

## **Becoming an Urban Science Educator**

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### **Abstract**

This autobiography examines research in which I was involved while learning to teach science in an inner city high school. As an experienced science educator I had mainly experienced schools associated with students from the middle class. When I came to a university in an inner city environment I had to learn first how to be streetwise in the city and then, when I began to teach, I had to negotiate with students my right to teach them. Most students were very resistant to my efforts to teach them science. The paper describes many of the difficulties I experienced as I endeavoured to teach science to students who were ethnically, culturally and socially very different from me. The significance of connecting the enacted curriculum to the interests and extant knowledge of students is emphasised. Implications of my experiences are described for three aspects of urban high schools: teaching science, identifying and enacting appropriate science curricula, and educating prospective science teachers.

I relocated to an inner city university because of my commitment to make a difference as an urban science educator. I believe the greatest need for educational change is in urban schools where science education invariably falls short of its potential for social transformation. It was time for me to address directly some of the more challenging and enduring problems in science education. I was fed up with studies that claimed to have resolved the equity issues in our major urban centres when it was patently clear to anyone who visited schools in those cities that problems were manifest and unresolved.

### **Initial Urban Experiences**

Being in the city was radically different from anything I had experienced. For six months I lived in the suburbs and had a short commute to the university. I remember clearly my initial train rides. As we approached my destination the train became crowded with high school students headed for the nearby City High School (CHS). The students were unlike any I had taught or observed. All were African American and many were from conditions of relative poverty. As I listened to them interact in the crowded conditions of the train I could scarcely understand their dialects. I wondered then whether I'd ever be able to teach students like these. At my station I disembarked, walked along the platform, up a smelly and heavily littered stairwell, and into a dilapidated street just six blocks from my office. The strangeness of the environment was greater than I expected and was analogous to being in a new country with a distinctive culture. So much was novel. But I was no tourist. I lived and worked here.

My sense making was saturated with deficiencies as I compared this with other places in which I had lived. Even though I chose to come to this urban community to practice

science education I perceived the environment and its inhabitants through jaundiced eyes and seemed to notice the squalor, disrepair, dirt, trash, neglect, and signs of poverty. To be here was different to such an extent that my life experiences and professional praxis were out of alignment with my expectations and capacity to cope successfully.

### Learning to Cope

“You’ve gotta develop an attitude.” Once more I was on a train, this time in New York City, and a young woman was advising me about riding the trains and walking the streets. I was accomplished in neither of these activities and I was explaining to her that my presence in the streets of Philadelphia was too interactive. I needed to build a way of being that acknowledged others and did not engage them overtly. I knew what she meant about having an attitude but decided that a useful goal was for me to better understand city neighbourhoods. I was now living in the city and decided to walk to my office, a four-mile hike that allowed me to traverse a variety of neighbourhoods en route to the university. In addition, I began an urban ethnography in which I explored local neighbourhoods every Saturday and Sunday morning.

I felt heroic in those days and was very conscious of the unusual nature of what I was doing and the associated risks. Being in the streets revealed just how much I had to learn. I could see no alternative than to gain first hand experience and knowledge of neighbourhoods like those of the students I was to teach. Usually I did not feel comfortable and I was alert for possible dangers that might await me. My tendency to feel heroic was potentially problematic, because romanticising events with me as hero and urban inhabitants as victims could distance me from those I sought to educate. However, over time I learned to feel at ease in being in the streets, interacting with others, navigating my neighbourhood, and walking to different parts of the city. I began to fit with the environment and no longer felt separate, like a stranger giving meaning to all that happens. The strange was becoming familiar and I could make sense of the smells, sounds, and sights of my urban environment. I regard my learning to become street wise as a necessary component of becoming an urban educator and I am certain I could not effectively teach in this community without first knowing what it means to live here.

Although I was learning a great deal about living in an urban community I was doing very little to learn about the teaching and learning of science in inner city schools. A growing concern was what to do in my science methods courses. Although I had lots of advice to offer my prospective teachers I was not all that confident that my knowledge was grounded either in good theory, research, or praxis. Most of my prospective teachers were struggling to enact much of anything I suggested and I began to wonder if it was their relative inexperience, the problems of finding suitable cooperating teachers, unteachable students, or the fallibility of my knowledge of what to suggest.

By just a few weeks into the fall semester of 1998 I realised that most of what I knew about science education was mainly applicable to middle class values and settings. Even though I had undertaken research in numerous countries my experience in all of them was essentially middle class. Furthermore, my teaching of science methods courses had focused on the teaching of middle class students in suburban-like schools. What I needed to do was very clear. I had to learn to teach science in urban schools where most students were African American, living in conditions of relative poverty. Otherwise my teaching about

science teaching would amount to little more than empty exhortations. I resolved to begin a program of science teaching at CHS, beginning with the most challenging group of students in the school. I declared that I would teach at the school for at least four years so that I would not be regarded as a researcher undertaking a short-term study; leaving an unchanged system after attaining my goals.

### City High School

My first visit to CHS, where I am presently teaching, also involved deficit seeing. CHS is nothing like the high schools I have experienced in Perth, Tallahassee, or even in a big city like Miami. It is an urban high school with an enrolment of more than 2,000 students, 98% of whom are African American and from conditions of poverty. Just like the city, my initial impressions of the school were negative. My tendency was to notice the undesirable features of what was there and those missing features that would in my opinion have enhanced the school. As I walked on the pavement alongside CHS I was reminded of a prison by the expansive brick and concrete wall, just a few barred windows, and a heavy metal door at the front of the school. The building was not an architectural masterpiece and from my perspective it was welcoming neither to students nor to faculty.

