

**Interim Progress Report**  
**The Teaching and Learning of Science in Urban High Schools**  
**(REC- 0107022)**  
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**What We Have Learned**

**I. What Students Know and Can Do**

One of the most important findings emerging thus far from our research is the clear indication that urban African American youth, with similar social and cultural histories, who are attending inner city neighborhood, charter and magnet schools are capable of and do learn science in their classrooms. Through intensive, longitudinal case studies across an interesting variety of urban schools where levels of science achievement are vastly different, we have evidence showing that students embody dispositions or strategies of action which are highly conducive to the learning of science although often undermined or not recognized as capital within science classrooms. Across the six research sites, we have placed much resource into exploring the social and cultural capital of students and learning the ways in which capital from many fields outside of school can provide a foundation for learning science. In the process of identifying strategies of action and the multiple fields in which they are enacted, we learn not only of practices that teachers and students are conscious of, but also those that occur without awareness, afforded by resonances with the structure of the field in which urban science education is enacted. Since, one focus of our research has been to explore the agency|structure dialectic as it pertains to science education in urban high schools, we are specifically examining teaching strategies which at a micro-level either shut down student participation or encourage it. Some of these practices, in verbal and/or gestural form, take less than a thirtieth of a second to enact, but either build on the cultural capital of students or deny its use. The research is highly significant since shut down strategies appear to be related to teachers having different social and cultural histories to their students, especially in urban high schools. In addition, such microlevel analyses have been instrumental in recognizing particular aspects of a classroom's structure which create physical or ideological resonances within the students so that they then draw upon strategies that have been traditionally viewed as solely appropriate for fields other than the science classroom to engage in learning science. A major research breakthrough that resulted was to learn that we could create conditions in which such natural dispositions that previously were traditionally viewed negatively could provide a foundation for scientific literacy. They could be "structured" through the provision of material resources that enabled the students to pursue their interests and build science-related attitudes such as curiosity, persistence and call for evidence. Consequently, we have learned to consider those practices about which a learner is unaware – as part of scientific literacy. More specifically, we have studied the foundational role of science-related dispositions in

## Interim Progress Report

building those parts of scientific literacy that are more discursive and are acquired and enacted consciously.

In Cristobal Carambo's classroom, for example, he redesigned his curriculum approach to provide students with constant opportunities to "do" science. Throughout his classroom, he created physical spaces with a large array of resources so that students could be involved in activities like making fast plants, performing dissections, or building operative devices such as a Ferris wheel and roller coaster with KEX. In Anita Abraham's classroom, she introduced laboratory activities twice weekly for her eleventh grade chemistry class whose prior experiences in a science lab were negligible. Across both of these research sites, through audio and video data sources, we have found such structural changes allow students – who ultimately "fail" their science courses, to participate as engaged, focused learners who were building and developing scientific identities within a community of learners. The students utilized strategies of determination (i.e. removing a frog's heart without cutting it accidentally; or having a penny turn a golden hue in a chemistry lab on alloys) and argument strategies to challenge or make sense of concepts being presented in a class lecture. Students within these classrooms utilized natural dispositions to develop new strategies of action associated with the culture of science, such as following procedures, utilizing scientific tools for their intended purposes, and utilizing canonical science language interchanged with everyday language.

Our research results thus far indicate that a highly successful way to assist students' development of scientific literacy is through structuring classrooms so that efforts are made to get them involved and doing science that provides them space to further develop or refine what they already know and do. In this manner, unlike the majority of their counterparts who have attended school before them, these youth will have a greater chance of interacting in society in socially transformative ways, having learned how to draw upon the cultural strengths they already possess to build new strategies they may need.

Summary of important findings:

- The boundaries of a learning environment are porous, allowing strategies of action from various fields, such as the home and neighborhood to appear therein.
- An individual's cultural toolkit can not be left outside of school, as if it were a hat that could be taken off and put back on. When different fields share common human or material resources, rule systems, or ideology, "structural resonances" arise and particular practices, including unconscious strategies of action, appear across fields.
- Being able to identify the strategies of action within students' toolkits is a necessary prerequisite to beginning to understand them and ultimately to help them learn science in a way that can be transformative.
- Science learning has a greater potential to be transformative when students can utilize their unconscious dispositions (i.e. talents, skills, values, attitudes or dispositions) to participate in the activity of "doing" and "talking about" science.

## **Interim Progress Report**

- The process of meaning-making is most productive when student can utilize aspects of their strategies of action to understand science as well as to meet personal goals, i.e. gain respect within a peer group.
- By allowing – rather than preventing – students’ strategies of action to emerge and contribute during the activities related to learning science, we provide spaces where both cultural production and reproduction can occur. Consequently, students can not only be transformed by science, but can also transform our notions of what is scientific.
- The formation of a scientific identity is linked to the recognition, understanding and encouraged use of the students’ cultural toolkits.
- Strategies of action such as being able to follow procedures, utilize scientific tools and access canonical science discourse mediate the conceptual learning of science as well as encourage student participation and engagement in the “doing” of science.

### **II.Out of Field Teaching**

As out-of-field teaching is a reality in many schools, particularly in poor, urban areas, in our research, we have undertaken an intensive case study in which we examined one teacher researcher’s teaching depending on whether she was in her field of physics, or out of her field and teaching chemistry or earth science. Studies that relate out-of-field teaching to student performance are often based on survey data, school records, and/or test scores, which give a limited picture of the complex environment of the classroom. This model is not an adequate account of learning, as it does not provide enough attention to how meanings are constructed by students or how learning is mediated by many factors other than the teacher’s knowledge. Consequently, we studied the interactions between the teacher’s subject knowledge and the other components of the classroom activity system, such as rules, community, or division of labor in order to investigate how other components may have reduced or exacerbated the potential negative impacts of her being out-of-field, or may have even produced positive effects. Within the complex setting of the classroom, it is possible to identify aspects of the school climate such as faculty relationships, material resources, and teacher strategies (such as uses of peer tutors and small group problem solving) that may ameliorate the potential negative effects of out of field teaching, and may even lead to some advantages for student learning.

### **III.Research to Practice**

Over the past two years, we have found that our methodological approaches to research (i.e. micro-level video analysis and cogenerative dialogue) allow teaching practices, particularly those of the teacher researchers involved, to transform in sometimes subtle and sometimes more dramatic ways. The practices of reviewing videotaped classes, incorporating microtechniques and engaging in cogenerative dialogue with both university and student researchers serve as methods through which the teacher

**Interim Progress Report**

researchers involved in our studies have come to understand the activity systems in which their students participate as well as identify their own unconscious strategies of action. For example, through our research, teacher researchers have learned about many of their unconscious practices, such as the use of touch while interacting with students, verbal breaching of student practices, or gestures that shut down or encourage student responses to science related activities. Building knowledge of such teaching strategies has been very important in helping us conceptualize teaching as practice that has components of which a teacher is aware and unaware and that are intended and unintended. Moreover we have made important headways into understanding how teacher agency structures and is structured by student agency.

The following “nuggets” represent breakthrough moments in the classrooms of teacher and student researchers whose involvement in research resulted in a shift in their teaching and learning practices. They capture examples of teacher and student agency, the intricate ways in which they interrelate as well as how individual and collective agency restructures the classroom to afford greater science learning. The school names are provided in parentheses.

*Nugget: Assignment turn in sheet (Southeast)*

During the first marking period, I found that many of my students were doing very poorly; well over half of my students were going to fail. In some cases, their test scores would have enabled them to pass; however, they had not turned in most of their lab reports, very few homework assignments, and only a small percent of class work. Many students were shocked to learn their grades and vehemently protested saying, “I did that assignment!” During this time my mantra became, “I’m not accusing you of not doing it. I’m saying you never turned it in to me.” Sure enough, a quick search through the locker or backpack usually unearthed the nearly completed assignment in question. However, I found little satisfaction in being able to say, “I told you so!” Being fairly absent-minded myself, I was sympathetic to their plight. I discussed the issue with my student researchers who pointed out that many students’ parents or guardians do not or are not able to help them get organized. We came up with the idea of an assignment turn in sheet showing all the assignments and due dates. As students turned in their assignments, the list would be stamped to indicate that they turned it in. This way, students could keep track of what they did and did not turn in. This small sheet of paper increased the rate of students turning in assignments from well below 40% in the first marking period to nearly 80% in the second.

*Nugget: Students Take Responsibility (Magnet High)*

As a teacher researcher in my own classroom, I found that my philosophy about assessment needed to be revised as I learned more about my students as learners. When given the opportunity, students freely expressed their fears and anxiety associated with certain forms of assessment, namely exams. In whole-class cogenerative dialogues, my students and I discussed strategies they felt made them more confident while taking traditional exams. As a “survivor” of my own undergraduate chemistry courses, I had mixed feelings about the use of these resources during exams. I was convinced that giving students access to formulae cards would prevent them from learning the material. During student interviews, classroom discussions, and video analysis I began to

**Interim Progress Report**

reconsider what it means to learn chemistry. Encouraged by these interactive activities with students and informed by activity theory and sociocultural theories of learning, I started to move away from memorization tasks and allowed students greater access to resources during assessment activities. I found that giving students the privilege of creating index cards with information they felt they needed for tests did not prevent them from learning chemistry. On the contrary, I found that providing access to these resources encouraged students to spend more time learning concepts because they no longer had to concentrate on memorizing abstract formulas and rules. Students began to build a more complex view of chemistry and were better able to apply these formulas and rules. And not only did student grades and understanding improve; student confidence and interest in chemistry were greatly increased. Students became more involved in their own learning and suggested more and more ways to support their learning, which we both found to be beneficial!

