

Interim Progress Report
The Teaching and Learning of Science in Urban High Schools
(REC- 0107022)
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Getting Started

An initial problem that had to be addressed was the recruitment of a suitable post doctoral researcher. I needed a person with a strong background in science, expertise in social and cultural theory, and demonstrated ability to do ethnography. I also wanted to have a researcher with a strong interest and background in urban high schools. Because of the timing of the award many of the candidates that appealed as ideal already had accepted positions as assistant professors. My initial search strategy was to approach colleagues at Teachers College and the University of California in Los Angeles to ascertain whether or not there were suitable candidates. Several leads failed to materialize in a person with the right profile. Then I decided to approach graduates who were placed as assistant professors in universities where the priority is not research. I identified Margaret Eisenhart as a person who had been major professor to several science educators with an interest in urban education and strength in ethnography. In all three cases I almost managed to recruit the candidate and in one case I even organized a research position for a spouse. However, after a month of serious searching a suitable candidate had not been hired. The main contenders were now doctoral graduates who were not well qualified and a small pool of people who had not completed their dissertation.

A call from a former master's student led me to seriously consider a different strategy. Rowhea Elmesky, an African American female, completed her master's degree with me when I was at Florida State University. At the time she was an elementary teacher with limited knowledge of science but a passion to learn more. As part of her master's degree I encouraged her to study physics. The physics professors, especially a nuclear physicist called Paul Cottle, were so impressed with Rowhea that they endeavored to recruit her to do a PhD in physics. She declined that opportunity but did commence a PhD in science education, beginning just as I left Florida State University to join the faculty at Penn. As part of her program of study she undertook numerous courses in mathematics and physics.

Rowhea's telephone call was to seek my advice on a dissertation topic. As we talked I made a decision to invite Rowhea to come to the position at Penn and to undertake her dissertation research on research on the teaching and learning of science in urban high schools. My Dean would only support the appointment if Rowhea were to graduate by December, just six months away. Rowhea agreed to come to Philadelphia under these conditions and accepted a position as a research associate, including the Dean's stipulation regarding graduation. With the support of her doctoral committee at Florida State, principally Nancy Davis and Paul Cottle, Rowhea came to Philadelphia and planned her doctoral research to align with the NSF funded study. She then began her study and worked relentlessly on a schedule of seven days a week and almost 24 hours a

Interim Progress Report

day. Not only did she meet her timelines but she set a standard and work ethic that has characterized our research group.

Rowhea's dissertation (see list of publications in Appendix A) is a very strong document, will be re-written as a book manuscript and will provide a basis for several manuscripts to be submitted later this year to the *American Educational Research Journal* and the *Journal of Research in Science Teaching*. Rowhea's growth as a high quality researcher also is evident in her participation at four national meetings at which she has presented research from her dissertation. In less than one year Rowhea is beginning to make her mark as a researcher in science education and I expect that in three years with the project she will become one of the leading early career science educators in the country.

Rowhea's conditions of service at Penn provide for free tuition in two courses a semester. She decided to study (on her own time) the Master's degree in Chemistry Education (MCE) to better prepare her to be a researcher in science education. The MCE degree is supported by the NSF and consists of 8 chemistry courses developed especially for high school science teachers, each taught by current researchers in chemistry and two chemistry education courses (ESI-9911825). Rowhea joins two doctoral students associated with our research as students in the MCE degree. Also, five of the six teacher-researchers in the research are also students in the MCE degree. Accordingly, Rowhea's enrollment in the degree brings her closer to the teachers she is studying and provides her with a greater understanding of chemistry; thereby improving her ability to undertake research on the teaching and learning of chemistry.

Recruitment of a Doctoral Research Assistant

Many doctoral students applied for the position of graduate assistant to participate in the project. I argued strongly that whoever took the position had to have as a goal that he or she would become a researcher in science education and focus his or her research on urban high schools. I also wanted the doctoral student to commit to further studies in science as part of their doctoral program of study.

Sarah-Kate Lavan was a former student of Okhee Lee's at the University of Miami, Florida. She was returning to Philadelphia to prepare for a bid to the Olympic games in 2004. Sarah-Kate is a serious science educator whose strength is in the biological sciences. In my interview with her I made it clear that she should commence the coursework in the MCE degree so that she could get to know the teachers who would participate in the research and also improve her background by studying graduate level chemistry. She agreed to do this with some reluctance and since has thrived in the program, which involves an intensive six week summer course and coursework on Saturday mornings through out the fall/spring. Sarah-Kate's involvement has benefited our research in several ways. First, she has got to know the teachers in the study extremely well and has been able to study with them as colearners and thereby have deeper insights into the way they teach. In addition she has been able to forge close links with Catherine (Cath) Milne who is a post doctoral researcher involved in the MCE degree. Cath has coauthored a number of papers with Sarah-Kate that connect learning to teach by increasing subject matter knowledge through studies of college science to the

Interim Progress Report

teaching and learning of science in high school classes. Sarah-Kate's involvement in the MCE has added to her capacity to undertake high quality research in our project.

Sarah-Kate began her study of teaching and learning science with Laurie Hazelwood at a neighborhood high school in the North of Philadelphia. William Penn High is a school that consists of mainly African American children from home conditions of economic hardship. Her research with Laurie lasted through the fall semester and focused mainly on getting to know the school and its structure. Sarah-Kate examined the tension between an evolving small learning community structure and the relative demise of the science department and the manner in which Laurie's teaching was detrimentally affected by the school structure. The structural elements studied at the school included block scheduling, small learning communities, and the science department. The focus gradually shifted to a study of Laurie's participation as a science teacher in the ninth grade academy, the school's response to a crisis it faced in educating ninth grade students who experienced transitional problems from middle to high school. The solution of creating a ninth grade academy resulted in Laurie being placed in a deteriorating building that was isolated from other science teachers and the materials necessary to run laboratories.

In January of 2002 I assigned Sarah-Kate to continue her research at Masterman High, a magnet school in Philadelphia where we had two teacher-researchers. I realized that it was virtually impossible to do high quality research with more than one teacher-researcher at a time. The opportunities at Masterman were unique and it necessitated more researchers if we were to capitalize on the chance to study the academic success of students from cultural and social histories like many of those who were not successful in neighborhood schools like William Penn, Furness, and City High. Accordingly, as a research group we decided that Sarah-Kate would collaborate with Sonya Martin at Masterman, and Laurie Hazelwood would undertake studies of her own practices at William Penn in the spring semester of 2002. These issues are further discussed below.