I am not sure when the switch in my perceptions of the school occurred or what catalysed the change. However, now I look forward to going to the school and as I enter the building I admire the ceramic murals and other decorative contributions of graduating seniors. Learning to regard a school as more than bricks, cement and metal bars requires a perspective of a school as a social organisation, a perspective that evolved as I became part of the school community.

The school district adheres to a policy of creating *small learning communities* (SLCs) within each school. The idea is to allow students to experience a small school and to thereby create a feeling of family, belonging, school loyalty and shared values. At CHS the 10 SLCs each contain approximately 200 students. Students can select an SLC according to their career or academic goals. However, not all students choose the SLC in which they will spend their high school lives. Some fail to meet the entry requirements and others are unable to maintain satisfactory performance levels. In these circumstances they are assigned to an SLC.

My teaching took place in an SLC known as Opportunity. The school bulletin lists *Opportunity* as "an academic and resource program to assist students who need to acquire additional academic credits because of extended absences or other extenuating circumstances. These credits will enable the students to achieve appropriate grade level or graduation requirements." However, the description in the bulletin is at odds with the perspectives of most students in Opportunity. Tyrone, a grade 9 student, told me that "Opportunity is the bottom of the trash can." Tyrone also thought that the change to a block schedule, with its longer periods, resulted in a great deal more time being wasted in each of the class periods. He emphasised that "I don't like it because what they are teaching me is too easy. I'm finished in about 20 minutes and sitting there for about 55 minutes doing nothing." Tyrone also was riled because he wanted to listen to music on his Walkman when he finished his work. He insisted that others could not hear the music and would not be disrupted.

*This Kid is Trouble*

The first time I set my eyes on Tyrone I had an instinct to back off. He did not look like the type of person I would want to mix with. His dreadlocks were arranged asymmetrically, his clothes looked like battle fatigues, and his broken front tooth gave him an appearance of a fighter. I was with Spiegel<sup>1</sup> in the main office. "That kid gets in trouble because people are afraid of him. He looks bad so they just get him out as soon as they can." Spiegel's words echoed my thoughts. Tyrone was headed toward the main office. Following some distance behind him was an angry male teacher who began to raise his voice as soon as he reached the office door. "What's the problem Tyrone?" Spiegel spoke quietly as Tyrone passed by. "He's suspending me because I went to get my coat." Tyrone replied softly. His response had credibility but events moved too quickly to learn more. The raised voice of the teacher became a shout and an Assistant Principal also began to berate Tyrone for his defiance. Within minutes a stream of colourful language flowed from Tyrone's mouth as he was ushered into the Assistant Principal's office. "They just don't know how to handle kids like Tyrone," said Spiegel with a resigned shrug of his shoulders.

*Enforced Absence*

Tyrone felt that teachers and NTAs<sup>2</sup> stereotyped most males as thugs and used that as a basis for suspending them from school. He explained to me that his long running battle with the NTAs resulted in him being absent so often that he was now repeating grade nine for the third time. I regard Tyrone as an enigma. He is very intelligent, wants to work hard, and succeed. But at the same time he has a spirit that will not be suppressed. He will not allow others in authority to dominate him and he does not condone duplicity when he sees it. Although some might describe him as being smart mouthed, Tyrone regards himself as principled. If an NTA calls him a bastard he will reciprocate with similar or even more profane language. His inability to "let it go" has cost him dearly with those in authority and he is continually getting suspended. Because of his appearance he is accosted frequently by NTAs and teachers and, because of his enduring spirit, his reactions are such that he earns suspensions of five days routinely. These absences soon sum to another failed semester.

*On the Way to the Forum*

I invited Tyrone to participate in a pre-session at the University of Pennsylvania Ethnography Forum. He agreed to participate and I came to the school to walk with him to the session. I located Tyrone in the lunchroom where he was speaking with a friend. He indicated that he would join me downstairs in the science lab in five minutes. At the designated time Tyrone arrived, but as we were about to leave Cowan (an NTA) burst into the room. "You and I have business," he shouted motioning Tyrone into the hallway. Although I felt outraged by the event, I waited for Tyrone to return, but to no avail. He was suspended for five days for "dwelling too long on the second floor" and was ushered from the school building. Tyrone later told me what happened. As he walked down the stairs to meet with me, as we had arranged, Cowan called on him to stop. Without explanation Cowan demanded his identity card, effectively suspending him until the card was returned. In this instance Tyrone was stopped because Cowan expected that he was breaking a school rule. Tyrone would have none of it and walked away to keep his appointment with me.

When Tyrone was taken into the hallway to discuss the dwelling charge and subsequent walk off his reaction to Cowan's aggression involved his use of profane language and an automatic five-day suspension. Needless to say Tyrone did not make it to the Forum and it took an intervention from me to have his suspension lifted after three days.

Because I have developed a close relationship with Tyrone it is easy to see how Cowan in this and other instances has catalysed problems based on his preconception that Tyrone is a troublemaker who needs to be controlled proactively. However, I can appreciate another side of this issue because I have been a beneficiary of proactive intervention from an NTA.