*Nugget: Tailor a Test (Magnet High)*

The next major shift in my assessment procedures involving tests was directly related to student conversations concerning values assigned to problems on the exams and student practices of choosing certain problems based on complexity and point value. I began to create self-tailored exams, as suggested by a student that allowed students to choose from various problems of different point value to equal 100 points. I created an exam with different sections that exceeded 100 points in total value and allowed students to choose any combination of problems that would equal 100 points without exceeding that value. Students were then able to avoid or minimize contact with certain concept related problems that they may not have felt particularly well suited to answer. Students were then encouraged to use the graded exam to examine the areas they felt they needed more help with before the next exam. This not only reduced stress and anxiety related to test performance, but provided students with a diagnostic tool that could direct their continued studies based on the problems they felt they were unable to answer. Students appreciated both aspects of this assessment tool and as a teacher I was able to take note of the section or sections that many students avoided. This gave me an idea of a concept area that may need to be re-taught in an overall class setting and provided insight about which concepts students felt most comfortable.

*Nugget: Point for point (Magnet High)*

By becoming more aware of student needs and concerns about exams as assessment, I began to see that while many students seemed competent enough while working in class and in groups, when placed alone with an exam, they often struggled. While this could be attributed to many things, I felt that student anxiety was a great factor. I found that by walking around and telling students they were or were not on the right track during their exams, they seemed to have increased confidence in answering questions. As I walked around, I began asking students to call me over for any questions at all – even if it was just to clarify what a question was asking. Seeing student confidence increase when they verbally confirmed that they understood how to begin to answer a question, I then began to work on students who did not understand how to answer questions. I began a process of giving a point of advice or information, like a formula, so that students could answer the problems and gain points for the exam. I began telling students as I constantly circled

**Interim Progress Report**

the class, “I’ll give a point and take a point”. Student hands shot in the air and I found I was moving all over the room giving small hints, confirming student answers, and working through whole problems with students. This process greatly reduced student stress and increased student participation, particularly among low testing students as I provided yet another resource that helped to mediate their goal of achieving well on a science exam and my goal of having students learn chemistry. I no longer worried about points and grades, but really began to focus on student understanding. In some cases, verbal answers replaced mathematical explanations on exams, again increasing student participation, student interest, and above all, student learning.

*Nugget: Partner exams (Magnet High)*

The final evolution in my use of exams as an assessment tool grew from my continuous use of groups for all activities in the classroom. A student suggested a partner exam for the culminating pressure chapter. I was not sure what this would look like in practice, but many students were visibly anxious about this exam. Following a discussion about the importance of shared responsibility for test taking and personal student learning, I allowed students to take the exam in groups of two. I was nervous about taking such a large leap towards what seemed like a radical activity, mostly because I was uncertain that this partner test would accurately reflect the knowledge of one student. As I circulated around the room, I was amazed to hear the conversations students were having as they answered the questions. They were making assertions, drawing diagrams, gesturing to explain concepts, and arguing when they disagreed. These interactions were, I decided, more important than the final solutions written on the paper and more valuable in terms of science learning and understanding. It was the activities needed to answer the questions cooperatively that contributed most to the building of their knowledge related to chemistry. I began to assess these interactions informally as well as the final product and I found that this interactive, community based discussion of science concepts was a more impressive representation of what students had learned than any other form of assessment I had previously used.

**IV. Students and sociocultural theory – a means for transformation**

We have seen enormous potential of building communities in which urban youth accept more responsibility for their learning. Teachers in our studies have involved their classes in discussions of video clips taken from their science classes and in the process have reached agreement on different roles, responsibilities and goals for science. Through cogenerative dialogues we have seen significant improvements in learning environments and motivation to learn among students.

In our most recent work with our student researchers, we have made a dramatic shift toward introducing them to theoretical constructs which inform our research, particularly sociocultural theory. In this manner, it has become possible to actively engage their assistance in the interpretation of data being generated. Moreover, it has become our belief that the students’ involvement in research becomes most empowering and potentially transformative to their lives through expanding the ways in which they are able to perceive the world and their experiences within it. Thus, across research sites, we work with students to help them understand sociocultural concepts such as culture,

**Interim Progress Report**

structure, agency, schema/ideology, hegemony, different forms of capital (social, cultural, symbolic), and strategies of action.

*Nugget: Ron, you code switch. You just don't realize it. (Charter High)*

The incident on February 11 made us question whether the socio-cultural theory which we were teaching the students was making any difference in their lives. But on this day, we realized that some of the kids were actually listening...and even better, they were making changes in their lives and lives of others. The cogenerative dialogue for this day began with students talking about what should have happened the previous day when Jen was absent. Most of the students began to take responsibility for their actions; however, one student, Ron, was still visibly upset, feeling disrespected by the teacher who was covering Jen's class. While Jen and Sarah-Kate listened to what the Ron had to say, Bradley spoke up and pointed out the importance of code switching. Ron was quick to tell the group that he does not do this; rather, he said that he acts the same way inside of school as compared to when he is on the outside. There was a feeling of group solidarity as the students, specifically Bradley, began to give Ron examples of when and where he might be code switching. He posed the example of going to church and Sarah-Kate pointed out that Ron does it every day in school when he talks to teachers and different members of the school staff. By the end of the dialogue, we could tell that Ron was beginning to think more deeply about this idea of using different strategies and dispositions as he negotiates his way through school and his life outside.

*Nugget: We can't give in to the stereotypes (Charter High)*

On my way to photocopy this afternoon I ran into Jen and her student teacher talking with Bradley, one of the students from our class. As I approached, I could see from Bradley's eyes that he was very upset and angry about something. Joining the huddle, I quickly learned that the student teacher was trying to diffuse a possible situation between Bradley and his friend. Becoming more and more upset about the fact that Bradley's close friend had "stepped to" him about a girl, Jen and I became involved in the conversation. We tried to explain that he has worked so hard and come so far that he should not allow someone else to take it away. We reminded him about what he had said, just four days ago in a co-generative dialogue, about the need for young black Americans to watch how they act and code switch so they can help break down racial stereotypes. Bradley was still quite angry when Jen walked him down the stairs and out the door to the subway. Afterwards, Jen confided in me that she felt that Bradley needed to hear things in his words. But it seemed to me that what Bradley was really responding to, was the little words of socio-cultural theory...words like strategies and resistance.

*Nugget: What a Change! (Charter High)*

Yesterday, one of the school's academic administrators commented to Jen and to me that she was impressed with some of the students in our class. She said that she has noticed a change in some of the students (particularly those who act up in other classes) and wondered what we were doing in our science class. We explained that we too had noticed the change and began to recount the things that our class has been doing to help students take responsibility for their own actions for learning as well as create an atmosphere of shared responsibility. Right from the beginning of the trimester, with the

## **Interim Progress Report**

intention of structuring the science classroom in such a way that provides the students with greater agency and responsibility, we actively involved them in making decisions and consequences regarding their behavior and learning. The first thing we did was to make explicit the importance of looking out for others in your group, making sure people around you understand what's going on in class, and asking if you don't understand. Second, introducing the students to sociocultural theory (ideas like capital, resistance, toolkit) helped them begin to see that they bring all sorts of knowledge and tools to the classroom and that all of us in the classroom have to help them figure out how to use those things to help themselves and others learn science.

*Nugget: What are we talking about today? (Charter High)*

One of the activities the students in the class enjoy is meeting for our Thursday lunch cogenerative dialogues. This is the time that the students, Jen and Sarah-Kate get to co-construct an understanding of the classroom activities and talk about ways in which the teaching and learning in the classroom can be improved. Generally, Jen and Sarah-Kate have a few ideas of what they would like to talk about, however the students usually bring to the table their ideas, questions and concerns. Today was not unusual in that the students had an agenda of their own. . . During lunch, Sarah-Kate posed the question of whether the class should continue to have a “do now” at the beginning of each class period because the students usually procrastinate and are inefficient in completing the task. The students strenuously agreed that they liked having some sort of pre-class activity because it gave them a chance to “start their brains” and get ready for class. As they proceeded, they discussed the previous day's class and how they enjoyed the activities. Mentioning that “Ms. Beers used things we were interested in, like basketball,” they came to a conclusion that they would all be more interested and productive if the activities included their interests and aspects of their culture. The result of this conversation had a direct impact on what Jen did as a pre-class activity the next day. Instead of having a traditional pre-class question (something related to the previous day), Jen decided to start the class by drawing on the students' life worlds. Students were asked to solve a logic question that was directly related to what the students were familiar with: riding the bus. What is interesting is that when asked about the class that day, all of the students said that they really liked the way that class was started and Jen and Sarah-Kate noticed a difference in the class too. Students were quicker to begin the activity and more lively in reporting back to the class about their findings. As a result, Jen is planning on keeping these types of activities in the beginning of class and the students are excited to see what challenges they have the next day.