In her first year as a graduate student Sarah-Kate Lavan made a successful start at Penn. She has completed nine graduate courses toward her doctorate, including four that count also toward a MCE degree. She is now well on track to graduate at the end of her third year with a PhD in science education and a MCE. With a high level of research productivity and a strong background in science I expect Sarah-Kate to be on an ideal trajectory as an early career researcher.

Added Value of Attracting Added Human Resources

During my negotiations with Larry Suter I pointed out that having NSF-funded research would be a magnet for others to do their research. This has proved to be the case. Stacy Olitsky is a Dean's Fellow who is supported by the Dean of the Graduate School of Education for the fall/spring semesters for four years. Stacy is undertaking her research with me as her advisor. As a first year doctoral student Stacy began to undertake research with Linda Loman, a teacher-researcher at Masterman High. Linda is a certified physics teacher who also teaches physical science at Masterman High. Stacy had a strong interest in studying the role of culture and social class as resources to support the learning of science. In her studies of African American youth at Masterman

Interim Progress Report

she is exploring how students from conditions of economic hardship succeed and in some cases fail despite their efforts to succeed.

Regina Smardon, a doctoral student in sociology, met me because of my studies in sociology. Her advisor, Diana Crane suggested we meet because I was undertaking studies in schools. Regina was doing research with Randall Collins a leading theoretician in conflict theory. She had an interest in examining the relationships between micro and meso level interactions and outcomes in a school setting. I warmly invited her to join us and she has shared office space and assisted us to think through theoretical and methodological issues. During her time with us (which is ongoing) she decided to complete research toward a master's degree in education that was supervised by Stanton Wortham, a leading linguistic anthropologist. She grounded her studies in the chemistry class taught by Cristobal Carambo and her empirical work supported the research undertaken by Cristobal, Rowhea, and me. Her theoretical understandings were honed by discussions with Wolff-Michael Roth, a member of our advisory group. Her master's research will be published in a sociology journal and a version is being written for the *Journal of Research in Science Teaching*. The latter paper explores the contradictions in micro and meso level strategies and outcomes.

Kate Scantlebury, an associate professor at the University of Delaware, has been a regular participant in our seminar series and has collaborated closely with Cath Milne on the MCE project and several of the teacher researchers including Cristobal, Laurie, Clare Tracy Stickney (City High), and Tracey Otieno (at Furness High). Kate has been an invaluable member of our research team and has contributed perspectives informed by equity and feminist theories.

Cath Milne is a post doctoral fellow employed by the Graduate School of Education to assist me with the internal evaluation of the MCE degree. As part of that evaluation we designed an intensive case study at Furness High where Tracey Otieno is a teacher researcher and a student in the MCE. Cath and Tracey undertook collaborative research at the Furness site and coauthored papers that were germane to both NSF funded projects (ESI-9911825 & REC-0107022). Cath was an active participant in the research and the seminar series – in fact she coordinated the seminar series in the fall of 2001. Because five of the six teacher-researchers in the study are also students in the MCE program, Cath has taught each of them in the Chemistry Education course she taught. Furthermore, she has been in each of their classes and is able to provide valuable insights into our research because of her familiarity with the teacher researchers not only as teachers but also as students. Cath is assuming a faculty position at New York University after two years as a post doc at Penn. She is to be replaced as an internal evaluator by two of the teacher researchers from our project – Sonya Martin and Tracey Otieno (see below for explanation of this career move and its implications for our research).

Eugenia Koo is a graduate student in science education at Penn. Because she was seeking certification in Chemistry I placed her with Tracey Otieno at Furness to undertake her student teaching. She also decided to study courses in the MCE degree and has since decided to complete the degree after she graduates with her science education degree this semester (Eugenia will graduate with degrees in engineering, science education and chemistry education). Throughout this year Eugenia has undertaken collaborative research with Cath and Tracey on the teaching and learning of chemistry

Interim Progress Report

and has coauthored a paper with Sarah-Kate and Cath. As a regular participant in the seminar Eugenia has become enculturated into our research community and it seems likely that she will commence doctoral studies in science education after a few years of teaching urban high school students.

The Teacher-Researchers

The intention was to recruit six teacher-researchers from three neighborhood high schools to participate in the study. We had identified the schools and teachers prior to the study being funded. However, as the study was about to commence two teachers from West Philadelphia decided to quit when their principal resigned and one of the teachers we had selected experienced academic difficulties in her studies in the MCE. Accordingly, had an opportunity to identify a new school and select either another teacher from William Penn or identify someone from the MCE at another neighborhood high school. In making these selections I sought the advice of Cath Milne who knew all of the teacher participants in the MCE degree. She recommended Tracey Otieno from Furness and Sonya Martin from Masterman.

I accepted Cath's recommendations. When I scheduled a meeting to discuss Sonya Martin's possible involvement in the project she asked if she could bring a colleague. Sonya was a former student of mine and a friend with whom I had collaborated on research when she was teaching at a neighborhood middle school. She is bright, a graduate from Bryn Mawr in biology, and is now gaining certification in chemistry and is a student in the MCE. Even though she was teaching in a magnet school for academically talented students I felt sure she could contribute a great deal to the study. So, I encouraged her to bring her colleague since she was a female physics teacher just completing a master's degree in physics education from Temple. Having a female physics teacher participate in the study had considerable appeal, especially as she also taught chemistry, a subject in which she had a relatively weak background. Her inclusion would allow us to study teaching in- and out-of-field. The appeal of this was to provide a necessary connection to the quantitative work of my colleague at the Graduate School of Education, Richard Ingersoll. He agreed with my assessment that Linda's case study could well provide a defining study in this important policy-related field.

Linda and Sonya agreed to be involved in the study and their principal readily agreed too, even though we were sure the involvement would be for one year only. Linda was eager to return to the West-Central part of the country where she grew up and Sonya was interested in joining our research group at the University as a replacement for Cath Milne who planned to obtain a faculty position after serving as a post-doctoral researcher with me for two years. Accordingly, the inclusion of Masterman, as a magnet school for selected students was a decision that took account of the likelihood that the fieldwork would be restricted to one year of data collection and follow-up analysis and interpretation that would no doubt extend for an additional two years and result in various forms of publication.