### *Proactive Intervention*

My least successful activities are those in which I address the entire class. Invariably someone begins a conversation that is sufficiently loud to be a source of distraction to other students and me. This is a basic classroom management issue. But what is the best way to enforce silence when I am speaking? On this occasion I was speaking to Dante about his annoying habit of speaking loudly to a peer whenever I spoke to the class. I believe that Dante was testing me and I was aggravated by his increasing tendency to be disruptive. However, my making his behaviour an issue gave him a public forum to impress his peers.

Dante looked at me with disdain and commenced a rebuttal, "You speaking so loud I have to..." "Choose your next words carefully," the softly spoken voice of an NTA stopped Dante dead in his tracks. "My bad," Dante said immediately.

The tall young African American NTA smiled reassuringly at me and left the class without another word. Unnecessary conflict was resolved before it began. If the NTA had not arrived at the most opportune of times I would have had a serious problem on my hands. I would have had to deal with Dante's verbal onslaught. I am certain that he would not have complied with any request I made of him following his anticipated outburst. I had made a serious error of judgment by raising the issue at that time and I was moments away from possible humiliation.

### *Refusal to Comply*

One thing I learned from Tyrone is never to ask these students to do something if you cannot deal with the consequences of them refusing to do what is requested. What could I have done with Dante? Students like him are not afraid of the law and do not respect authority. Hence, threatening detention is no deterrent as most refuse to attend. In fact, if a student fails to attend a detention, s/he is suspended for five days. These students are not only unafraid of being suspended; many relish the thought of having a reason not to come to school and to stay at home or in the streets. If an optimal learning environment is to be established it is important to build a community that is self-regulating. In such a community the participants want to learn, and trust and have respect for one another. The students can develop the rules and the custom of adhering to them, not breaking them.

### *Why Make this the Line in the Sand?*

"Dr. Tobin this is marvellous. What are we doing here?" The principal entered the room and was focused on three roof to floor length pendula, two the same length, and one slightly shorter. The three were connected close to the roof by looping them over a long dowel rod.

Three students were exploring resonance. "It's not going as well as it might look," I remarked as she entered the room. Fifteen students were present and only five of them were engaged in productive activity. Furthermore, the noise level was unacceptable to me and I was trying to get it down as she entered the classroom.

The principal looked around the class and noticed Clarence wearing his cap reversed. Although Clarence was working the principal managed to catch his eye and pointed to her head with her forefinger. Clarence continued to work, shaking his head ever so perceptibly, but with resolve. "Young man. Give me the cap. I'll give it back." The principal moved toward Clarence who once again shook his head ever so slightly. At this stage I felt decidedly aggravated. There was going to be trouble here. So far the principal had broken two of the cardinal rules Tyrone has taught me. She chose to make an issue of something trivial and in so doing interrupted one of the few students who was working. Also, she made a request without thinking through whether she could deal with the consequences of Clarence not doing as she asked. I groaned inwardly. "Outside young man!" The principal raised her voice and the stakes. Clarence once again shook his head and continued to work. The principal strode into the hallway and Clarence continued to work.

"You need to go see the principal man. Don't make this into a bigger problem than it has to be." Clarence looked at me in stunned silence. Betrayal! He slammed his chair back and walked defiantly from the room, his cap still on his head. The principal began to scold him as soon as he reached the door, but Clarence would have none of it. He continued to walk past the principal and had to be apprehended by an NTA.

### Teaching Science at CHS

When I spoke to Spiegel about coteaching we agreed to focus the curriculum on a form of science that would be relevant to the students and had the potential to transform aspects of their lives. I had in mind investigations focused on the students' neighbourhoods, somewhat akin to the science that Angela Calabrese Barton undertook with students from a homeless shelter. I thought of this as street science and envisioned the students mainly learning science outside of the classroom. When I discussed the focus of the curriculum with the principal of CHS she was not enthusiastic and viewed my suggestions as examples of low expectations and stereotyping. "Will it prepare these young people for higher studies in chemistry? If your students wanted to study more science they would be disadvantaged." The principal was resolved and I did not want this to be the issue that prevented me from teaching in Opportunity. Accordingly, I agreed to teach a half-unit on chemistry followed by a half-unit on physics.

#### *Getting Started*

My initial chemistry activities involved as much hands-on activity as possible. I wanted the students to associate science with doing. However, many students did not enjoy doing science and preferred to sleep, not participate, or talk socially with their peers. Most would not wear safety glasses and if I insisted they would not participate. Also, with few exceptions, the students would not persist with an activity beyond the first day.

The first activity on chromatography involved the students in separating the colours from marker pens. For the remainder of the week I wanted them to use a range of solvents

to separate out colours in M&Ms, lipstick, and other types of pen. The students complained that the activities were boring and that we had done this yesterday! Similarly students refused to continue into a second and third day their investigations of chemical reactions between soluble salts (involving temperature changes, colour changes and precipitates). The students wanted fresh activities that were interesting to them and did not develop a curiosity about the chemistry associated with their experiences. It did not appear as if they were able to generate open-ended questions and certainly they did not regard questions as springboards for scientific inquiry and hands-on investigations. In fact, when I asked questions designed to stimulate inquiry the students answered them using as few words as possible.