*Nugget: What's it Worth? (Magnet High)*

During cogenerative dialogue about exams and assessment, a student pointed out to me that she could make more informed choices about how to take my exams if she knew the point value assigned to each problem. While this may be a common technique for more experienced teachers, I had not previously considered the importance of student knowledge concerning point values assessed to test sections. It was not until the student told me she sometimes had to sacrifice certain problems in order to complete other sections due to time restraints that it became clear that knowing the value of the sections would influence her decision about which problems to skip. I began printing the point

**Interim Progress Report**

value for each problem as well as an explanation about what would be considered a complete answer for essay questions. I noticed that students felt more confident given this information that should they need to sacrifice a problem, they could do so strategically. I noticed students began to search through exams and mark problems with different point values for priority so they could work in the most efficient manner they deemed necessary dependent on the individual. Again, we had negotiated a way to increase student involvement in their own learning process and students had found yet another way to increase their own confidence while being assessed.

**V. Teacher researchers and activity theory – a means for transforming the classroom**

In addition to our methodological approaches which include the extensive use of student researchers, we ensure that teaching and learning practices can change throughout the research process through our theoretical lenses – one of which is activity theory. More specifically, one premise of activity theory is to introduce change within a particular cultural field through the identification and understanding of the many activity systems that exist therein and the ways in which they interrelate, overlap and sometimes contradict one another. Thus our use of activity theory in making sense of science classroom teaching and learning helps ensure that the understandings developed throughout the research process continuously impact teaching practices. Different individuals within the classroom have differing and/or similar goals and utilize various resources and strategies of action to accomplish them. By identifying the contradictions that may exist within or between activity systems, we are able to make specific changes to alleviate the conflicts of goals. (The practices of reviewing videotaped classes, incorporating microtechniques and engaging in cogenerative dialogue with both university and student researchers serve as methods through which the contradictions can be identified.) In fact, when teacher researchers involved in the grant have come to understand the activity systems in which some of their students participate as well as identify their own unconscious strategies of action, they have altered their practices within the classroom.

The following “nuggets” provide examples of how teacher researchers altered components of the activities occurring within their classrooms to allow greater opportunities for students to learn science in meaningful ways. They narrate how the teachers introduced additional material resources, altered physical spaces of the classroom, helped students to access greater human resources and/or introduced a structure for a different division of labor.

*Nugget: “Fast Equals Smart” (Magnet High)*

During one meeting between Stacy and Linda, Linda described how most of the students who were doing poorly in her class handed in their tests early and incomplete. She saw their failure to turn in complete tests as possible evidence of their lack of knowledge or self-reflection. A few weeks later, the four student-researchers spoke about how they become nervous while taking tests. One expressed how when a certain boy finishes first, she thinks there is something wrong with her that she is not even near finishing, and she just turns it in. The other girls joined in, “Oh it makes me feel stupid.” “Yeah, I go turn mine in too.” About a week later, Linda said, “after the conversation

**Interim Progress Report**

with those kids, next time I give a test, no one will be able to hand it in early... that it doesn't put any pressure on kids that I have to finish fast that means I'm smart." Unintentionally, the teacher had initially set up the rules so that during the test, an important object of the students was to look smart. This idea of "fast equals smart" could have developed in previous years and increased in importance as students worked in this competitive atmosphere. Linda changed the rules in the classroom of how tests should be taken so that students could no longer get up from their seats, which reduced the contradiction between the rules of test taking, students' goal of "looking smart" and students' goal of communicating their knowledge of science with the teacher. The lower-performing students could now work toward developing identities as science learners, by turning in complete tests and earning better grades, rather than fearing a negative identity as a "slow student." Only a few of the past several tests that the teacher gave were not fully completed by students. The process by which the teacher changed these rules demonstrates how the changed division of labor resulting from the research process can facilitate change.

*Nugget: Scientific Literacy: Writing, Reviewing and Revising (Southeast)*

The greatest benefit of becoming a teacher researcher has been the catalytic effect it has had on my teaching practice and the learning of my students. Following the devastating results of a multiple choice achievement test on gas laws that I was required to give my students at the end of my involvement in a collaborative, quasi-experimental study, I gave my students a make-up exam. Because I was very troubled by the disparity between student performance on this achievement test and the knowledge and understanding they demonstrated during classroom interactions, I decided to try something I had never done before. Instead of giving another conventional exam, I did two demonstrations and asked the students to write a semi-structured essay about them. The demonstrations were the can-crushing demo and the demonstration where the egg gets drawn into a flask. Their essays were structured such that the first paragraph was to describe what they observed happening in the first demo. In their second paragraph, students were to explain the phenomena they observed by describing what was happening on the molecular level. They repeated this pattern in their third and fourth paragraph for the second demo. In the fifth and final paragraph, they were asked to compare the two demonstrations.

I was very apprehensive about giving this type of exam. I was afraid that students would be resistant to writing essays, especially in their science class. I was particularly nervous because the day of the demo exam there was going to be a visitor in my classroom, the external evaluator for the Master of Chemistry Education Program (in which I was a student). Much to my amazement, students were more than willing to write about chemistry. One low-performing student who rarely participated in class actually exclaimed, "Finally!" when I described the assignment. Apparently this student loved to write and I never knew or would have known had I not attempted something different. After watching the demos, students began to write. I was astonished, as my normally noisy classroom grew silent with students concentrating on their writing.

Having "outsiders" coming into our classroom and seeing our activities from a different perspective has been invaluable. The day of the demo essay, there was an "outsider," the evaluator of the MCE program, in our classroom. After the class finished

**Interim Progress Report**

their essays and turned in their papers, the evaluator came over and spoke about what a wonderful activity it was. I told him that I was very surprised at how well the activity went and admitted that I had never done anything like it before. I also admitted how apprehensive I had been to try it on a day a visitor would be coming. The evaluator asked what was going to happen next. I said I wasn't sure but that my students' responses to the demo essay made me regret that this was the end of the gas laws unit. He agreed and said that this should not be an endpoint, but a new departure. He suggested that instead of immediately moving on to another topic, I should make use of this assessment to further student learning. He suggested having students from different classes peer review each other's essays and then possibly giving students another opportunity to create a final draft incorporating the comments of their peers. This sounded like such a great idea; I knew we had to try it.

The following day, I made copies of all their essays, eliminating their names so the essays would be anonymous, and distributed them to other classes so their peers could read their work, score their essays and give them feedback. Before doing this, we discussed as a whole class what a good essay should contain and came up with a rubric for rating each paragraph of the essays. Students took the responsibility of grading and critiquing each other's essays very seriously. Again, I was amazed at the level of participation and engagement in this activity.

On the third day, students wrote the final draft of their demo essay. They had the benefit of all our class discussions, the feedback from their peers and some feedback from me. This process allowed the students to self reflect, and allowed me to identify and address the misconceptions some students were harboring. If we had not gone through the revision process, only I would have been able to see their misconceptions, and there would have been no opportunity for the students to reflect and correct their erroneous beliefs about why the can crushed and why the egg was drawn into the flask. This process of writing, reviewing and revising transformed assessment from a judgmental, grade-producing device into a learning tool for the students, and for me.

*Nugget: Labs students can touch (Southeast)*

At Southeast High School there is only one science lab for a student population of approximately 1250 students. There is also one lab technician who is responsible for ordering materials, prepping for laboratory activities, and maintaining the laboratory facility. As a teacher, when I bring my students to the lab, we are all visitors in the lab technician's domain. She maintains tight control over the distribution of materials and goes to great lengths to minimize student contact with the chemicals and equipment in her lab. At times, the technician becomes so worried about the possibility of students contaminating her solutions that she practically does the lab for the students.

The restrictive structure of laboratory science at my school, both in terms of human and material resources, has forced me to seek out activities which can be safely done within the confines of my own classroom. As I began finding and implementing labs that do not require a laboratory, I was pleasantly surprised by the increased level of student participation in the learning activities. In spite of the fact that students were using materials like baking soda and vinegar instead of hydrochloric acid and sodium hydroxide, students were engaging in scientific practices which were previously forbidden by the imposed structure of the laboratory technician. In the less restrictive space of the classroom, students could handle the materials and equipment. During these

## **Interim Progress Report**

in-class labs, students began to generate their own questions. Instead of supplying them with answers, I was able to direct them back to their materials where they had the freedom to design and carry out experiments to arrive at their own answers. At last, students were able to participate in the doing of science, rather than simply being spectators.

### *Nugget 11: Students as resources (Charter High)*

Students were asked to complete study sheets as a homework assignment in order to prepare for the review session today. Jen had intended for the students to get into groups, check their answers with their group members and together, come up with any questions for her about the material that going to be on the final exam. However, what transpired was remarkably different. Instead of the typical teacher-student-teacher interaction where Jen would be the resource, students began asking questions of their peers and demanding that they explain their ideas clearly, slowly and in a way which others could understand. In this regard, Jen was no longer the main resource in the classroom as she acted as facilitator for the students' study group.

The following is what transpired:

Jen: Who has a question or something they need clarified? Donald?

D: How are planets and life forms formed from the stars?

K: I know. I want to say it.

J: Go ahead.

Kevin began answering the question but was providing incorrect and incomplete answers. LaShonna, listening to his explanation, knew that she could provide additional clarification, leaned over and raised her hand. Also recognizing that the answer Kevin was providing was not correct, Jen restated Kevin's response and requested that LaShonna "go ahead and help him out". LaShonna explained her ideas about accretion, but it was described too quickly for Donald to write down. Donald then asked for LaShonna to repeat herself. Again when he couldn't get the whole process, LaShonna asked him if he wanted her to repeat it again, but this time more slowly. After LaShonna repeated the answer another time, Jen restated the concepts using LaShonna's words making sure that everyone wrote down what LaShonna had stated.