Tracy Otieno was at Furness High, a school in the South of the city in which the demographics were somewhat different than the other two participating neighborhood schools. Unlike William Penn and City High – where the student population is almost 100 percent African American, Furness has a significant proportion of Asian students

Interim Progress Report

(27%), Latino (7%) and also Caucasians (24%). Like the other schools the majority at Furness is African American (42%). As a former engineer and peace-corp. volunteer Tracey had many of the attributes we wanted in a teacher-researcher. She had a relatively short teaching career but had taught for one year at City High before transferring to Furness. As a student in the MCE and already a collaborative researcher with Cath Milne, we regarded Tracey as an ideal teacher-researcher.

The negotiation of entry to William Penn was made difficult by a change in principal and an unexpected clash between him and the teacher-researcher, Laurie Hazelwood. Laurie also was a physics teacher and a student in the MCE. Eventually we obtained the permission of the principal and except for structural changes in the school, which resulted in some interesting research opportunities; the site has been quite stable. As mentioned above, Laurie began her research with Sarah-Kate Lavan but continued in the spring in collaboration with me, mainly undertaking research on her own practices with the support of student researchers from her classroom. As is evident from the attached publications in Appendix A, Laurie has shown significant growth as a teacher-researcher.

University City High (referred to here as City High) has been involved in research on science teaching and learning for as long as I have been in Philadelphia – beginning in 1997. Cristobal came to City High from Miami where he had been involved as a master's degree student in a program coordinated by me while I was on the faculty at Florida State University. So, Cristobal's involvement in the study continued his collaboration with me in research and scholarly activities. He joined the MCE program in his second year at the school. Cristobal taught in a small learning community that was relatively low performing in a school that is low performing.

The small learning community coordinator, Clare Tracy Stickney, also had been involved with me in collaborative research in the past several years and she continued her involvement, exploring the role of administration in affording the learning of science. She provided our study with invaluable perspectives on the home and community lives of her students. Clare became a regular participant in the research seminars and undertook research on her own practices. Her regular involvement in our research facilitated significant changes in the way science is taught and structured in the school and major structural changes in the forthcoming year are a direct reflection of our research. Next year City High will reorganize its SLC structure, having six instead of nine. Also, it is planned to have a science department with Cristobal as Chair.

A second teacher from City High, Anita Abraham, also joined the MCE program and agreed to participate in the study. As a mother she was not sure that she could carry the burden of being a teacher, parent, graduate student and teacher-researcher. I was unsure too and not optimistic that Anita would juggle the demands of so many pulls on her time. In the fall semester Anita and I struggled to get the research in her classroom up and running. The student researchers were enthusiastic but Anita was teaching physics, a field in which she was out of field and I found myself coteaching to an extent that detracted from my role as researcher. I was relieved when Rowhea suggested to me that she take over the research with Anita, but I was not sure that effective collaboration would occur. In the spring of 2002 Rowhea commenced her collaborative research with Anita and it really has blossomed into a productive endeavor. Rowhea and Anita have undertaken serious research and Anita has emerged as a committed researcher.

Interim Progress Report

The research with Cristobal has been productive. As well as his classroom and small learning community being my major research site, Cristobal has hosted research undertaken by Regina, Rowhea and Kate Scantlebury. At the present time Faye Allard, a graduate student in sociology, is also undertaking research on gender issues that will shape the nature of science curricula for females in urban schools and Melissa Sterba, a lawyer, is focusing research on female violence and math and science curricula in urban high schools. These studies are collaborative with Clare and Cristobal and are supervised by me. These latter studies are not funded by our NSF grant but support what we are evidence of research being accepted as an essential part of school life.

All teacher-researchers had an interest in writing a doctoral dissertation based upon their research. All seven, including Clare, enrolled for a PhD at Curtin University (in Perth, Australia). Our study is the great beneficiary of this practice. Every teacher researcher diligently undertakes systematic research and writes regularly. In addition, they attend our seminar and some of them attend my classes to improve their understanding of research methodology and relevant theory. Barry Fraser, the head of the science education center at Curtin and one of the world's leading researchers in science education, are co-supervising all seven dissertations. The association with Curtin University means that leading researchers from Curtin, such as Barry Fraser, collaborate closely with the teacher-researchers and visit their classrooms. Substantively, three teacher-researchers from the first year, who will leave their classrooms in the forthcoming year, have a high incentive to continue their research and fully analyze, interpret and write up their dissertation. For example, Linda Loman, who will teach next year in Colorado, will spend the entire summer in our research lab to complete as much of the analyses of in- and out-of-field teaching as is possible. When she is in Colorado she will continue to write papers and her dissertation. I doubt this level of commitment would have been possible had she not been a doctoral candidate as well as a teacher researcher.

The Research Team

There will be some changes in the forthcoming year to the central participants in our research team. Most researchers will continue but several will leave and some will change their roles. The two doctoral students, Sarah-Kate Lavan and Stacy Olitsky, will continue with the research team. Stacy will take some courses in the MCE to improve her background in chemistry and both Sarah-Kate and Stacy will begin their doctoral dissertation research and it will be focused on their research. During the summer Sarah-Kate and Stacy will continue their collaboration with Sonya and Linda respectively. As mentioned earlier, Linda will work full time in the lab in the summer. Linda's full time participation will enable Stacy and her to fully analyze the videotapes and other data sources from the year of research. We also plan to hire student researchers from Linda's class to afford the full analysis of the data. It is expected that Stacy will continue to write the results of the research during the Fall before turning her research to a new teacher in the project. We are considering the inclusion of an African American male who teaches in a Friends' High school in the city. The inclusion of a parochial school will add a significant structural factor that is of great interest in Philadelphia, given the recent State takeover of the city schools and efforts to privatize the schools. The new teacher is a student in the MCE program and an outstanding teacher.

Interim Progress Report

Cath Milne has obtained a position at New York University and will discontinue her role as a key researcher on our project. She will initiate her own research in New York and will seek her own funding. As replacements for Cath two of our teacher-researchers will join our research team via their involvement as internal evaluators in the MCE project. Because of their enrollment as doctoral students they will complete their research and write it up for a dissertation and publication. Sonya Martin has been employed by the Graduate School of Education for three years to collaborate with me in the way that Cath previously collaborated. She will be primarily participating in evaluation activities associated with the MCE but will undertake an intensive case study of one school in which teachers from the MCE are involved. Tracey Otieno has obtained a one year sabbatical leave from the school district and will also participate full time in the evaluation of the MCE and will undertake a case study of one school in which there are MCE participants. Sonya and Tracey will both complete a full analysis of the data collected in their classrooms in the first year of our study. Their results will be written up for presentation at meetings and will be submitted for publication in the science education journals with the highest impact ratings (*Journal of Research in Science Teaching* and *Science Education*).