### *Relevance of the Enacted Curriculum*

Every day I questioned the relevance of the science I was teaching the students in Opportunity. Sometimes they questioned it too. During an initial discussion of Newton's second law of motion an announcement from the principal interrupted the lesson to provide details about the Stanford-9 testing that was to occur later in the week. One of the students seized the opportunity to declare that he had taken the SAT-9 three times and there never had been a question on Newton's laws. His assertion was received enthusiastically by several peers who joined him to challenge the relevance of studying Newton, force, and motion.

A second example arose the next day when we looked at the physics of delivering a fast ball in baseball. One of the less involved students suddenly showed interest and asked how it was possible to hit a fast pitch for a home run. I decided that the next day students would read a short piece on everyday applications of Newton's second law and respond to questions in writing. The idea was intended to address several goals. First, the students did not appear to learn from oral description of applications or from demonstrations. Second, when students were given questions to respond to in writing they tended to answer in as few words as possible. Third, students had little persistence in answering extended response questions and were easily distracted.

As the students entered the room I handed them a single page to read. The gist of the science was that Newton's second law could be re-organised to show that force times time is equal to mass times velocity. The implications of losing momentum in a short time interval were described in terms of punches in boxing, hits in football, collisions involving automobiles, motorcyclists and cyclists, use of seatbelts and safety, uses of helmets in various sports, and the design of running shoes. Although the list (without a more complete description) does not reflect my concerns about sex equity, I endeavoured to include examples that would appeal to males and females. The reading concluded with five questions that required the equation  $Ft = mv$  to be applied qualitatively to a variety of everyday experiences.

As is customary in the class there were numerous students who refused to engage from the beginning of the lesson. I planned to begin with  $f = ma$ , replace  $a$  with  $v/t$  and then use algebra to arrive at the appropriate form of the equation. Then, in a discussion, we would apply the equation to selected examples from the everyday lives of students. I began with baseball since we explored this the day before when we also debated how auto design could minimise the impact force on passengers during a collision. A very small number of students (2 of 20, both females) showed intense interest, responded to my questions, and

nodded their heads at my explanations. However, from the outset, most students were disinterested and only too willing to be distracted at the slightest opportunity. Having fully applied the concepts in several contexts and placed the key points on the chalkboard I asked the students to read the brief description and respond to the questions.

The initial problem for those who appeared willing to participate was that they did not know what to do. Because the questions were embedded in the text they could not identify them easily or discern how many were to be answered. I responded proactively by calling to the attention of all students the location of each question. Unfortunately, few students were attentive and I had to interact with each individual. As I did this I took care to explain that each question was an opportunity to show how science can be applied. I wanted students to understand that each question could be answered by applying several interconnected ideas and that short answers may not provide a complete response to a question.

With 20 minutes remaining in the lesson I decided to have a discussion of answers to the questions. The first question asked whether laws should require boxers to wear gloves having a greater mass than 8 ounces. I then wrote an extensive answer to the question on the board so that the students had a model of how 10 points could be distributed for the response. Less than five students copied my response despite the fact that I had informed them that questions like this would be on their tests or SAT-9 type tests. As I worked through each question I searched for ways to involve students. However, even though almost an hour was allocated to consider and respond to the questions there were few students who had attempted to answer them and were motivated or prepared to contribute.

When the lesson ended I dismissed the students and had an empty feeling in my stomach. Who had benefited from the last 75 minutes? As I looked across to Spiegel he shrugged his shoulders. "I am fed up with this group," he said. My sentiments exactly. But I did not share my reservations with him. "We have got to get to these students," I said with fierce determination. "We cannot give up!"

### *I Took Them Outside*

I was very apprehensive about taking the students outside. For the most part they were unruly even when I took them down to the computer lab. Taking them into the streets seemed to be an invitation for trouble. Yet, I was a firm believer in doing science out of doors if that were possible. Accordingly, I decided to enact a series of outdoor activities.

We had been doing sound for some time and the students were not as engaged as I had hoped. The unit on music was not the success I expected it to be and the students were seemingly bored. We had used a slinky to show longitudinal and transverse waves and also had discussed the difference between standing and travelling waves. The students had seen resonance in open and closed pipes and it seemed appropriate to discuss the velocity of sound waves and also to discuss other properties of sound waves such as reflection. We then discussed reverberation, echoes, and ways to measure the velocity of sound.

The students contributed very little to the plan to measure the velocity of sound, although they certainly had the ability to work out a suitable design. Instead, in an interactive way, I led a discussion by explaining what we would do and asking students questions to solicit as much involvement from them as possible. Soon we had the design worked out. I found two large pieces of pine to strike together at one-second intervals to create a loud "clap."



The few students in attendance were quite docile. I demonstrated echoes by hitting the wood together some 50-60 feet from a school wall. The echoes were discernible but not discrete because there were so many walls in the vicinity. Then we went to a quiet side street that was flat. I asked for volunteers to move away from Spiegel who had agreed to clap the pieces of wood. Only Tyrone volunteered to walk with me down the street until we were far enough away for the sound to take a half-second to reach us. The rest of the students preferred to watch from a distance and crowded under a tree.

When we returned to the classroom I was reminded of the low level of mathematical competence of most of these students. The distance travelled by sound in a half second was 171 meters and none of the students was able to calculate the velocity, or at least have an intuitive idea of what it was. Accordingly, I showed them how to use the data to calculate the velocity. Then, so that they could show what they learned about the velocity of sound, echoes, and reverberation, I asked them to write a narrative, draw an illustration, or prepare a poster to hang from the ceiling. Although several students commenced the activity, when the folders were submitted at the end of the semester, only a few included their efforts and none had completed the task.