### *Nugget: Translating the language of chemistry into everyday language (Southeast)*

As a research team we began to notice that many of the problems with comprehending chemistry had less to do with the science than the language. We began developing activities that would address the issue of language. The textbook was laden with science terms and English vocabulary which many of my students found alienating. The homework problems from the end of the chapter required students to search and find information in the chapter, but did little to help students to decode the language. To help students with this important skill, I began giving students a particular audience to which they needed to address their explanation. For example, students would be asked to work in pairs where one person would pretend they were the ten year-old sibling of the other, and the other was meant to come up with a way of explaining a particular chemistry concept to the ten year old. The job of the ten year old was to prevent the explainer from using textbook terms that the younger sibling would not understand. This required students to translate the language of chemistry into everyday language. Students could

## **Interim Progress Report**

use slang, analogies, metaphors and expressions that were familiar to them and their peers in explaining chemistry concepts. This helped students to feel more comfortable with the chemistry, to identify and clear up misconceptions, and to break down some of the barriers to learning chemistry.

### *Nugget: Role-playing in Chemistry (Southeast)*

A major barrier to participation in science learning activities identified by the research group is the conflict students face between trying to maintain their social status with their peers and being seen as a science nerd. Students will often times opt not to participate, sacrificing their chemistry grade, in order to look “cool” in the eyes of their peers. As I became more keenly aware of this dilemma, I began considering ways to make my goal of student learning and participation more compatible with their goal of looking “cool.” I attempted to broaden the definition of “doing science” and sought new roles students could adopt in science learning activities. I began trying to create activities where students were not playing the traditional student role. We did labs where students played the role of research scientists experimenting with proportions of materials to develop the best formula for the bounciest “rubber” ball. Students did presentations and demonstrations to teach their peers. Students played the role of evaluator, assessing each other’s work. Not every role suited every student, but by changing the means of participation, more students became actively involved in the class.

## **Presentations and Publications**

Over the past two years we had a major presence at four international/national meetings; Ethnography Forum, Association for the Education of Teachers of Science, American Educational Research Association, and the National Association for Research in Science Teaching. All members of our research team, including teacher-researchers, were active at two or more of the meetings. The list of papers presented is included in Appendix A. Also in Appendix A is a list of papers and book chapters that have been written in relation to our research. In the remainder of this year a number of the papers prepared for presentation at the annual meetings will be submitted to journals for publication.

## **Website Construction**

A website for our research is under construction. At the present time we are using it to allow colleagues to access Quicktime movies, transcripts, and audio from our research. In addition some of the papers from the research are available for download from this site. We intend to have this site fully functional by summer 2003 so that it can be a major resource for cross site analysis during the third and final year. The URL for the website is <http://learning.gse.upenn.edu/~urbansc/>

## **The Seminar**

Each Thursday from 4:30 pm until approximately 6:30 pm we conduct a research seminar and/or a research meeting. A schedule of presentations for the seminar is provided in Appendix B. Every other week we discuss our research and aspects of methodology. These sessions vary from the very practical how to sessions (e.g., how to

## **Interim Progress Report**

use imovie2 to edit videotape) to discussions of theory and its applications for research (e.g., applications of cultural-historical activity theory to our research).

### **The Advisory Board**

The advisory board will meet as a group in May of 2003. As individuals Kathy Borman, Wolff-Michael Roth, and Angela Calabrese Barton have visited Philadelphia to discuss our research in relation to their scholarship. In addition, following her presentation at the PI meeting at NSF we invited Elizabeth Moje to collaborate with us on our research. We have found her work to be quite similar in its theoretical orientation and we can learn from what she is doing and learning from her research (and vice versa).

### **Looking Ahead**

The goals for the third year of the project are to ensure that we obtain compelling answers to all of the questions we have proposed to answer. Hence we will participate in cross site analyses and investigations and meetings of the research team will be every focused on identifying the patterns of coherence and the associated contradictions. Since Tobin will have a sabbatical leave in the fall of 2003 a strong emphasis will be on writing and dissemination. In the final year the two doctoral students who have undertaken two years of research on the study, LaVan and Olitsky, will begin their dissertations. LaVan will finish her degree in the spring of 2004. Similarly, six of the seven teacher researchers will write doctoral dissertations based on their research in this project. Accordingly, the yield from the study will be very high.

The last five weeks of the year are very significant in urban high schools and this year will be no different. We will be extremely active in each of the teacher research sites and highly innovative curricula will be enacted based on what we have learned to this point in our research. At two neighborhood, comprehensive high schools we will employ cogenerative dialogues as an integral part of creating student centered learning environments and building collective responsibility for teaching and learning. Also we will employ the principles of "back design" in a process in which we make the most of student practices to create curricula experiences that are relevant and culturally adaptive for students, while creating opportunities to build scientific fluency. Our research focus in this time will be to create trajectories for students becoming more fluent in science and obtaining evidence of their uses of science discourse. How students come to know science and how they can represent what they know will be the focus.

In the summer we have employed urban youth in ways that have defined the foundations of our research in the subsequent fall/spring semesters. This year we want to employ five youth from City High as curriculum developers and have them create and adapt resources to fit a theme of what one of them, Shakeem, refers to as ghetto science. We expect they will create resources using video tape and digital media, including computers and DVD, for the use of teacher researchers in the forthcoming year and specifically, for peers from the schools in which our research is situated. The artifacts and the process of developing them will become resources for our research and we expect in the summer session to expand the roles and identities of youth researchers, especially in regards to becoming science teacher educators, curriculum developers and classroom researchers.

## Appendix A

### Publications Associated with the NSF Grant (REC- 0107022)

#### Papers Presented at AETS - [Association for the Education of Teachers in Science](#)

##### Second Year (2003)

01. Elmesky, R. (2003, January). *Crossfire on the streets and into the classroom: Meso|micro understandings of weak cultural boundaries, strategies of action and a sense of the game in an inner-city chemistry classroom*. Paper presented at the annual meeting of the Association for the Education of Teachers of Science, St. Louis, MO.
02. LaVan, S.K. Martin, S. (2003, January). *Teachers and inquiry: Learning high school chemistry through inquiry*. Paper presented at the annual meeting of the Association for the Education of Teachers of Science, St. Louis, MO.
03. Olitsky, S. (January, 2003). *The Teaching of Science as Mediated by the Use of Resources, Social Capital, and Cultural Capital*. Paper presented at the Association for Educators of Teachers of Science, St Louis, MO.
04. Otieno, T., (2003, January). *Can-crushing, Colliding Molecules and Communicating: Making Connections Between Levels of Representation*. Paper presented at Association for the Education of Teachers of Science, St. Louis, MO.
05. Scantlebury, K. (2003, January). *Queen mother, flyy girl and 'ho: The influence of African American girls' culture of femininity on learning high school science*. Paper presented at the Association for Educators of Teachers of Science, St Louis, MO.
06. Tobin, K. (2003, January). *Forging new pathways to scientific literacy*. Paper presented at the annual meeting of the Association for the Education of Teachers of Science, St. Louis, MO.

##### First Year (2002)

07. Elmesky, R. (2002, January). *When urban African American high school students' learning of physics leads to agency*. Paper presented at the annual meeting of the Association for the Education of Teachers in Science, Charlotte, NC.
08. Tobin, K. (2002, January). *The transformative potential of science teacher education for the teaching and learning of science in urban high schools*. Paper presented at the annual meeting of the Association for the Education of Teachers in Science, Charlotte, NC.

**Papers Presented at the [Annual Ethnography in Education Research Forum](#)**

**Second Year (2003)**

09. Carambo, C. (2003, February). *Structure, agency and the evolution of scientific literacy in an urban high school*. Paper presented at the Urban Ethnography Conference, Philadelphia, PA.
10. Elmesky, R. (2003, February). *How to better teach kids like me*. Paper presented at the Urban Ethnography Conference, Philadelphia, PA.
11. Elmesky, R. (2003, February). *"Gonna make a fire!": How urban students' strategies of action afford scientific literacy*. Paper presented at the Urban Ethnography Conference, Philadelphia, PA.
12. Hazelwood, L. Giombetti, C. & Scantlebury, K. (2003, February). *Catalysts or Identities of African American Females in the Urban Science Classroom: Agency and Structure*. Paper presented at Urban Ethnography Forum, Philadelphia, PA.
13. LaVan, S.K. & Martin, S. (2003, February). *We don't know what we're talkin' about: Peer group interactions and the formation of learning community*. Paper presented at the Ethnography Forum, University of Pennsylvania, Philadelphia, PA.
14. Olitsky, S. (2003, February). *Social and Cultural Capital in Science Teaching: Relating Practice and Reflection*. Paper presented at the Urban Ethnography Forum, Philadelphia, PA.
15. Scantlebury, K., Otieno, T. (2003, February). *"Science is corny!": Resolving Tension Between Student Identity and Science*. Paper presented at the Ethnography Forum, Philadelphia, PA.
16. Tobin, K. (2003, February). *Seeing and using science in everyday life*. Paper presented at the Urban Ethnography Conference, Philadelphia, PA.