Teacher researchers at two schools, City High and William Penn, will continue this year and throughout the project. Cristobal, Clare, and Anita will continue their research with Ken and Rowhea at City High. Laurie will continue her involvement at William Penn and next year she will collaborate with Sonya and Tracey.

Jennifer Beers, from High Tech High in City Center will join the project as a teacher-researcher. Jen will be in her second year of teaching at High Tech High, which is a charter school that has students who are similar in nature to those at City High and William Penn High. Jen is an ideal participant since she did her student teaching at City High and participated actively in our research, including Gale Seiler's dissertation research. She has coauthored a paper that is accepted for publication with Wolff-Michael Roth, me, Rowhea, Cristobal, and a student-researcher, Ya-Meer McKnight. With degrees from Penn and the Australian National University Jen has majored in biology, biological anthropology, and science education. She expects to join the MCE degree and undertake doctoral studies in science education. In the meantime she wants to become an accomplished urban science teacher and has a keen awareness of the potential role of research in improving the quality of teaching and learning. Sarah-Kate Lavan is expected to undertake collaborative research with Jen Beers. Jen has already agreed to participate and school administrators have endorsed the plan and are enthusiastic about her involvement.

Presentations and Publications

This year 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.

Interim Progress Report

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 fully develop the website during May 2002. 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 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

Following a one week visit in which Wolff-Michael Roth collaborated on research at City High, the advisory committee will convene for a two day meeting on May 9th and 10th. The advisory board consists of Kathy Borman, Angela Calabrese Barton, Wolff-Michael Roth, and Jay Lemke. The agenda for their meeting is included as Appendix C.

The Research Agenda

As was explained in the earlier narrative, the study commenced intensively with investigations concerning the urban high school youth and their learning of science. The studies included the manner in which the students went about learning science and focused on their use of cultural capital to make sense of physics. We were able to do a mix of traditional laboratory type physics and physics in the world around us. The decision to have the students make a movie on "Sounds in the city" was a good one. The students showed us in this movie how they could connect science to their lives out of school and they showed a lot of pride in what became a somewhat advanced technical task of making and editing a movie using computer tools. The summer research also broke ground in terms of the uses of students as researchers. I include as Appendix D a description of the roles of students as researchers and some of what we learned. This text will be edited and expanded to provide the basis for an article that will be submitted as a methodological piece for publication in a journal.

In the fall of 2001 the focus of the study shifted to schools and classrooms and we used the plan of the study as it was negotiated with Larry Suter. The research questions I listed at that time became a starting out point for research at our differing sites. In Appendix E there is a matrix that shows the extent to which the research at each site addressed each of those questions.

The next report will be more summative in its look back at the first year of our research. In that report I will provide a substantive update on what we have learned and where the research priorities will focus in the forthcoming year.

Appendix A

Publications Associated with the NSF Grant (REC- 0107022)

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

02. 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.
01. 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 23rd Annual Ethnography in Education Research Forum

10. 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.
09. 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.
08. 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.
07. 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.
06. 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.
05. 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.
04. Loman L. (2002, March). *My cultural awakening in the classroom*. Paper presented at the Ethnography in Education Research Forum, University of Pennsylvania, Philadelphia, PA.
03. Martin S. (2002, March). *Not so strange in a strange land*. Paper presented at the Ethnography in Education Research Forum, University of Pennsylvania, Philadelphia, PA.
02. 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.

Interim Progress Report

01. 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

05. 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.
04. 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.
03. 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.
02. 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.
01. 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.

Papers Presented at NARST-National Association for Research in Science Teaching

17. 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.
16. 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.
15. 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.
14. 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.
13. 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.
12. 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.

Interim Progress Report

11. Martin, S. (2002, April). *Teacher and students as researchers: A socially transformative experience*. Paper presented at the annual meeting of the National Association for Research in Science Teaching, New Orleans, LA.
10. 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.
09. 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.
08. 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.
07. 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.
06. 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.
05. 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.
04. 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.
03. 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.
02. 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.
01. 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.

Dissertation

- 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.

Interim Progress Report

Masters Thesis

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.

Chapters in Books

03. Tobin, K. (in preparation). 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.
02. Tobin, K., Elmesky, R. & Carambo, C. (in press). 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.
01. 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.

Collaborative Publications and Papers Involving REC- 0107022 and ESI-9911825

Presented Papers

05. 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.
04. 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.
03. Milne, C., Otieno, T., Koo, E. & Hatched, 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.
02. 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.
01. 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 Publications Involving REC- 0107022 and DUE-9979635

Presented Papers

02. 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.
01. 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.

Journal Article

Roth, W-M., Tobin, K., Elmesky, R., Carambo, C., McKnight, Y., & Beers, J. (in press). Re/making identities in the praxis of urban schooling: A cultural historical perspective. *Mind, Culture and Activity*.

Appendix B

SEMINAR CALENDAR: FALL 2001/SPRING 2002

Date	Presenter	Presentation Title
9/13/01	Gale Seiler	Emancipatory science education - from a lunch club to the classroom
9/27/01	Ebony Fowlkes, Markist Johnson & April Sample	Student Researchers as Ethnographers: A look into the lives of three urban African American students
10/11/01	Ken Tobin	Students as researchers: Agency and the breaching of inequities in urban science education.
10/25/01	Judy McGonigal	The Process of Doctoral Research Autobiography
11/1/01	Wolff-Michael Roth	Macro and Micro levels of research in science classrooms
11/8/01	Catherine Milne & Tracey Otieno	Small Learning Communities, Subject Departments and the Cultural Production of School Science
11/15/01	Gale Seiler Rowhea Elmesky	Understanding social reproduction: The recursive nature of coherence and contradiction within a science class Struggles of Agency and Structure as Cultural Worlds Collide as Urban African American Youth Learn Physics
12/6/01	Stacy Olitsky, Linda Loman & Sonya Martin	Cultural capital, social capital and cultural reproduction in school science
1/16/02	Ken Tobin & Rowhea Elmesky	The anatomy of an urban high school science study
1/30/02	Linda Loman, Sonya Martin, Anita Abraham, Cristobal Carambo, Tracey Otieno & Laurie	Teacher-researchers in their urban science classrooms: What they're learning and how they're changing

Interim Progress Report

	Hazelwood	
2/14/02	Stacy Oltisky, Sarah-Kate Lavan, Cath Milne & Rowhea Elmesky	Social and cultural perspectives on the teaching and learning of science
2/28/02	Linda Loman, Sonya Martin, Anita Araham, Cristobal Carambo & Laurie Hazelwood	The powerful role of autobiography within critical ethnography: Five urban science teachers tell their stories
3/7/02	Ken Tobin	Fresh perspectives on research on learning environments in urban high school science
	Jim Gallagher	Leadership development in mathematics and science education

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.