An interesting irony about the outside fieldtrip is that my fears of losing students could not have been further from what happened. We left the building with 11 students and returned with 13 having picked up 2 who were late and otherwise unable to enter the building.

### *Persistent Problems*

#### *Sporadic attendance*

I did not satisfactorily contend with the students' sporadic attendance at school. Only a small proportion of the students in my class at any given time was there the day before or the day after. Hence it is difficult to identify issues that are relevant to those in attendance. Since I cannot easily predict who will be present on any given day the enacted curriculum tended to be planned to keep moving forward. The average level of absenteeism in my class was approximately 40% with a range from close to zero to almost 100% absent. Out of a class of 35 students only 15 might be present on a given day. Of those fewer than 3 would be in the class at the official start time of 8:15 a.m. and even 20 minutes into the class students would be straggling in. Of those who did come, none would have their materials out ready to begin work and many brought neither paper nor writing tools to class.

I regard it as a high priority to plan for sporadic attendance and late arrival. It is all very well to declare this as a symptom of a dysfunctional school, but it is quite another matter to cope with the consequences day after day. One way to address this problem is to have an individualised program that students can access automatically when they arrive in class. If the system includes all assignments and handouts the students who have missed class can be held responsible for their own progress. The use of computer and Internet technology might provide convenient access to assignments from remote locations such as home, public libraries and computer laboratories.

*Sleeping students*

As many as six or seven students would come into class and put their heads down to go to sleep. What should I do about sleeping students? I can put them outside but then someone else has to deal with the problem. I can give them a detention, or I can suspend them. None of these possible solutions has more than momentary appeal. Perhaps I could set up my own detentions; however, this has not been an option because I am only at the school for three hours a day. There are many reasons for students sleeping in class. Punishing them for sleeping or having their heads down does not take into account the reasons for their actions. We need to better understand why students have their heads down and address the problems rather than continually deal with the symptoms. Not only that, I prefer to establish a system whereby students accept responsibility for their own actions, including their need for sleep and their use of class time. I would like to see them as autonomous, including their acceptance of responsibility for participating in class, completing assignments, and learning at acceptable levels.

*Failure to do homework*

Getting students to do their homework was a problem for me because I was the only teacher in Opportunity who set homework and expected it to be done. A minority of the students did their homework, but peer pressure reduced the numbers and also made those who had done it reluctant to go public. Should I go over homework when students have not attempted it? Should I ask students who were here yesterday to complete the homework while I re-teach yesterday's lesson for those who were absent? What about students who are absent for several consecutive days? Should each student have an individualised program? I decided for the future that an individualised approach might be planned and enacted in such a way as to address many of the problems I encountered.

Not having a suitable textbook to take home until midway through the semester limited the types of activity I could set for homework. When we finally got a textbook it was more than 20 years old and unsuitable for many reasons that included the content having little relevance to current times and a failure to include minorities and females in substantive ways in texts and pictures. Also, for many students the conceptual difficulty and reading level were too high. This problem was exacerbated by few books being in their homes and my students being unwilling to access books from public and school libraries.

*Signs of Progress*

Reggie looked stern as he walked directly toward me. I noticed his bandaged left hand and thought about the stories of him slugging the officer who had pulled him over during a car chase earlier this week. I didn't flinch as his right fist brushed against my jaw. He broke into a broad smile as he grabbed at my gut. "You outta shape man!" He gave me a hi-five and continued down the hallway. Reggie was back in school and five months ago this incident could never have happened. Students were beginning to acknowledge my existence.

*Options to Consider**Teach those who want to learn*

Some of the conventional wisdom of teaching does not appear to work well with these students, at this time. For example, monitoring of the students while they work is sometimes constructed as “being in their faces.” I had developed the habit of moving around the class, getting to see what each person is doing, looking at his/her work, and as necessary providing scaffolding to facilitate the learning of individuals and groups. Also, if students appear to be unsettled I often will stand close to them to encourage their participation by my proximity. Students often show their displeasure with me roaming from group to group and will exclaim: “Back off man! Get out of my face.” When Tyrone observed my teaching on videotapes he also advised me to “Back off. Only teach them when they want to be taught.” I have taken this advice seriously and now approach most students only when I am invited.

Tyrone’s advice to teach only those who want to be taught is also a potential way out of the relative failure of whole class lecturing. When a whole class presentation is seen as desirable it might be that those who are interested in learning can be invited to a part of the classroom where a focused presentation can be given to these students. Students who elect not to participate can be offered an alternative activity such as copying notes or reading and responding to questions. Providing students with alternative ways of participating is an approach that has potential. I will ensure that at any time students have the option of doing what they are good at doing and can pursue their interests. For example, all students seem to know how to read<sup>3</sup> and answer questions from the book. As sad as it may seem, allowing them to read and write science is one way to increase the rate at which students participate and presumably learn. Let them start from what they can do and over time, when they learn how to participate consistently, then they can learn new ways to participate.