**First Year (2002)**

17. Abraham, A. (2002, March). *Learning how to merge Eastern and Western cultures*. Paper presented at the Ethnography in Education Research Forum, University of Pennsylvania, Philadelphia, PA.
18. Carambo, C. (2002, March). *Looking back to move forward: An autobiographical look at my changing vision of science and "urban" students*. Paper presented at the Ethnography in Education Research Forum, University of Pennsylvania, Philadelphia, PA.
19. Elmesky, R. (2002, March). *Urban students learning physics: Understanding the weak boundaries of culture*. Paper presented at the Ethnography in Education Research Forum, University of Pennsylvania, Philadelphia, PA.
20. Elmesky, R. & Abraham, A. (2002, March). *Urban African American students building strategies of action in a high school chemistry laboratory*. Paper presented at the Ethnography in Education Research Forum, University of Pennsylvania, Philadelphia, PA.
21. Hazelwood, L. (2002, March). *The re-education of an urban science teacher*. Paper presented at the Ethnography in Education Research Forum, University of Pennsylvania, Philadelphia, PA.

**Interim Progress Report**

22. Lavan, S.K. & Martin, S. (2002, March). *Social structure of high schools and enacted science curricula*. Paper presented at the Ethnography in Education Research Forum, University of Pennsylvania, Philadelphia, PA.
23. Loman L. (2002, March). *My cultural awakening in the classroom*. Paper presented at the Ethnography in Education Research Forum, University of Pennsylvania, Philadelphia, PA.
24. Martin, S. (2002, March). *Not so strange in a strange land: An autobiographical approach to becoming a science teacher in an urban high school*. Paper presented at Ethnography Forum, University of Pennsylvania, Philadelphia, PA.
25. Olitsky, S. & Loman, L. (2002, March). *Contradictions, collaboration and change in an urban magnet school science class*. Paper presented at the Ethnography in Education Research Forum, University of Pennsylvania, Philadelphia, PA.
26. Tobin, K. (2002, March). *Social and cultural perspectives on the teaching and learning of science in urban high schools*. Paper to be presented at the Ethnography in Education Research Forum, University of Pennsylvania, Philadelphia, PA.

**Papers Presented at AERA - [American Educational Research Association](#)**

**Second Year (2002)**

27. Elmesky, R. (2003, April). *Classrooms with translucent walls: The overlapping social fields within science classrooms*. Paper presented at the annual meeting of the American Educational Research Association, Chicago, IL.
28. Elmesky, R. (2003, April). *The Role of Structure in the Learning of Science*. Paper presented at the annual meeting of the American Educational Research Association, Chicago, IL.
29. LaVan, S.K. & Martin, S. (2003, April). *This is not your parents' chemistry course: Using group work to improve science learning and scientific literacy*. Paper presented at the annual meeting of the American Educational Research Association, Chicago, IL.
30. Milne, C. and Otieno, T. (2003, April). *Looking at Learning Environments from a Socio-cultural Perspective: Examining Sites of Concentrated Practice in the Chemistry Classroom*. Paper proposed for the annual meeting of the American Educational Research Association, Chicago.
31. Milne, C. & Otieno, T. (2003, April). *"We can't let them use Bunsen burners. We don't know what they might do." How Structures Affect an Enacted Science Curriculum at an Urban High School*. Paper presented at American Educational Research Association Annual Meeting, Chicago, IL.
32. Olitsky, S. (2003, April). *Coherence, Contradiction and the Formation of School Science Identities*. Paper presented at American Educational Research Association Annual Meeting, Chicago, IL.
33. Scantlebury, K & Tobin, K. (2003, April). *Just another day: The impact of urban African-American girls' lifeworlds on their struggles and survival in high school science*. Paper presented at American Educational Research Association Annual Meeting, Chicago, IL

**Interim Progress Report**

**First Year (2002)**

34. Carambo, C. (2002, April). *Through the eyes of a science teacher: Teaching here is no slam dunk!* Paper presented at the annual meeting of the American Educational Research Association, New Orleans, LA.
35. Tracy-Stickney, C. (2002, April). *Research, reform, and reproduction cycles: Confronting a problem in grade nine.* Paper presented at the annual meeting of the American Educational Research Association, New Orleans, LA.
36. McKnight, Y.(2002, April). *Students, teachers, success: Playin' the game and makin' it at school.* Paper presented at the annual meeting of the American Educational Research Association, New Orleans, LA.
37. Tobin, K. (2002, April). *Learning to teach transformatively in urban schools.* Paper presented at the annual meeting of the American Educational Research Association, New Orleans, LA.
38. Tobin, K. & Carambo, C. (2002, April). *Coherence and contradictions in teaching and learning to teach science in urban schools.* Paper presented at the annual meeting of the American Educational Research Association, New Orleans, LA.

**Papers Presented at NARST-[National Association for Research in Science Teaching](#)**

**Second Year (2002)**

39. Tobin, K. (2003, March). Theoretical and empirical perspectives on the involvement of participants as researchers in urban science classrooms. University of Pennsylvania: Pre-conference workshop at the National Association for Research in Science Teaching.
40. Roth, W-M. (2003, March). *From theory to method to genre of research writing.* University of Pennsylvania: Pre-conference workshop at the National Association for Research in Science Teaching.
41. Elmesky, R. & Sample, A. (2003, March). *The gift of sight: What student researchers bring to critical ethnography.* University of Pennsylvania: Pre-conference workshop at the National Association for Research in Science Teaching.
42. Olitsky, S. (2003, March). *Student Researchers: Researchers, informants, interpreters of theory?* University of Pennsylvania: Pre-conference workshop at the National Association for Research in Science Teaching.
43. Lavan, S-K. & Beers, J. (2003, March). *Driving educational reform with cogenerative dialoguing to identify and resolve.* University of Pennsylvania: Pre-conference workshop at the National Association for Research in Science Teaching.
44. Seiler, G. & Johnson, M. (2003, March). *Urban science education through the eyes of youth.* University of Pennsylvania: Pre-conference workshop at the National Association for Research in Science Teaching.
45. Abraham, A., Carambo, C. & Hazelwood, L. (2003, March). *Teaching in the urban science classroom: Does being a teacher-researcher make a difference?* Paper presented at the National Science Teachers Association.
46. Carambo, C., Tracy, C., Abraham, A., Tobin, K. & Elmesky, R. (2003, March). *Theoretical and empirical perspectives for improved science education in urban high*

**Interim Progress Report**

- schools*. Symposium presentation presented at the annual meeting of the National Association for Research in Science Teaching, Philadelphia, PA.
47. Elmesky, R. (2003, March). *Bangin' on tables to talk about frequency: Broadening the narrow view of what is science*. Paper presented at National Association of Research in Science Teaching, Philadelphia, PA.
  48. Giombetti, C. & Scantlebury, K. (2003, March). *Gangsta', Gentlemen and Good Girls: Science Students Build Capital*. Paper presented at National Association of Research in Science Teaching, Philadelphia, PA.
  49. Hazelwood, L. (2003, March). *Co-constructing science in an urban classroom: Making do with what you have*. Paper presented at the annual meeting of the National Association for Research in Science Teaching, Philadelphia, PA.
  50. Milne, C. E. (2003, March). *Making a silk purse from a sow's ear? Teaching science in an urban high school without a science department*. Paper presented at for the annual meeting of the National Association for Research in Science Teaching, Philadelphia, PA.
  51. Olitsky, S. (2003, March). *In and out of field teaching strategies that help students become successful science learners*. Paper presented at the National Association for Research in Science Teaching Annual Meeting, Philadelphia, PA.
  52. Otieno, T. (2003, March). *It's not quiddich: structure, agency and identity in an urban science classroom*. Paper presented at the annual meeting of the National Association for Research in Science Teaching, Philadelphia, PA.
  53. Otieno, T., Martin, S., Carambo, C., Abraham, A., and Hazelwood, L. (2003, March). *Teaching in the Urban Science Classroom: Does being a teacher-research make a difference?* Paper presented at presentation at the annual meeting of the National Science Teachers Association, Philadelphia, PA
  54. Sterba, M. (2003, March). *First Lady of Da Bridge: Recognizing Female Agency through Research*. Paper presented at National Association of Research in Science Teaching, Philadelphia, PA
  55. Tobin, K. (2003, March). *The agency-structure dialectic in urban high school science classrooms*. Paper presented at the annual meeting of the National Association for Research in Science Teaching, Philadelphia, PA.

**First Year (2002)**

56. Carambo, C. (2002, April). *In the midst of our transformation*. Paper presented at the annual meeting of the National Association for Research in Science Teaching, New Orleans, LA.
57. Elmesky, R. (2002, April). *Crossfire on the streets and into the classroom: A micro analytical approach to ethnographic research*. Workshop presentation at the annual meeting of the National Association for Research in Science Teaching, New Orleans, LA.
58. Elmesky, R. (2002, April). *A new face for urban science education*. Paper presented at the annual meeting of the National Association for Research in Science Teaching, New Orleans, LA.