9/13/01 Emancipatory science education - from a lunch club to the classroom

In this seminar, Gale Seiler focused upon social reproduction and agency within the context of a new science elective course that was offered in University City High School in the spring of 2001 and designed to engage a student-emergent and cultural funds of knowledge curriculum. The science elective course design was based upon research conducted within a science lunch club (Seiler, 2001) in which a group of male students met over lunch to talk about science topics that were of their interest. Whereas, the lunch club context was seemed conducive towards encouraging students' agency, the science elective course seemed less so. This seminar addressed the complicated historical, cultural, social, and structural forces in which the course was embedded and how they acted upon the stakeholders so as to understand how and why good intentions were and were not able to counteract the structures that supported social reproduction.

Interim Progress Report

9/27/01 Student Researchers as Ethnographers: A look into the lives of three urban African American students

During the summer of 2001, five University City High School students were employed under research grants from the Spencer Foundation and the National Science Foundation. One of their projects involved the development of their own ethnographies in which they individually chose to foreground cultural nodes of either home, neighborhood or school. This seminar provided a forum for three of the students to share their projects with our research group. Markist Johnson presented an ethnography of his neighborhood through a self-created PowerPoint presentation that accented how he felt about his life. In April Sample's portion of the seminar, she presented a personally created collage of PowerPoint slides that featured information about her family and the rules she lives by, her future goals as well as people whom she respects. In contrast, Ebony Fowkles chose to present her ethnography in the form of an individually-authored rap about her life. Ebony provided detailed explanations of each line of rap lyric, and in doing so, she communicated significant aspects of her home, neighborhood and school.

10/11/01 Students as researchers: Agency and the breaching of inequities in urban science education.

The purpose of this seminar was to describe how high school students can become researchers in science education and to present examples of their involvement in a four-year program of research in urban science classes. Specific attention is directed toward their roles in conducting audio and video interviews, writing narratives based on their experiences, and creating video ethnographies based on the teaching and learning of science and the social and cultural dimensions of their lifeworlds. Issues of voice are addressed in a context of students interpreting data and authoring manuscripts for publication in peer reviewed journals. Ethical issues are addressed, particularly those associated with increased access student researchers have to their peers and families and the extent to which minors can provide informed consent to participate as researchers.

10/25/01 The Process of Doctoral Research Autobiography

During this seminar, Judy McGonigal provided a presentation that not only shared research findings associated with her dissertation, yet also described the process of dissertation development. She demonstrated that her writing of a dissertation did not occur in linear steps, but rather emerged as she examined reoccurring themes that appeared as she reflected upon her past and present. More specifically, Judy shared stories of her experiences that reflected her struggles to understand the multiple meanings of the concept of scientific inquiry.

11/1/01 Macro and Micro levels of research in science classrooms

In this seminar, Wolff-Michael Roth's presentation focused on a research analysis strategy he refers to as "zooming". By utilizing data from a physics classroom where students were interacting in groups at computer stations designed to help them learn Newtonian theory, Roth showed that, by zooming between macro and micro lenses, a researcher can identify patterns that occur simultaneously at the multiple levels. His presentation clearly showed that the combination of such macro and micro level analyses can provide deep insight into what is occurring in science classrooms.

11/8/01 Small Learning Communities, Subject Departments and the Cultural Production of School Science

This presentation examined the enactment of structures such as Small Learning Communities and subject departments and the iterative relationships between such structures and resources, including material and human resources, and schemas such as beliefs about the purpose of schools in communities and rules about the establishment of SLCs. Since much of the documentation that was published about the enactment of SLCs in Philadelphia makes little direct reference to learning or cultural production but instead refers to creating safer environments, bringing the home and community into the school and developing SLC curriculum based on themes, this seminar addressed: What happened to the learning of students as a result of this change to the structure of urban high schools? What was the role of agents in the enactment of these structures? One apparent consequence of the implementation of SLCs is the demise of subject departments. What impact does this have on a discipline such as science that requires the maintenance of resources such as materials and chemicals, and laboratory spaces?

11/15/01 Understanding social reproduction: The recursive nature of coherence and contradiction within a science class

This seminar focused on sharing the results of a dissertation study concerned with understanding how schools and science classrooms within schools continue to contribute to social reproduction and to the disenfranchisement of inner city African American students. This research looked at the benefits of starting with the cultural capital of the learner in a classroom, rather than with external standards. More specifically, Gale Seiler discussed what occurred when a non-required science course was developed at a local high school two coteachers endeavored to enact a student-emergent curriculum as a way to foster student agency and to counteract the reproductive nature of schools. The class was examined as a field within multiple other fields. The dialectical relationship between structure and agency in the class was used to frame the analysis, and the tension between them was examined at several levels through video and audio analysis. Structural and rational choice views of action were abandoned in favor of an understanding hinged upon strategies of action that actors construct from cultural toolkits in and through practice. In the research setting the students and teachers co-constructed a class that could be

Interim Progress Report

described and characterized in certain ways yet contained many counter-examples and alternative characterizations. A continuum of successes and failures, agency and subjectivity were found in the trends and counter-trends in the course. The contradictions were examined to portray the complexity of the interactions and the possibilities for agency within them.