I have now changed the focus of my attention from the whole class to individuals. I endeavour to recruit one student at a time to join a community of learners in which science activities are constructed around the interests and values of the students and what they can do. For example, in a lesson on motion the students were building and racing balloon powered cars. Thirteen students were present, seven were seemingly asleep and, of the six awake, four were participating. When I began five months ago my efforts would have been directed toward getting the seven sleeping students awake and involved. Now I realise that my efforts are better spent teaching the four participants. Facilitating those who want to learn has become my goal as I endeavour to build a community of learners. As for those who are not participating? That is their decision. The door is always open if they take the initial step to get started. Of course, I do not abandon them and still make invitational overtures to them to get involved. However, I do not let that be my principal goal, as it was when I first started. It is better to focus my energy on those who will participate and want to learn than to antagonise those who are determined to resist and disrupt the learning of others.

*Enact multiple activities in each lesson*

For each lesson I now think in terms of multiple 10-15 minute activities in which students participate. Creating variety through the use of short activities separated by well-

managed transitions appeals as a possible way to increase student participation and achievement. In my classes I soon realised that students needed to learn to concentrate and sustain their participation. I was unsuccessful in implementing anything close to six activities in a 90-minute lesson, but I regarded the inclusion of short, varied and interesting activities as a way to address the goal of having students learn to learn.

#### *Encourage alternative ways of participating*

Creating a management system to allow me to focus my efforts on students who want to learn makes a lot of sense. In Opportunity my biggest challenge is to effectively deal with those who are unwilling or unmotivated to learn on a particular day. Rather than placing the onus on me to get students to participate, I would prefer to allow them to choose to participate in alternative ways. If alternative activities are available and the students have the responsibility for all assignments there is merit in providing them with autonomy and the associated responsibility. In addition, I recommend an opt-out alternative that students can select occasionally, perhaps to a limit of five times per semester (still with the proviso that all assignments are their responsibility). The opt-out activity could involve participation in non-science activities of the students' choosing as long as the activities do not disrupt others in the class.

#### *Setting up a portfolio system*

The students rarely bring notebooks or pens to class. If they have them, they don't get them out. Dealing with this problem every day suggests that something proactive needs to be done. I envision each class having colour-coded folders in which students place their notebooks (paper) and pens for science. Their folder would be stacked on a shelf with the students' names prominently displayed on the spine.

Having such a system will solve numerous problems. All assignments can be placed in the folders and students can have the responsibility to complete them even when they are absent (in which case they complete them when they return to school). Completed classwork and homework also can be left in the classroom portfolio. This system will provide me with access to student work and allow me to provide them with regular feedback.

#### *Involve others to support learning*

To the extent possible parents, siblings, guardians and persons from the community can be involved in supporting learning. Many of the students in my class have jobs and need to earn money to support themselves and their families. Some need to support their own children. However, as Tyrone pointed out to me, "a lot of people from around my way dropped out of school. Now they see the value of education and make sure I go to school." He also pointed out how influential his brother is in keeping him at school. His brother is incarcerated but has been educated while in jail and is insistent that Tyrone go to school, attend class regularly, and make an effort to learn. It was my experience that every time I contacted a parent/guardian I made progress in getting a student better focused on learning. It is easy to assume that the parent/guardians are not interested in the education of the

students for whom they have responsibility. Such an assumption is another example of the seriousness of negative stereotypes that eventually inhibit the learning of students such as those in Opportunity.

### Searching Backward While Looking Forward

Since I began teaching the students from Opportunity I have done whatever I can to increase the quality of participation and learning. When I took over the class I endeavoured to teach chemistry in ways that were engaging. It did not take me long to notice that the students resisted any efforts on my part to enact a curriculum that was inquiry-oriented and focused on the attainment of goals like those included in the School District's standards. For more than five months almost every effort of mine was unsuccessful in promoting the meaningful learning of science for most of my students. I now realise that there is little difference between what I was able to accomplish as I enacted the curriculum and what Spiegel achieved during my observations of his class prior to beginning my teaching. Just as I had a jaundiced view of Spiegel's teaching, I am certain that any observer of my teaching would conclude that my expectations for participation and achievement are too low and that these are the primary causes of the problems I experienced. However, such judgments would be harsh and do not take account of my goals and the difficulties of attaining them with these students.

Had I not had the experience of teaching these urban high school students my advice to prospective teachers encountering problems such as those I have experienced would have been to enact problem centred learning, emphasise inquiry and hands-on activities and, to the extent feasible, participate in field trips. Certainly I would have advocated small group work and minimised activities associated with reading and answering questions from a text. I would have encouraged the students to connect their science activities to technology and the lifeworlds of their students and I would have expected all of my suggestions to work. Failure would have been interpreted as an inability of prospective teachers to teach appropriately. However, for more than five months I floundered. Every day I enacted activities that I expected to be successful, but they fell short of my expectations and eluded the students' interests. It is imperative that I communicate these findings to student teachers because they should not feel that the research and theory they read necessarily applies in all contexts. It is critical that prospective teachers understand the significance of elements of social class (especially poverty) and ethnic diversity as factors that will shape enacted curricula, the participation of students, and what teachers can accomplish.

My decision to begin with more orthodox forms of science was a setback to the enacted curriculum because I never could actually connect with the students' interests and performance capabilities. The initial activity on chromatography captured the students' interests because of its novelty. But students had no interest in follow-up activities, possibly because the topic was imposed on them. It would have been preferable if I had found out about their interests and built a science curriculum around them. Not only that, getting the students involved in selecting what to study would have been good pedagogy and a demonstration of my trust in them.

