culture (social life). Tobin (2006) continues, "Agency requires access to the resources of a field and the cultural capital needed to appropriate them." The field of a classroom is the perfect place to enact culture through positive encounters. For me, teaching and learning of science education has become a myriad of encounters. Each encounter, whether big or small, plays a vital part in science education. Successful encounters create "…resonances for the teacher and students," which produces "…positive emotional energy and sets up conditions for the emergence of solidarity" (Tobin, 2006).

As the teacher, I set up basic guidelines in the class that ultimately became the structure on which the classroom learning builds. Some of the structures included dignifying student responses and not being easily offended. Once the students became aware of the structures in

class, they were able to act on them in positive relationships, not only with the teacher but also with the science material. These positive interactions are crucial in the teaching and learning of science because they promote the positive emotional energy necessary for student learning. Students want to feel they belong and are apart of a larger role in the classroom.

Re-evaluating Science Education

This new vision of instruction makes so much sense! I have always had trouble engaging certain students. I questioned why particular students love science while other students shut down mentally and emotionally when faced with science curriculum. After valuing social and cultural capital in individual interactions with students, science learning noticeably increased. Since students were not so "put off" in class by the teacher or other students, they were able to focus on learning science. Motivation and respect for authority appeared to be connected with the positive social interactions between teacher and students. Cultural alignment within my class improved, and students performed well in an urban educational setting. According to Tobin (2006), teachers who learn how to interact successfully with students will be able to promote a positive culture (cultural alignment), which affords science education. The teaching of science includes not only how students learn but also what motivates learning. Without positive social interactions with their teacher, certain students will reject any form of instruction. Student/teacher relationships, as a result of cultural alignment, provide important pedagogical tools for the teacher.

Autobiography Part III

Previewing Live Interactions

In my third year of teaching chemistry at Mastery Charter High School, I have been working to improve student/teacher relationships within my classroom. With an urban school

environment of 93% African Americans, it has been important to understand how students communicate and interact with me as the teacher and how I can best interact with the students. Understanding what students value in relationships and in a learning environment has been surprising.

Implementing valuable ideas and learned experiences from my past came rather naturally in the classroom through my role as a cooperating teacher. This supervisory role afforded me the opportunity to carefully analyze the student/teacher interactions in class. While studying various interactions within my classroom, I decided to videotape several encounters between the students and the student teacher. While only brief in length, the video clips were extremely valuable in learning what promotes cultural alignment with the classroom. My eyes were opened to see the social and cultural capital that students value. Once I taped the interactions, I used conversational and video analysis to understand the student/teacher interactions (a more in-depth reflection can be found on my University of Pennsylvania graduate program website: http://www.sas.upenn.edu/%7Ejustinpb/reflections6.html).

Conversational and Video Analysis

During the beginning of the 2007-2008 school year, I had the opportunity to mentor and supervise a female student teacher, Ms. Gaustead, from Ursinus College. The usual planning, preparing, and designing of effective instruction became more involved as I explained and described my own pedagogy for eight weeks. The following conversational analysis shows a mini-lab activity of an eleventh and twelfth grade Chemistry class. During this class period, twelve students practiced their observation skills. The student teacher is helping out a group of four students at the near table (see Figure 1). Sara, a very outgoing and charismatic student, calls out to the teacher in a seemingly rude manner. Ms. Gaustead's response is shown below:

Conversational Analysis Legend:

T: Teacher, Ms. Gaustead

Mary/Sara: Students

CAPITAL LETTERS: phrase louder than surrounding conversation

(.) : indicates a slight pause, less than 0.10 seconds long

(phrase?) : indicates an uncertain hearing

ºphraseº : indicates utterance produced in low voice

Conversational Analysis Transcript:

01 S: ALRIGHT, EXCUSE ME, UM, TEACHER MA'AM.
02 T: WHAT'S MY NAME?
03 M: (Looking at board) Miss Gow-stead
04 T: (To group close to camera) I guess we are going to have to talk to each other.
05 T: "Gow-stead." (Teacher turns head to student and phonetically pronounces name, which is spelled on board)
06 M: Miss Gaustead.
07 S: ºGausteadº (.)
(Approaches far group that just called out)
08 T: Alright we're doing good.
09 S: (Do we want to fill this beaker?)
10 T: What did I say about every time we see 0.5?

Salient Aspects of the Video

The following meso-level analysis explores the role and identity of the teacher with the students. The socio-cultural connections are vital in understanding the classroom and supporting all students in the learning of science. The student teacher, Ms. Gaustead, has known the students for two weeks and has interacted with them for approximately a week prior to this video analysis. The video shows many student/teacher interactions, but the most salient interactions are noted below.

Students at the near table are gaining assistance from the teacher (See Figure 1) when a student, Sara, calls out louder than the surrounding talk. The teacher and several students respond by looking toward the disruptive student (See Figure 2).

Figure 1.
Ms. Gaustead, the student teacher, helps a group of students. Her close proximity and willingness to get involved communicates her interest to the students.