11/15/01 Struggles of Agency and Structure as Cultural Worlds Collide as Urban African American Youth Learn Physics

This seminar presented the dissertation research findings of a critical ethnography that focused on five urban African American students, coming from economically disadvantaged homes in Philadelphia, who were considered at risk with regard to their position within society as well as within the small learning community of their low-academically performing school. Through the study, the youth were provided with traditional and nontraditional opportunities to build understandings of some of the most essential concepts of physics as learners. Moreover, they also had the chance to work as research assistants, teacher educators and curriculum developers. The findings of the research conclusively revealed that African American, urban youth from some of the most challenging situations *are* capable of learning physics concepts, especially when, in the process of meaning-making, their personal goals unrelated to science are also met. Through the physics teaching and learning that occurred within this study, as well as their work as researchers, teacher educators and curriculum developers, the youth had opportunities to utilize their cultural capital to build new knowledge schemas and to develop access to new resources. Thus this seminar clearly indicated that poverty stricken African American urban youth can be changed by science and science too can be changed by them.

12/6/01 Cultural capital, social capital and cultural reproduction in school science

This "work in progress" seminar was presented by the research group at Masterman High School Two, consisting of two teacher-researchers and one university-researcher, presented their research proposals, the theoretical perspectives (i.e. cultural historical activity theory) informing the questions they ask, the methodology they used to generate information and their approaches to constructing data and interpretations. They explained in detail the student researchers that form a part of their research team including the selection method incorporated and multiple roles engaged by the students. Finally, the presenters provided examples of how the involvement of student researchers has affected the daily events within the science classroom

1/16/02 The anatomy of an urban high school science study

This seminar was designed to provide concrete, relevant images of the stages of the research process. Utilizing actual data collected at University City High School, the following research stages were discussed:

Interim Progress Report

- 1) Defining research problems
- 2) Identifying research questions
- 3) Methodology-dependent research strategies
- 4) Macro and micro level analyses
- 5) Interpretation and research findings

1/30/02 Teacher-researchers in their urban science classrooms: What they're learning and how they're changing

This seminar was presented by the teacher researchers associated with the project. During the seminar, each individual provided a short summary of their research interests and how an overview of the research agenda within their classrooms. Linda Loman's presented her interests of understanding student questions within a science classroom within the framework of cultural historical activity theory (i.e. Engeström, 1999). Sonya Martin discussed a research focus that concentrates on learning how she has changed as a chemistry teacher since her enrollment in the Masters of Chemistry Education (MCE) program at Penn. Cristobal Carambo addressed the recent successes with the small learning community in his urban high school and discussed his interest to study particular students whose academic and social status in the SLC has underwent significant improvement. Anita Abraham presented her focus on studying the formation of teacher/student relationships as well as the effects on teacher/student relationship when efforts are made to embrace students' cultural capital within her science classroom. Tracey Otieno's presentation discussed the importance of understanding student gestures as a part of students' conceptual growth in science. Laurie Hazelwood's research focus centered upon the structural constraints (i.e., administration, physical setting, resources) that she encounters as a teacher in an urban science classroom.

2/14/02 Social and cultural perspectives on the teaching and learning of science

This seminar provided a prospective of the research foci of the university researchers whom are working in conjunction with the teacher researchers. The presenters explored the social and cultural factors associated with the teaching and learning of science in urban high schools. Sarah-Kate Lavan examined the existence of nodes within the science classroom of Sonya Martin, the culture that was enacted at each, and the implications for science teaching and learning. Stacy Olitsky focused upon the components of the activity systems present in Linda Loman's classroom to understand what the activity of learning science within classroom looked like from various perspectives. More specifically, she looked at what components of the classroom environment interfere with student learning and achievement in science, at how the classroom can become a site for positive change, emerging from the collaborative efforts of teacher and students. Rowhea Elmesky presented preliminary research findings regarding the development of chemistry laboratory strategies of action such as such as being able to follow procedures, utilize scientific tools and access canonical science discourse. Such strategies of action were seen to mediate the conceptual learning of

Interim Progress Report

chemistry as well as encourage student participation and engagement in the “doing” of chemistry. Cath Milne presented the idea of schools as “ethnoscapes” and addressed theoretical perspectives of culture, fields, and institutional nodes in context of research being conducted in Tracy Otieno’s classroom.

2/28/02 The powerful role of autobiography within critical ethnography: Five urban science teachers tell their stories

This seminar focused upon autobiography as a tool of critical ethnography to restore to teachers the voice often taken away from them by university researchers. Four teacher-researchers associated with the grant presented unique, captivating autobiographical accounts emphasizing those life events that have shaped their teaching within urban science classrooms. What seemed most impressive about the seminar was the emergence of four major themes across the teacher-researcher autobiographies: (1) the awkwardness of being a “cultural other,” (2) the value of social capital, (3) lack of resources for the science classroom, and (4) the importance of a teacher’s science content knowledge.

3/7/02 Fresh perspectives on research on learning environments in urban high school science

During this seminar, Ken Tobin discussed a recent chapter which viewed learning environments as dynamic and interactive sociocultural entities that are shaped by the agency of individuals interacting with human and material resources in ways that afford their agency while constraining what they can accomplish. Moreover, the seminar illustrated how teaching in urban science classrooms can only sustain productive environments with the collective acceptance of all members of a learning community and a conscious awareness of the intersection of cultural fields and a necessity to build science literacy on the capital from those fields while actively suppressing strategies of action from those same fields that would otherwise inhibit learning.

3/7/02 Leadership development in mathematics and science education

Jim Gallagher utilized the seminar forum to present preliminary findings associated with an NSF-funded project focused on understanding leadership development in science and mathematics education. The project drew upon two main data sources – results from interviewing 80 leaders and an examination of national data bases to determine characteristics of current leaders, the events that led to their leadership and influence, and the roles they have undertaken. More specifically, educational background, context, and an individual’s capabilities, opportunities, responsibilities, and influences were studied in depth, and preliminary findings have shown that:

1. Career paths for leaders are unpredictable.
2. Bringing teachers to campus altered career paths.
3. Leadership in one arena draws on experience in others.