**Interim Progress Report**

59. Hazelwood, L. (2002, April). *Co-constructing science in the urban classroom*. Paper presented at the annual meeting of the National Association for Research in Science Teaching, New Orleans, LA.
60. LaVan, S-K., (2002, April). *More than chalky fingers and eraser dust: When cultural production and reproduction of canonical science occurs at the chalkboard node*. Workshop presentation at the annual meeting of the National Association for Research in Science Teaching, New Orleans, LA.
61. Loman, L. (2002, April). *Making science accessible using cultural capital, social capital, and resources creatively*. Paper presented at the annual meeting of the National Association for Research in Science Teaching, New Orleans, LA.
62. Martin, S. (2002, April). *Transformative Science: Teacher as researcher, promoting catalytic changes in the classroom*. Paper presented at National Association for Research in Science Teaching, New Orleans, LA.
63. Milne, C. (2002, April). *Enacting school science: Agency, resources, and cultural schema*. Paper presented at the annual meeting of the National Association for Research in Science Teaching, New Orleans, LA.
64. Olitsky, S., Loman, L., Martin, S. (2002, April). *Thin coherence & weak boundaries: Enacting school science culture in an urban magnet school*. Paper presented at the annual meeting of the National Association for Research in Science Teaching, New Orleans, LA.
65. Otieno, T. (2002, April). *Student researchers as agents of change*. Paper presented at the annual meeting of the National Association for Research in Science Teaching, New Orleans, LA.
66. Scantlebury, K. (2002, April). *Gender, race, and cultural production of science in urban high schools*. Paper presented at the annual meeting of the National Association for Research in Science Teaching, New Orleans, LA.
67. Tobin, K. (2002, April). *Sociocultural lenses on classroom life*. Workshop presentation at the annual meeting of the National Association for Research in Science Teaching, New Orleans, LA.
68. Tobin, K. (2002, April). *Lab activities in low performing highly segregated urban high schools*. Paper presented at the annual meeting of the National Association for Research in Science Teaching, New Orleans, LA.
69. Tobin, K. (2002, April). *The laboratory in science education: Foundations for the 21st century*. Paper presented at the annual meeting of the National Association for Research in Science Teaching, New Orleans, LA.
70. Tobin, K. (2002, April). *Students as researchers: Agency and the breaching of inequities in urban science education*. Paper presented at the annual meeting of the National Association for Research in Science Teaching, New Orleans, LA.
71. Tobin, K. (2002, April). *Credible tales: Authorial voice and the complementarity of alternative perspectives*. Paper presented at the annual meeting of the National Association for Research in Science Teaching, New Orleans, LA.
72. Tobin, K. (2002, April). *High stakes in urban science: For whom are the stakes high? What are the costs? Who pays them?* Paper presented at the annual meeting of the National Association for Research in Science Teaching, New Orleans, LA.

**Interim Progress Report**

73. Tobin, K. & Carambo, C. (2002, April). *Unleashing the transformative potential of science for students from urban high schools*. Paper presented at the annual meeting of the National Association for Research in Science Teaching, New Orleans, LA.
74. Tobin, K. & Roth, W-M. (2002, April). *Macro and micro methods in research on the teaching and learning of science*. Paper presented at the annual meeting of the National Association for Research in Science Teaching, New Orleans, LA.

**Paper presented at the American Chemical Society Annual Meeting**

75. Milne, C., Scantlebury K. and Otieno, T. (2002, August). *Framing Urban High School Teacher's Professional Development from a Liberatory Perspective*. Paper presented at the American Chemical Society Annual Meeting, Boston, MA.
76. Otieno, T. (2002, August). *Paperclips + Polymers ? Problems: The Role of Laboratory Activities in High School Chemistry*. Paper presented at the American Chemical Society Annual Meeting, Boston, MO.

**Paper presented at the Spencer Student Urban Research Symposium**

77. Olitsky, S & Loman, L. (2002, March). *The Mediation of Science Learning in an Urban Magnet School*. Paper presented at the Spencer Student Urban Research Symposium, Philadelphia, PA.

**Collaborative Papers Presented Involving REC- 0107022 and ESI-9911825**

78. Lavan, S-K., Koo, E. & Milne, C. (2002, April). *Teachers and inquiry: learning about chemistry through inquiry*. Paper presented at the annual meeting of the National Association for Research in Science Teaching, New Orleans, LA.
79. Milne, C. (2002, January). *Teachers inquire: Learning about chemistry education in a Masters of Chemistry Education program*. Paper presented at the annual meeting of the Association for the Education of Teachers in Science, Charlotte, NC.
80. Milne, C. (2002, April). *The influence of cognitive and socio-cultural factors on enacted and learned curriculum in a professional education program for practicing science teachers*. Paper presented at the annual meeting of the American Educational Research Association, New Orleans, LA.
81. Milne, C., Otieno, T., Koo, E. & Hatchet, J. (2002, March). *Examining Sites of Concentrated Practice in a Chemistry Classroom*. Paper presented at the Ethnography in Education Research Forum, University of Pennsylvania, Philadelphia, PA.
82. Milne, C. E., Otieno, T., & Tobin, K. (2002, March). *The learned curriculum in a professional education program for practicing teachers: The importance of agency and context*. Paper presented at the Ethnography in Education Research Forum, University of Pennsylvania, Philadelphia, PA.
83. Milne, C. & Scantlebury, K. (2002, April). *Cultural transformation and professional education program for teachers: Coherence and contradictions*. Paper presented at the annual meeting of the American Educational Research Association, New Orleans, LA.

**Interim Progress Report**

**Collaborative Papers Presented Involving REC- 0107022 and DUE-9979635**

84. Beers, J. (2002, April). *Learning to teach at the elbows of others*. Paper presented at the annual meeting of the American Educational Research Association, New Orleans, LA.
85. Roth, W-M. (2002, April). *Use of coteaching to transform learning and teaching in urban high schools*. Paper presented at the annual meeting of the American Educational Research Association, New Orleans, LA.

<b>Conference Papers Summary</b>	<b>1<sup>st</sup> Year 2002</b>	<b>2<sup>nd</sup> Year 2003</b>
AETS - Association for the Education of Teachers in Science	3	6
Annual Ethnography in Education Research Forum	12	8
AERA - American Educational Research Association	9	7
NARST-National Association for Research in Science Teaching	20	18

**Dissertations**

01. Elmesky, R. (2002). *Struggles of agency and structure as cultural worlds collide as urban African American youth learn physics*. Doctoral dissertation, The Florida State University. **(Recipient of AERA Div G Outstanding Dissertation award.)**
02. Sterba, M. (2003). *The female code of the street: Examining female physical and sexual aggression in urban classrooms*. Doctoral dissertation, University of Pennsylvania.

**Masters Thesis**

01. Smardon, R. (2002). *Code of the Classroom: The contradictions of cultural production in an urban science class*. Paper written to satisfy thesis requirement for a Masters of Science in Education, University of Pennsylvania.

**Book (In preparation)**

01. Tobin, K., Elmesky, R. & Seiler, G. (in preparation). *Maximizing the transformative potential of science education: Learning from research in inner city high schools*.

**Chapters**

01. Abraham, A., Elmesky, R. & Pringle, R. (in preparation). *Forms of capital and the development of scientific identities*.
02. Carambo, C. (in preparation). *Sociological perspectives on inquiry in the urban science classroom*.
03. Elmesky, R. (in preparation). *Classrooms with translucent walls*.
04. Giombetti, C. & Scantlebury, K. (in preparation). *Gangsta', gentlemen and good girls: Science students build capital*.
05. Hazelwood, L. (in preparation). *Science play: Structure and agency in two fields of urban science education*.

## Interim Progress Report

06. LaVan, S.K. & Martin, S. (in preparation). *What do you know about chemistry, you're just a kid? Incorporating students' life-worlds in order to make connections and breach social reproduction.*
07. Loman, L. (in preparation). *My cultural awakening in the classroom.*
08. Martin, S. (in preparation). *Not so strange in a strange land: An autobiographical approach to becoming a science teacher in an urban high school.*
09. Olitsky, S. (in preparation). *Social and cultural capital in science teaching: Relating practice and reflection.*
10. Otieno, T., and Milne, C. (in preparation). Paperclips + polymers → problems: *Learning to use levels of representation in a high school chemistry classroom.*
11. Seiler, G. (in preparation). *All my life I been po': Street code as a resource for science teaching.*
12. Sterba, M. (in preparation). The female code of the street: Respect and the struggle to control female sexuality.
13. Tobin, K. (in preparation). Becoming fluent in science: Teachers and students as bricoleurs in resource rich|starved urban high schools.
14. Tracy-Stickney, C. (in preparation). School structure and the potential of science education in an urban comprehensive high school.

## Chapters in Other Books

01. Tobin, K., Elmesky, R. & Carambo, C. (2002). Learning environments in urban science classrooms: Contradictions, conflict and the reproduction of social inequality. In S. C Goh, & S. K. Myint (Eds). *Studies in educational learning environment: An international perspective.* Singapore: World Scientific Publishing Co.
02. Tobin, K. (in press). Teaching science in urban high schools: When the rubber hits the road. In R. Yerrick & W-M. Roth (eds). *Establishing scientific classroom discourse communities: Multiple voices of research on teaching and learning.* Mahwah, NJ: Lawrence Erlbaum Associates.
03. Tobin, K. (in press). Teaching science in urban high schools. In J. Wallace, & J. Loughran, *Leadership and professional development in science education: New possibilities for enhancing teacher learning.* London: RoutledgeFalmer Publishers.
04. Tobin, K. (2002). Beyond the bold rhetoric of reform: (Re)Learning to teach science appropriately. In W-M. Roth and J. Desautels. *Science education as/for sociopolitical action* (pp. 125-150). NY: Peter Lang Publishing.

## Articles for Refereed Journals

01. Barton, A. C., & Tobin, K. (2002). Learning about transformative research through others' stories: What does it mean to involve "others" in science education reform? *Journal of Research in Science Teaching*, 39, 110-113.
02. Carambo, C. (in preparation). Sociological perspectives on inquiry in the urban science classroom. Manuscript to be submitted to the *Journal of Research in Science Teaching*.