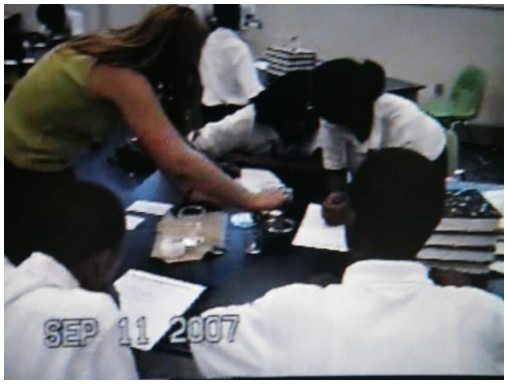

Figure 2.
Ms. Gaustead is interrupted by Sara at the far table. Other students look on waiting to see how Ms. Gaustead will respond.

Immediately and without much hesitation the teacher calls back, "What's my name?" (turn 02). Sara realizes that the teacher might have been offended and attempts to correct her speech in a low voice (turn 07). After finishing her interactions with the near table, she proceeds to the far table (Figure 3).

Figure 3.
Ms. Gaustead proceeds to the far table to interact and pursue Sara, who “rudely” interrupted.

Figure 4.
The learning of science continues as Ms. Gaustead demonstrates her desire to help the students with the lab, preferring the learning of science over the issue of being easy offense.

Ms. Gaustead says her name phonetically as spells on the board, “Gow-stead” (turn 05). Two students, Sara and Mary respond by correctly saying her name. The teacher encourages the students by telling them what a good job they are doing (turn 08). As a result of the teacher's previous interactions, Sara feels like she can ask her original question. The teacher proceeds to help the group answer a critical question concerning the mini-lab (Figure 3).

Seeing Through a Theoretical Framework

For this analysis I have chosen to use the social-cultural theory framework. This framework is based on the premise that learning occurs through socialization. Social interactions and the way relationships are handled play a key role in the learning of science. For the students to be active members engaging the science material there must be a sense of cultural alignment within the classroom.

The teacher plays a vital role in this cultural alignment. There is cultural and social capital at stake within the classroom. Ms. Gaustead promoted this positive cultural and social capital when she engaged the students at the near table (Figure 1) and pursued the student who called out (Figure 3). After the rude interruption (turn 01), the teacher's response, “What's my name?” (turn 02) is the ***agency***, or the ability to enact culture. The other students in class looked on and waited to see how the teacher would respond. Her response was firm and correcting, yet she was not easily offended. By addressing the interruption, she shapes future interactions and establishes a structure for appropriate social behavior and an interest in science learning. She emphasized the importance of authority and respect by addressing the correct pronunciation of her name. Her method of handling the mispronunciation built social capital in the classroom.

Sewell (1992) writes concerning the dialectical relationship between agency and structure. The field of a mini-lab enabled the teacher to enact culture through a brief interaction with students. After the correction of her name, the teacher positively pursues the students with her comment, "Alright, we're doing good" (turn 08). The correction becomes an important ***structure*** to the development of mutual respect. As a result of the capital established in the previous interaction, the student feels free to ask the question she originally intended, "Do we want to fill this beaker?" (turn 09). Now aware of the appropriate structure, students are able to act within the classroom culture and, therefore, continue their learning of science (Figure 4). For Ms. Gaustead the learning of science more important than a surprise offense (turn 02).

A More Crystallized View of Science Education

I have begun to understand the value of cultural alignment and social/cultural capital within the classroom. With the improved student/teacher relationships, students can perform better in an urban setting where relationship development provides a critical link to learning. As a result, students more actively understand and pursue scientific ideas within the classroom. Spending time and energy to carefully analyze visual and verbal student/teacher interactions has been a valuable tool for my ongoing reflective practice. As seen with the conversational and video analysis, I am able to reflect on my classroom routines and use the data to change the way I interact with students. This constant change is at the heart of my reflective practice.

Socio-cultural theory and the dialectical relationship between agency and structure have been vital theoretical frameworks to help me understand student/teacher relationships. This science educational theory has been brought to life through conversational analysis. Reading literature from authors such as Sewell (1992) and Tobin (2006) have influenced my view of the

classroom. I see through a different lens and am now able to employ my theoretical structure on a daily basis while interacting, educating, and learning in the classroom.

A View of the Wild Path Ahead

My journey as a science educator has been surprising, interesting, and enlightening. I have consistently sought to know how to approach differing cultures in the teaching and learning of science and what appropriate academic/personal expectations I have for students. I have slowly come to realize that the teaching and learning of science has more to do with the relationships developed in the classroom than with the actual presentation of material. The pedagogical tools that are necessary in an inner city science classroom are proper cultural alignment and the correct perspective on social and cultural capital. Valuing what students value (actively listening, engaging relationships, dignifying responses, and being transparent) has changed the way I approach science education. As a teacher my expectations of *students becoming scientists* changed to *students being scientifically literate and curious about the world around them*. I expect them to realize that, "The person who does the work does the learning." As a result, students responded positively to the increased workload and expectations and assumed more of the responsibility of science education. This has been a positive transformation in my journey of science teaching and learning and no doubt will continue to shape classroom relationships in the future.

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