Interim Progress Report

4. Mentors and opportunities for contact with senior people in the field matter.
5. Ideas matter.
6. Colleagues matter.

Appendix C
NSF Grant Advisory Board Meeting
Schedule for May 9-10, 2002
GSE Room 202

Thursday, May 9, 2002

9:00 am – 2:00 pm *Research Site Visits with University Researchers*

School Site	Advisory Member	University Researcher(s)	Teacher-Researcher(s)
Masterman	Jay Lemke	Sarah-Kate Lavan & Stacy Olitsky	Sonya Martin Linda Loman
City High	Angie Calabrese Barton	Rowhea Elmesky	Anita Abraham
Furness	Kathy Borman	Cath Milne	Tracey Otieno
William Penn, High Tech High and City High	Wolff-Michael Roth	Ken Tobin	Laurie Hazelwood Cristobal Carambo Clare Tracy Stickney Jen Beers

3:00 – 4:15 pm *Research Presentation & Discussion – Rowhea Elmesky*
(40 min presentation, 35 min debate/questioning session)

4:30 – 6:30 pm *Interactive Seminar*

Contextualized Research Discussions: Interactive Groups (45 min)

- 1) Jay Lemke, Linda Loman, Sonya Martin, Sarah-Kate Lavan, & Stacy Olitsky
- 2) Angie Calabrese Barton, Anita Abraham, Rowhea Elmesky
- 3) Wolff-Michael Roth, Ken Tobin, Cristobal Carambo, Clare Tracy Laurie Hazelwood, & Jen Beers
- 4) Kathy Borman, Cath Milne & Tracy Otieno

Advisory Board Reports (15 min per presenter)
Angie Calabrese Barton, Jay Lemke, Kathy Borman, & Wolff-Michael Roth

Conclusions (15 min)

7:15 pm *Dinner at the White Dog*

Friday, May 10, 2002

9:00 am – 2:00 pm *Research Presentations with Whole Group Discussion*
(60 min per presenter with 30 min for presentation, 20 min for
debate/questioning session and 10 min for recess)

9:00 – 10:00 am Ken Tobin

10:00 – 11:00 am Sarah-Kate Lavan

11:00 -12:00 pm Stacy Olitsky

12:00 - 1:00 pm Cath Milne

1:00 - 2:00 pm Working Lunch (Advisory Board Internal Discussion)

2:00 – 3:00 pm *Plenary*

Appendix D The Use of Student Researchers in our Research

The inclusion of students as researchers in our studies has made a very striking difference in what we study and how we study it. (Cath Milne, personal communication, 10/8/01)

Critical ethnography calls for a research process that abolishes the hierarchy typically associated with traditional research methodologies (i.e. research performed “on” or “for” a particular group) through researching “with” rather than “on” the researched community. As this study is conducted as a critical ethnography concerned with looking at the teaching and learning of science in urban science classrooms, we find it imperative that each stakeholder has a powerful voice in the research process so that no one person’s voice silences another’s. Traditionally, the tendency has been for the researcher to drown out the voices of other stakeholders, particularly due to the power attributed to the researcher position. Seiler (2001b) urges a movement beyond such hegemonic research practices when she writes, “Our institutional practices and traditions in social research perpetuate unequal power relations between the researcher and the researched. Thus we have looked for ways of structuring our research team so as to transform the differential power relations between participants as well as those implicit within the social setting itself.” Whereas, typically, a university researcher would spend hours of observations and often judgments “from the side” in a particular classroom or classrooms, our research plan is innovative in its inclusion of student researchers into the research teams at every research site; thus providing perspectives that otherwise would either not have been heard or, if heard, perhaps would have been ignored.

Yet more than simply eliciting student views into the research process, in this study, the students are expected to take an active role in the data collection process, such as interviewing others, creating video ethnographies and/or writing journal entries as well as in the macro and micro data analysis procedure. For instance, one of the major tasks for student researchers involves watching video tapes of taped classroom interactions and selecting vignettes that are salient to them. They then engage in cogenerative dialogues regarding these vignettes with both the teacher and student researchers as well as with fellow students who may or may not be “researchers.” In addition to video analysis, student researchers transcribe interviews that they or other members of the research team have conducted sometimes in relation to the video vignettes and other times on more general issues. What we have found is that often other students feel more comfortable speaking with a fellow classmate about school, neighborhood or home related issues than with an adult researcher, and the data resulting are consequently richer and more meaningful.

In conclusion, when students have opportunities to bring to the forefront issues that they see as salient, the research process shifts into a very different light. The following excerpt is an audiotaped reflection recorded by a student researchers after reading newspaper articles on a neighborhood mass murder that involved individuals she knew.

Interim Progress Report

I think in the Lex Street case that they still don't have enough information on them four guys that supposed to have did it ... I also think that in my own perspectives that if they did do it, they shouldn't just have life in jail. If it was a mass murder all over the city – the worse they had the unfortunes, I think that they should get the death penalty or the electric chair ... And I also think that -- I also think in the Lex Street case that if they knew it was a bad neighborhood or whatever, they shoulda — I mean the cops be everywhere else. I don't think the cops shoulda took at least a hour just to get there. I think it woulda been -- he woulda lived. I don't think it woulda -- I think it woulda been more evidence if — it woulda been at least two lives still alive. Even if they knew. And the people that's on the block, the captain or whatever, she knew that a bad house, a drug house that was goin' on for years with different people. I think they shoulda looked into that more. (Ebony, personal communication, 8/14/01)

Certainly, this quote demonstrates the type of information that becomes accessible when students take a central role in the research process and the power of encouraging their voices to ring out – not only for others to make sense but to make sense for themselves as well. In this particular instance the graphic insights provided by Ebony into her lifeworld can assist us to see the breadth of experience she carries with her into the classroom. In our research team of adults and students none of the adults (university and teacher researchers) had experienced murder, whereas each of the five student researchers involved in the initial summer had experienced murders on multiple occasions. It was strikingly clear to us that the lives of the student researchers and their peers from whom we wanted to learn in our research were greatly different than our own. During that summer we learned of the value of giving students the tools to represent their lives out of school and the result was a collage of different genres than we would have employed. The creation of video-ethnographies and raps were just two examples of an array that has proved useful in providing us with glimpses into students' lives in their neighborhoods, streets and homes. From the perspective of teaching and learning science we have begun to use such resources to consider how the roles of students in school can be aligned with their lives out of school and how curricula can be tailored to the students' interests and what they know and can do.

Our use of student researchers has been extensive in two main ways. At each research site we have involved at least two researchers per teacher in activities that have included video analysis and associated cogenerative dialogues, interviewing peers and transcribing salient parts, maintaining electronic journals, participating in science lunch clubs with the purpose of creating science curricula that are sensitive to the interests and cultural capital of students, interpreting data, and co-authoring texts about the teaching and learning of science. At our research lab on Market Street student researchers from City High have assisted us with transcribing audio and video tapes of lessons and editing videotapes to identify video vignettes they consider salient to effective teaching and learning. Subsequently they have assisted us in analysis, interpretation and co-authoring of manuscripts.