**Interim Progress Report**

03. Elmesky, R. (in preparation). "I am science and the world is mine": Sustaining student agency across fields. Manuscript to be submitted for publication in the *Journal of Research in Science Teaching*.
04. Elmesky, R. (in preparation). When urban African American high school students' learning of physics leads to agency. Manuscript to be submitted for publication in the *Journal of Research in Science Teaching*.
05. Elmesky, R. & Tobin, K. (in preparation). Expanding the role of student researchers. Manuscript to be submitted to the *Journal of Research in Science Teaching*.
06. Elmesky, R. (in press). Crossfire on the streets and into the classroom: Meso|micro understandings of weak cultural boundaries, strategies of action and a sense of the game in an inner-city chemistry classroom. *Cybernetics and Human Knowing*.
07. LaVan, S.K. & Beers, J. (in preparation). Cogenerative dialogue: A mechanism for enacting structural change. Manuscript to be submitted to the *Qualitative Studies in Education*.
08. LaVan, S.K. & Martin, S. (in preparation). This is not your parents' chemistry course: Using group work to improve science learning and scientific literacy. Manuscript to be submitted to the *Journal of Research in Science Teaching*.
09. Loman, L. (in preparation). Playing in the Outfield. Identifying and developing strategies for teaching in and out of field in an urban science classroom. Manuscript to be submitted to the *Journal of Research in Science Teaching*.
10. Milne C. E, Scantlebury, K. & Otieno, T. (in preparation). The researched and the researchers: Framing urban high school teachers professional development from liberatory education perspective. Manuscript to be submitted to the *Journal of Chemical Education*.
11. Olitsky, S. (in preparation). The roles of schemas, resources and community in teaching science in and out of field. Manuscript to be submitted for publication in the *Journal of Research in Science Teaching*.
12. Olitsky, S. and Loman, L. (in preparation). Coherence, contradiction and the formation of school science identities. Manuscript submitted for publication in the *Journal of Research in Science Teaching*.
13. Olitsky, S. and Loman, L. (2002). Coherence, contradiction and the formation of school science identities. Manuscript submitted for publication in the *Journal of Research in Science Teaching*.
14. Roth, W-M., Tobin, K., Elmesky, R., Carambo, C., & McKnight, Y. (in press). Re/making identities in the praxis of urban schooling: A cultural historical perspective. *Mind, Culture and Activity*.
15. Scantlebury, K. (in preparation). Queen mother of Da Bridge and othermother: Building scientific literacy from the lifeworlds of urban African-American girls. Manuscript to be submitted for publication in the *Journal of Research in Science Teaching*.
16. Scantlebury, K. (in preparation). Flyy girls, smuts & baby daddy's: Students' gender roles and learning science in urban schools. Manuscript to be submitted for publication in *Gender and Society*.
17. Seiler, G., Tobin, K. & Sokolic, J. (2003). Reconstituting resistance in urban science education. *Journal of Research in Science Teaching*, 40, 101-103.

**Appendix B**

**SEMINAR CALENDAR: FALL 2002/SPRING 2003**

<b>Date</b>	<b>Presenter</b>	<b>Presentation Title</b>
9/26/02	Stacy Olitsky	Student Researchers: Researchers, informants, interpreters of theory?
10/17/02	Ken Tobin & Rowhea Elmesky	Sociocultural theory and applications to video microanalysis
10/24/02	Ken Tobin	Scientific literacy from a sociocultural perspective
10/31/02	Rowhea Elmesky	“Second time around”: Student researchers coming to understand sociocultural theory
11/7/02	Linda Loman & Stacy Olitsky	The practical aspects of working with students as researchers
11/14/02	Student Researcher Panel	Becoming a student researcher – April Sample Student Researchers: You think you know but you don't - Amani
11/21/02	Kate Scantlebury	“Seeing” gender: privileging African-American girls’ experiences in urban science classes
12/12/02	Elizabeth Moje	Looking for third space: An examination of everyday and secondary school literacy, knowledge, and discourse
12/19/02	Angela Calabrese Barton	Ecologies of parental engagement in urban science education
1/23/03	Rowhea Elmesky	Crossfire on the Streets and into the Classroom: Meso Micro Understandings of Weak Cultural Boundaries, Strategies of Action and a Sense of the Game in an Inner City Chemistry
2/13/03	Kate Scantlebury	Queen Mother of Da Bridge and Othermother : Building scientific literacy from the lifeworlds of urban African-American girls.
2/27/03	Research Group Ethnography Forum Rehearsal Presentations	See titles in Appendix A of the report.

**Interim Progress Report**

3/20/03	Research Group NARST Rehearsal Presentations	See titles in Appendix A of the report.
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## **SUMMARY OF SEMINAR PRESENTATIONS**

A colloquium is a session where individuals present an aspect of their research, a presentation that they are developing for a conference or a research paper that they are writing. Then the audience has the chance to ask questions and discuss aspects of the research. With the structure of this grant, the bimonthly seminars have served an important role in the induction of our teacher-researchers into the university research community. Through being participants as well as presenters, their theoretical background has expanded enormously and they have come to mix theory with their own teaching practices.

### **9/26/02 Student Researchers: Researchers, Informants, Interpreters of Theory?**

During this seminar, Stacy Olitsky discussed the experiences of her research group over the summer as the student researchers were introduced to various theoretical concepts that can be used in analyzing classroom events. Focusing mainly on the concept of cultural capital, she discussed how the students' thoughts, interpretations, and motivations for engaging in research differed significantly from those of the university-researcher and teacher-researcher, leading to some important insights regarding the role of cultural capital in this science classroom that may not have occurred without a team approach to applying theoretical frames to the analysis of classroom events. She also discussed some of the contradictions that emerged from this team approach.

### **10/17/02 Sociocultural theory and applications to video microanalysis.**

During this seminar, Ken and Rowhea presented understandings of some of the fundamental concepts associated with sociocultural theory with particular focus on distinguishing between: 1. strategies of action, cultural toolkits and habitus 2. praxis, practice, and action. 3. social, cultural and symbolic capital In addition, they addressed culture, structure and agency, with reference to Sewell as well as Engstrom. All of these understandings were presented within a context of a high school chemistry laboratory video vignette.

### **10/24/02 Scientific literacy from a sociocultural perspective.**

During this seminar, Ken Tobin focused on scientific literacy as examined from a perspective of cultural and social theory. He explored specific issues associated with doing research from this perspective and identified differences with the traditional approaches which have been grounded in positivism and then cognitive psychology (cognitivist perspectives). Moreover, Ken addressed the implications for planning, enacting and assessing, in traditional manners.

### **10/31/02 “Second time around”: Student researchers coming to understand sociocultural theory**

Our research has consistently been cutting edge in terms of including student researchers as intimate members of a research team in ways that extend beyond selective inclusion of their views into the research process. This presentation was based upon work done by Melissa Sterba, Cassondra Giombetti and Rowhea Elmesky, over the summer, with four of our student researchers. Over the years, we have gradually evolved our student researcher practices from a level in which the students produce artifacts and data resources for our interpretation to a level in which they select the artifacts and data of salience for our interpretation. However, during the summer of 2002, we established more complex goals in which we would develop common theoretical lens with the youth so that they could participate side by side with the adult researchers in the analysis and interpretation stages of research. This presentation provided token artifacts revealing the process in which we engaged. Rowhea highlighted the challenges and successes of introducing theory to these youth as well as discussed some patterns and contradictions that emerged throughout this dynamic learning experience.

### **11/7/02 The practical aspects of working with students as researchers**

Together, Linda Loman and Stacy Olitsky presented a seminar which addresses the practical issues that must be considered when students become researchers. The presenters will share the types of activities in which students were engaged this summer as well as their impressions and informal evaluations of such tasks. In addition, Stacy and Linda discussed what they have learned regarding power dynamics and student voice throughout their work with student researchers.

### **11/14/02 Becoming a student researcher**

Previous seminars have illuminated our work with student researchers through the voices of the university and teacher researchers who have been involved with them. During this seminar, however, a group of student researchers from across our research sites were invited to attend seminar – to ensure that their voices are central to the discussions we hold. In addition to the benefiting the group as a whole, this particular seminar provided a forum for the student researchers to learn from one another and an opportunity to further develop as researchers. In the first portion of the seminar, two of our veteran student researchers provided short presentations on their experiences within their researcher role to the entire research group. During the second portion, we interacted in smaller groups consisting of student researchers, both veterans and beginners, as well as adult researchers.

**11/21/02 “Seeing” gender: privileging African-American girls’ experiences in urban science classes**

This presentation explored how gender influences urban African American girls’ cultural, social and symbolic capital in high school. Gender is a considered a socially variable entity and as such participants do not garner ‘gender capital’ but gender may impact participants’ accrument of capital within a field. Gender is field dependent, subject to power relations, and as such may be uneven and discontinuous. Girls rely on their cultural, social and symbolic capital to enact science in these different fields. Within an urban science classroom, those fields may include chalkboard instruction, mini-lectures, conversations between participants in groups and one-on-one interchanges, lab work and the transitions between these activities.

**12/12/02 Looking for third space: An examination of everyday and secondary school literacy, knowledge, and discourse**

In this seminar, Elizabeth Moje of the University of Michigan presented a paper in which she and others analyzed the intersections and disjunctures between everyday (home, community, peer group) and school literacies, knowledges, and Discourses of middle-school-aged youth in a predominantly Latino/a, urban community in the United States. Drawing from data collected across four years of an on-going community ethnography, she presented findings on the strength of various funds of knowledge and Discourse available to a sample of 30 young people in the community and school we studied. She then presented the patterns analyzed across each of the different documented funds. Such findings on the funds that youth have available to them outside of school to suggest possibilities for how to build third space around literacy and content learning in the seventh- and eighth-grade, public school science classrooms of these youth, and implications for literacy teaching and research in other content areas as well.