Science as I knew it, and had experienced it in schools, did not seem to have a place at this time for these students. No matter how I restructured my ideas about what should work or interest them, the few successes were at best short term and were limited to just a few

students. It was not as if I didn't ask students about their interests, how to improve the class, and what they wanted to get from the course. Questions associated with these issues were asked of students frequently and I tried to learn from their responses. However, I was not able to discern any promising starting points from the students' suggestions and interests. Instead I enacted a litany of activities that fell short of my expectations and their interests. It is possible that my lack of experience with these students prevented me from hearing their interests and translating them into science activities.

I wondered about the extent to which the institution of public schools was a problem when I read a draft of a chapter written by Deborah Stern in which she described a curriculum oriented toward social justice at a small alternative school for high school dropouts. Her description of inner city public high schools as over crowded and over regulated institutions where students are largely invisible is consistent with my experiences at CHS. Despite the schools-within-a-school policy that led to the development of heavily tracked small learning communities like Opportunity, the students at CHS do not participate in curricula that are emancipatory and socially transformative. Stern's students examined issues of social justice using resources such as newspaper articles about people like them, issues that arose in gangs, crime, court decisions, jail, and life and death in urban communities. Her students could relate to such issues.

What are comparable topics in science? I have searched for doorways into the lives of these students; doorways to connect what they do at school and how students live their lives. What Barton and Darkside have done in New York City is most impressive, and I have endeavoured to learn from their valiant efforts to break from the mould. Their redefinition of science has enormous potential for us to connect social justice, science and the students' lives. But they have accomplished very impressive results outside of a traditional framework of public schools. Whereas Barton can work with volunteers I teach students who have been assigned to the low track and are required to be at school. It remains to be seen whether or not I can redefine science and elicit comparable levels of cooperation from students like those in Opportunity.

Whatever we try in Opportunity fits within a framework of other activities that are undertaken in the school. These students have to learn to learn. Yet there is irony in me making that statement. They are street wise and have survived in very difficult circumstances. Of course students from Opportunity know how to learn. What they are not good at doing is joining in small group conversations and learning from the conversations of others. This too is nonsense! The most formidable challenges I had in Opportunity involved some of these students when they embarked on tirades to justify a perspective or course of action. The students are extremely articulate and they interact in their dialect at a speed that is overwhelming when the conversation involves a topic that interests them. In terms of science the most vocal they ever got was when they refused to participate in street science activities on the several occasions I tried to get them involved and when they protested the relevance of studying Newton's Laws. In fact during their protests about learning Newton's Laws I stepped back in astonished admiration of how a group of previously sullen non-contributors could spring to life to display an awesome array of discursive resources on which the learning of science could build. No matter how hard I tried, I could not re-create occasions like those they produced with relative ease. I could not find doorways through which they could enter to participate in science. It could be the institution or, more than likely; it is just that I am not yet street wise within the domain of Opportunity. I am still on a journey of learning to teach science to students like those I have

described in this paper. Until I become street wise there is a great deal of potential in those students that will remain invisible to me, even as I continue to see deficits. It is not that I am unwilling to see their potential to learn, it is that I am yet unable to see what is there for others to see and exploit to benefit the students.

For as long as I have been in teacher education I have emphasised the importance of building relationships with students and negotiating the right to teach them. I was adamant that students do not just bestow the right for people to teach them. All teachers must earn that right and that involves students constructing themselves as learners with respect to would-be teachers. What I did not understand was just how difficult it was to earn the trust and respect of these students. For several months I found many students ignored me when I spoke to them. Most did not respond to my questions or oral remarks and few initiated any approaches that could be construed as positive. Only now can I say with confidence that I am building rapport with a significant number of students. I regard rapport as a precursor to trust and respect—so there is a considerable distance yet to traverse.

Yesterday, as I crossed the street to go to my office a student from Opportunity called from the car window: “Heh old head! How’s it goin’ man? There’s my science teacher.” I was delighted to see Reggie in the passenger’s seat with his Dad. Both wanted to shake my hand. “You will be back this year won’t you Tobin?” I nodded my head, my affirmation signifying more than just an answer to his question. For me this was a big occasion and I was proud. Reggie acknowledged his teacher in the street. For me there is no higher status than to be acknowledged as Reggie’s science teacher. In terms of my becoming an urban science teacher, this is one of many milestones that are still to be passed.

#### Coda

Communicating what I learned from research on my teaching of science in an urban setting has involved me in writing and presenting numerous papers, some as sole author and others with co-authors (colleagues, coteachers, and students). Each of the papers emphasises different themes and voices and is written in a different style. As I look back on the different ways of writing about research it is a propitious moment to consider the relative merits of each.

#### *Auto/Biographical Writing*

Writing this autobiographical paper was an emotional experience compared to writing in other genres in which affective state is relatively unimportant. I began to delve deeply into the troubled lives of some of the students I am teaching and explored their involvement in activities that included drug use and dealing, prostitution, crime, and violence. The prevalence of such issues cast a shadow over the transformative potential of science education. I wondered where social justice could fit in the curriculum and how it could intersect with science. Inevitably the focus returned to my own role and shortcomings as an urban science teacher. Influenced by my recent reading of an autobiography of a runaway street kid (Lau, 1995), I began to see for the first time that I had failed to be a stable source of support for the learning of the students who needed me most. I realised that my middle class life and value system saturated what I considered to be rational decisions. As my autobiography unfolded the emerging story line focused on my learning to teach in urban

settings. Ironically, when I began the paper I was not conscious of this as a goal, let alone a focus for my writing. My purpose in doing the study in the first place was not to learn to teach science in urban settings but to find out how to teach science successfully in urban environments. There is a critical difference in these goals statements. I assumed I already knew how to teach science and it was just a question of adapting or applying what I knew to urban contexts. Doing the study and then writing it as auto/biography has deepened my sensitivity to the ontological differences between knowledge that can be spoken and written and knowledge that must be enacted. There is no doubt that my experiences at CHS were all about learning to teach urban students and had little to do with adapting existing knowledge.