Appendix E
RESEARCH QUESTIONS ADDRESSED AT THE RESEARCH SITES

The following tables depict the research questions being addressed at each research site by the university-researcher, teacher-researchers and/or student researchers.

Research Questions	University City		William Penn	Furness	Masterman	
	Cristobal Carambo	Anita Abraham	Laurie Hazelwood	Tracey Otieno	Sonya Martin	Linda Loman
Which teaching roles afford appropriate practice and learning of students?	High	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)?	Medium	High	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	High	Low	Low	Medium
How do teachers use symbolic and material resources to enhance the learning of students?	Low	High	Medium	High	Low	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?	Medium	Low	Medium	High	Medium	High
What components of the students' cultural capital are conducive to their learning of science?	Medium	High	Low	Medium	High	Low

Research Questions	University City High School		William Penn	Furness	Masterman	
	Cristobal Carambo	Anita Abraham	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?	Medium	Medium	Low	Medium	N/A	Medium
What components of the students' cultural capital make it difficult for them to learn science and detract from the learning of their peers?	Medium	Medium	Low	Medium	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	N/A	Medium	High	N/A	Low
What are the key ideas/values and practices that constitute the dominant culture of the school?	Low	N/A	Medium	N/A	High	High
How do specific aspects of the dominant culture afford and inhibit the learning of different students?	Low	Low	Medium	N/A	High	High
In what ways is the dominant culture oppressive to some students?	Low	N/A	Medium	N/A	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	Medium	Medium	N/A	N/A	High
How does the resistance of students to the dominant school culture afford and inhibit their learning?	Low	N/A	Medium	N/A	High	Medium
Is there evidence of the growth of counter-cultures and if so, how do they constrain learning positively and negatively?	High	N/A	High	N/A	N/A	Low

Research Questions	University City		William Penn	Furness	Masterman	
	Cristobal Carambo	Anita Abraham	Laurie Hazelwood	Tracey Otieno	Sonya Martin	Linda Loman
How do the classroom learning environments afford the learning of science?	High	High	High	High	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)?	Medium	High	N/A	High	Low	High
How does the enacted curriculum take account of the students' interests and cultural capital?	N/A	High	High	Medium	Low	Medium
How does the organizational structure of science (including the uses of human, symbolic and material resources) shape enacted science curricula?	N/A	High	N/A	High	Medium	High
How does the organizational structure of science afford and/or inhibit the development of learning communities among science teachers and students?	N/A	N/A	N/A	High	High	Medium
How are the practices of teachers and students constrained by the physical space in which the science curriculum is enacted?	N/A	Low	High	Medium	High	High
How does the organizational structure of science afford the creation and maintenance of appropriate learning environments?	N/A	Medium	N/A	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	N/A	N/A	Medium

Taking A Closer Look at Each Research Site

University City

At University City, there are three different on-site researchers with varying research foci. Anita Abraham and Cristobal Carambo are teachers of science in two different small learning communities (SLC) and Clare Tracy Stickney is the SLC coordinator of the community in which Cristobal teaches.

Clare's research focuses on understanding how administrative leadership can impact student learning in urban science classrooms. More specifically, this research focuses on understanding what type of facilitative role an administrator should and can take in helping to improve the communication between students and their teachers such that students' skills, interests and abilities can be built into a solid science curriculum that opens up opportunities for social mobility.

In Cristobal's classroom, the research team focuses on trying to understand what teaching practices afford meaningful science learning among urban students. Emphasis is placed on understanding the culture being enacted from outside fields such as the street and home with the intention of breaching those that take away from the learning process. Analysis of student-student and student-teacher interactions in whole class, lab groups and one on one interactions provide insight into what type of science curriculum would be transformative to the students' lives. Research related to coteaching within an urban environment adds depth and perspective to the research as well.

In Anita's chemistry classroom, the research team has focused on understanding the dynamics of teacher-student relationships in a science learning environment. In addition, researchers collect and analyze data to identify the varying locations and times when cultural capital of students appears within the classroom. Moreover, the research team is interested in understanding how these cultural strategies affect the teacher-student. In addition to research focused upon understanding the building of rapport with students, this research also looks at the teaching practices that Anita engages in the chemistry laboratory setting. Video and audio tape analysis of lab group work looks at how students can or can not their cultural toolkits to include scientific laboratory strategies of action as they interact with tools and resources in the chemistry laboratory.

William Penn

Research at William Penn, which involves Laurie Hazelwood as a teacher researcher, is focused on discerning roles and cultural codes in an urban science classroom of a neighborhood high school. Not only is the focus to identify these roles, codes, and boundaries and understand how they interact, it is the porosity and contradictions between them that is also being studied using cultural historical activity theory and cultural sociology as theoretical lenses. In addition, the research team is interested in understanding the role of social capital in creating co-participation in the science classroom and whether it can compensate for lacking resources.

Masterman

Linda Loman

Research performed in this magnet high school looks at components of the science classroom activity system and how learning is afforded or inhibited therein. More specifically, the research team has focused upon identifying current teaching practices and understanding how they are used differently at various times and places in the classroom. Questioning practices have served as a focal point for data analysis as well as studying when and where social capital is being built by students and/or the teacher.

Sonya Martin

In this magnet high school, the research team has focused on recognizing teacher strategies that afford learning in the science classroom. As Sonya is enrolled in a Master of Chemistry Education program, the research team looks for understandings of how enrollment in a long term teacher education program affects teacher depth of knowledge, and specifically, the use of an inquiry model of science instruction. In relation the identification and analysis of teaching strategies engaged by the Sonya, researchers collaborate to identify and understand student strategies of learning as central to a study focused on the improved teaching and learning of science.

Furness

Tracey Otieno

At Furness, research has focused upon the differential interactions of teachers and learners in the classroom as teachers move from teacher roles in which the teacher is framed at the center of the interactions to situations where students have a more central role in the teaching and learning of science. In examining the relationship between teachers as learners and teachers as teachers, the research team looks at how education courses can provide access to tools that assist teachers to make this transition. More specifically, they look at tools that Tracey is using in the Master of Chemistry Education program and how she enacts these tools in her science classroom (local conditions) and whether these tools afford learning for the students. The researchers also look the structure and enactment of the curriculum including how symbolic and material resources are used differentially at various nodes or sites of concentrated practice within the science classroom. Also central to the research is building understandings of the structure of the school, in terms of organization, resources and physical space impact the science learning environment.