**12/19/02 Ecologies of parental engagement in urban science education**

In this seminar, Angela Calabrese Barton presented a paper in which she framed parental participation in science education through an “ecologies of engagement” perspective. She utilized the term “ecologies” because it focuses on the whole system – parents in relation to their environment. At the same time, she focused on discussing parent “engagement” rather than parent “involvement” since involvement has been used to describe things parents do. In this seminar, Angie presented research findings that suggest we must expand our understanding of parental involvement to also include their orientations to the world and how those orientations frame the things they do.

**1/23/03 Crossfire on the Streets and into the Classroom: Meso|Micro Understandings of Weak Cultural Boundaries, Strategies of Action and a Sense of the Game in an Inner City Chemistry Classroom**

As this nation shifts towards an educational focus of “teaching for social justice,” this critical ethnographic article illuminates the importance of considering overlapping fields (Seiler, 2002) to help understand what is occurring within inner city neighborhood classrooms. While prior attention has focused on the apparent deficiencies of urban schools (i.e. Kozol, 1992), such discussions do not take into account the complex sociocultural issues associated with a classroom field. This paper provides descriptive narratives of the unfolding day by day events occurring within urban neighborhoods and homes, as well as common practices, shared strategies of action and a “sense of the game” (Bourdieu 1990) embodied within urban youth as they enter a chemistry classroom of a Philadelphia comprehensive neighborhood school. Moreover, by identifying and interpreting the patterns of coherence as well as contradictions of what is occurring on both the meso and micro levels in the chemistry classroom, this paper provides alternate understandings of practices typically labeled as disrespect, acting out or violence. More importantly, the implications of being able to understand porous boundaries in the classroom are addressed in terms of the accessibility of science to urban youth and their development of scientific literacy.

**2/13/02 Queen Mother of Da Bridge and Othermother: Building scientific literacy from the lifeworlds of urban African-American girls.**

Urban African-American girls’ lifeworlds impact their science identities in multiple ways. In this presentation I explore the manner in which two high school girls build social, cultural and symbolic capital in lifeworlds such as the home, streets, basketball court, and school. I will discuss how the girls’ strategies of action in other settings influence their participation and learning in a high school chemistry class and the extent to which what they learn of science is potentially transformative to their lives out of school.

## **Appendix D**

### **The Use of Student Researchers in our Research**

A paper written for publication in the *Journal of Research in Science Teaching* is now available on request. Let me know if you would like a copy.

**Appendix E: Research Questions Addressed At the Research Sites**

The following tables depict the research questions being addressed at each school by the university, teacher, and/or student researchers. The questions are rated on a scale of 1-3 to signify the level of depth at which the question is being addressed with 1 representing a high level of focus. Changes in significance from the first to the second year are indicated in red.

Research Questions	City High		Charter High	Comprehensive	Southeast	Magnet High	
	Cristobal/Clare	Anita Abraham	Jen Beers	Laurie Hazelwood	Tracey Otieno	Sonya Martin	Linda Loman
Which teaching roles afford appropriate practice and learning of students?	High	High	High	Medium High	High	High Medium	High
How does the teachers' cultural capital change so as to afford the learning of students (i.e., practice of science/cultural production)?	High Medium	High	Medium	Low Medium	High	Medium	Medium
How do teachers build social capital with students (e.g., earn respect and build rapport) and thereby afford the learning of students?	High	High	Low	High	Low	High Low	High Medium
How do teachers use symbolic and material resources to enhance the learning of students?	High Low	High	Medium	High Medium	High	Low	Medium High
How do the scientific practices of teachers (i.e., talking and doing science in the classroom) afford the learning of students and emergence of a community of practice in which coparticipation occurs?	High Medium	High Low	High	High Medium	High	Medium	High
What components of the students' cultural capital are conducive to their learning of science?	High Medium	High	High	Medium Low	High Medium	High	Medium Low

**Interim Progress Report**

Research Questions	City High		Charter High	Comprehensive	Southeast	Magnet High	
	Cristobal/Clare	Anita Abraham	Jen Beers	Laurie Hazelwood	Tracey Otieno	Sonya Martin	Linda Loman
What components of the students' cultural capital make it difficult for them to learn science and detract from the learning of their peers?	High Medium	Medium	High	Low	High Medium	High N/A	Medium
When students act in ways that are resistant to the goals of the teacher, how do teachers adapt their teaching to provide opportunities for students to participate and learn science?	High	High N/A	Low	Medium	High	N/A	Low
What are the key ideas/values and practices that constitute the dominant culture of the school?	Low	Medium N/A	Low	Medium	Medium N/A	High	High
How do specific aspects of the dominant culture afford and inhibit the learning of different students?	Low	Medium Low	Low	Medium	High N/A	High	High
In what ways is the dominant culture oppressive to some students?	Low	High N/A	Low	Medium	Medium N/A	Medium N/A	High
What contradictions are evident in the culture of the school (i.e., the dominant culture) and the subgroup cultures of specific students?	Low	High Medium	N/A	Medium	High N/A	Medium N/A	High
How does the resistance of students to the dominant school culture afford and inhibit their learning?	Low	Medium N/A	Medium	Medium	High N/A	High	Medium
Is there evidence of the growth of counter-cultures and if so, how do they constrain learning positively and negatively?	Medium High	N/A	N/A	High	Medium N/A	N/A	Medium Low

**Interim Progress Report**

Research Questions	City High		Charter High	Comprehensive	Southeast	Magnet High	
	Cristobal/Clare	Anita Abraham	Jen Beers	Laurie Hazelwood	Tracey Otieno	Sonya Martin	Linda Loman
How do the classroom learning environments afford the learning of science?	High	High	High	High	High	Medium Low	High
How is the curriculum enacted so as to initiate and sustain student participation and learning (or, how does the activity structure afford appropriate practices and learning of science)?	High Medium	High	High	N/A	High	Low	High
How does the enacted curriculum take account of the students' interests and cultural capital?	High N/A	High	Medium	High	High Medium	Low	High Medium
How does the organizational structure of science (including the uses of human, symbolic and material resources) shape enacted science curricula?	High N/A	High	Medium	High N/A	Low High	Medium	High
How does the organizational structure of science afford and/or inhibit the development of learning communities among science teachers and students?	High N/A	High N/A	N/A	Medium N/A	Low High	High	Medium
How are the practices of teachers and students constrained by the physical space in which the science curriculum is enacted?	High N/A	Low	N/A	High	Medium	High	Medium High
How does the organizational structure of science afford the creation and maintenance of appropriate learning environments?	High N/A	High Medium	Low	Medium N/A	Low High	N/A	High
To what extent (and how) do district and school administrators establish and maintain expectations of high school performance?	N/A	N/A	N/A	Medium N/A	N/A	Medium N/A	N/A (Medium)

### Summary of Matrix Results

The responses to the questions represented on the matrix in the previous section are summarized below for all six classroom sites, with the strength of emphasis represented in parentheses. These emphasis indices range from 17 (high emphasis at all six sites) to 2 (medium emphasis at one of the six sites).

Research Questions	Emphasis Across Sites
Which teaching roles afford appropriate practice and learning of students?	17
How does the teachers' cultural capital change so as to afford the learning of students (i.e., practice of science/cultural production)?	14
How do teachers build social capital with students (e.g., earn respect and build rapport) and thereby afford the learning of students?	13
How do teachers use symbolic and material resources to enhance the learning of students?	13
How do the scientific practices of teachers (i.e., talking and doing science in the classroom) afford the learning of students and emergence of a community of practice in which coparticipation occurs?	13
What components of the students' cultural capital are conducive to their learning of science?	12
What components of the students' cultural capital make it difficult for them to learn science and detract from the learning of their peers?	9
What components of the students' cultural capital make it difficult for them to learn science and detract from the learning of their peers?	9
When students act in ways that are resistant to the goals of the teacher, how do teachers adapt their teaching to provide opportunities for students to participate and learn science?	9
What are the key ideas/values and practices that constitute the dominant culture of the school?	9
How do specific aspects of the dominant culture afford and inhibit the learning of different students?	10
In what ways is the dominant culture oppressive to some students?	6
What contradictions are evident in the culture of the school (i.e., the dominant culture) and the subgroup cultures of specific students?	8
How does the resistance of students to the dominant school culture afford and inhibit their learning?	8
Is there evidence of the growth of counter-cultures and if so, how do they constrain learning positively and negatively?	7
How do the classroom learning environments afford the learning of science?	17
How is the curriculum enacted so as to initiate and sustain student participation and learning (or, how does the activity structure afford appropriate practices and learning of science)?	12
How does the enacted curriculum take account of the students' interests and cultural capital?	11
How does the organizational structure of science (including the uses of human, symbolic and material resources) shape enacted science curricula?	11
How does the organizational structure of science afford and/or inhibit the development of learning communities among science teachers and students?	8
How are the practices of teachers and students constrained by the physical space in which the science curriculum is enacted?	12
How does the organizational structure of science afford the creation and maintenance of appropriate learning environments?	8
To what extent (and how) do district and school administrators establish and maintain expectations of high school performance?	2