Having created the desired focus for the paper I turned to issues of voice. Initially I was constrained by the conventions of interpretive research and a commitment to the use of verbatim transcripts as thick description, particularly when I was examining issues about teaching and learning. However, with encouragement from Michael Roth and Judith McGonigal, I focused on the genre of auto/biography and used my own words to tell a story that was consistent with the data. Once I had adjusted the voice to be consistent throughout the paper I gained a deeper appreciation of the significance of auto in autobiography.

The writing of the paper made a significant difference to the way I think about my roles as teacher, teacher educator and writer. I believe the best way to learn to teach in given circumstances is, with the assistance of others from whom to learn, to teach in those circumstances. The fallibility of knowledge of teaching as it is written and spoken was never more evident to me than when I tried to apply what I knew in urban settings. Now I cannot imagine teaching a science methods course without having an active classroom in which to show what can and cannot be accomplished, and associated field experiences in which prospective teachers can create their knowledge of teaching science by teaching science.

As a writer I have seen that autobiography is a powerful way to connect to others having an interest in science teaching and learning. Possibly because of the emotional involvement of the reader with unfolding events there is more of a connection with the issues expressed in autobiography than in other forms of my writing. The genre allows me to portray my perspectives on those issues from my praxis that I regard as having most salience to the larger domain of science education.

### *Metologue and the Voice of Participants*

An earlier paper (Tobin, Seiler, & Smith, 1999) was written with an experienced urban science teacher (Seiler) and a prospective teacher from my methods class (Smith). We used metologue to allow each of us to participate in a conversation that retained our discrete voices on issues we regarded as critical to learning to teach in inner city schools. Bringing these differing perspectives into the foreground is vital in research in science education where, for too long, researchers have reported central tendencies and assertions built around the preponderance of evidence. Our style of writing allowed us to include assertions about which we agreed and personal perspectives that reflected our different roles and experiences as educators. The presence of multiple authors and voices allowed us to learn from one another in the writing and to communicate with readers in ways that would not be possible using autobiography. In addition, my learning from writing the metalogues and subsequent writing set a stage for writing this autobiography.



Another application of metalogue allowed me to highlight the student voice in a paper that focused on student resistance in urban science classes (Tobin, Seiler, & Walls, 1999). One of the authors, Edward Walls, was a student in two of my science classes in Opportunity. His candid perspectives and our associated discussions allowed us to learn much more about teaching science to low track students in an inner city high school than otherwise would have been possible. The inclusion of Walls as a researcher in the study allowed us to access and write about issues and perspectives that otherwise would have been beyond our reach.

Wolff-Michael Roth and I used metalogue to develop and explicate a perspective that knowledge of teaching is re-presented only while teaching (Roth & Tobin, 1999). The context was studies that we had undertaken separately, in which we were teacher-researchers. The interactions between the two of us were a significant resource for our own learning. From our respective studies we each prepared vignettes that were appropriate for writing a paper about coteaching as a vehicle for learning to teach. Then we identified several issues that were salient in the vignettes and took turns writing in a collaborative manner about each of them. In so doing we were able to explicate and elaborate our emerging theory through the contexts portrayed in our selected vignettes. We both learned from the process and communicated to readers our understanding of teaching as praxis in a variety of practice settings. Those insights were a foundation for the rationale for this autobiography. Initially, I was privately resistant to the idea that my difficulties in teaching science to inner city students had anything to do with knowledge limitations. However, in working through the theoretical issues pertaining to the nature of knowledge of teaching and how to construct it I began to see that my ultimate success in teaching in Opportunity would depend on my learning to teach there. Hence, writing for publication, giving seminars to colleagues and teachers, and making presentations at national meetings all set a stage for writing and learning from an autobiography.

#### ... and Finally

Writing to learn is something we often hear in the context of literacy people advocating participation in writing activities of elementary and high school students. However, the phrase applies very aptly to me. Writing in research is not just for others. The process of writing a paper necessitates levels of analysis, interpretation and synthesis that do not occur for me unless I write. What is apparent as I enter a phase of my career when it is safe to deviate from traditional ways of writing, is that alternative writing genres not only allow researchers to present different aspects of what has been learned from research, but also facilitate additional learning for the researcher. In this context, and with an added reminder of the need for the use of multiple writing genres in research, I strongly recommend auto/biography as a way to learn from research and report what has been learned to readers.

#### Notes

1. Spiegel is the regular teacher of the classes I taught for a five-month period on which this autobiography is based.

2. Non teaching assistants (NTAs) are male and female personnel who are hired to maintain order in a school. They keep unauthorized personnel from the school building and enforce rules and orderly conduct.
3. Many students read well below grade level and it is important to have available in class a variety of appropriate texts that incorporate a range of reading levels.

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