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Capacity Building for Teaching Science in Urban Schools

My Vexation: The current state of science education in urban secondary schools

As a secondary science teacher I was keenly aware of the importance of a sound basic science education to my secondary students. For the most part my students were not going on to become scientists or work in careers directly related to science but all of them would be adults living in a world very much affected by science and technology. When I looked at a class of ninth grade students I saw the people who would one day swell the ranks of workers in various ordinary jobs that are essential to our economy.

If we truly expect all of our students to fulfill their responsibilities as adults then we have to provide the type of education that will equip them to do so. Currently, the vast majority of students in urban secondary public schools are ill equipped upon graduation to assume most of these responsibilities. An unscientific survey of current honors students and current college students who are recent graduates from my local secondary high school reveals a disturbing picture. When asked to explain global warming and why we should be concerned 3 out of 4 could not give a satisfactory explanation. Is this a symptom of normal youthful disinterest or a deeper, more disturbing issue?

My window into urban secondary classrooms has come from multiple sources. These sources include my five years teaching in two urban middle schools, observations of masters' candidates in their classrooms, journal entries of my pre-service teachers' practicum experiences, and anecdotal accounts by urban secondary teachers and students. These experiences and words evoke a wide array of emotions. I have sat in some classroom seething with rage about deplorable physical conditions. I have also been awestruck by the amazing teaching that was taking place on some classrooms. It never ceases to surprise how much some teachers can do given their limited resources.

The lack of resources at the classroom level is indicative of funding issues unique to urban districts. Due to smaller residential tax bases and usually smaller pupil numbers than suburban schools they are panelized by state-level funding formulas. They must also devote larger portions of their funding for services such as assessment support, school social workers, police patrols, and upkeep on decaying physical plants. Science instruction in many instances is conducted in classrooms with outdated, damaged equipment. The lack of technology was startling with its absence. The chalkboard and overhead projector were the primary mode for transmitting content. Hands-on laboratory experiences were few and far between. In a study conducted by Condon and Roscigno (2005) on spending in elementary schools in one Ohio district, they revealed that disparities in spending corresponded to racial and social class make-up of schools. Schools with higher numbers of disadvantaged students had less funding devoted to instructional resources, teacher salaries and building maintenance. This may seem like a no brainier but the debate about the role of funding as it relates to student achievement still rages on in the education community. This issue is now much more important since the imposition of state-level accountability mandates and federal government No Child Left Behind legislation.

State and federally mandated accountability measures have shifted the spotlight to measurable instructional outcomes. Students and teachers across all communities are now expected to perform at specified levels or there will be consequences. Students are expected to pass a specified number of end-of-course exams to qualify for graduation. This pressure to produce favorable passing rates is experienced by all in the system from the superintendent to students and classroom teachers. Given the reality of accountability measures many instructional changes have occurred in urban schools.

Instruction has devolved into directives to teachers centered on completing the content that would appear on the end-of-course state assessment and keeping the students under control. To this end teachers are provided with pacing guides and schedules of periodic assessments to track students' progress. Surprisingly many of these students' only encounters with science content are from their text books or their teachers' overhead notes. Science is an abstraction necessary to pass the end-of-course test and is totally unrelated to their lives. Inquiry teaching is as foreign as live specimens in an urban biology class. I sat in one classroom where the students were expected to memorize past test questions verbatim. When questioned about this, the teacher justified his action on the grounds that students were chronically absent so he didn't have enough time or continuity to teach the content. Other instructional strategies include having students copy and memorize vocabulary terms from the text, color and label diagrams, and create flipbooks. One would expect general chaos under these conditions but for the most part the classrooms were very quiet. On many occasions even the teacher's voice

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was absent. Instruction usually consisted of directions to complete worksheets or exercises from the text. In classrooms where there were student and teacher talk the vast majority of the time the talk was not focused on science content.

Most schools have no-tolerance policies designed to swiftly remove disruptive students from the classrooms in the effort to keep the focus on instruction. To this end teachers are charged with enforcing a large number of school rules dealing with issues ranging from student use of cellular phones, bullying and student dress. This atmosphere of enforcement has had results. The number of reported assaults by students on teachers has increased more than four times between 2001 and 2005 (Prestidge, 2006). When compared to surrounding suburban districts this increase has been astounding given that the greatest increases in those areas were at the most two-fold.

My graduate pre-service teachers leave the program eager to start their roles as science teachers. I can venture a guess that many teachers currently in science classrooms were at one time just as eager. What has occurred in the ensuing years to quench their fires? Yes, there are issues of resources but I would venture that the greater issue is the confrontational relationships with their students which they encounter on an almost daily basis that is the larger issue. These relationships stem from myriad factors. Differences in race, class and cultural orientation generally tops the list. Each teacher brings into the classroom her entire socio-cultural history or historicity (Engstrom, 1994). The intersection of her historicity with that of her students' creates multiple micro relationship schemes. These relationship schemes are also impacted by the materials or lack thereof that are available for instruction, school climate and policies that are imposed by stakeholders external to the classroom. Thus teachers must navigate through these complex systems to accomplish their goal of teaching students science. All too often these complex systems are unique to the school community or district.

My Venture: To develop a set of strategies that urban secondary schools can use to increase their capacity to effectively teach science.

How can we as science education researchers begin to assist school-level science teachers in meeting their goals to effectively teach science given the complexity of relationships that are enacted in classrooms and schools? I think we need to look at each district and school as microcosms. Each district comes with specific challenges and unique assets. I will term these unique assets context-specific resources. Once the challenges that have a negative impact on sound science education and the context-specific resources are identified, a plan for improvement can be formulated with all stakeholders.

The challenge for the science education researcher is to allow the improvement plan to emanate directly from the context-specific resources, the challenges unique to that community and best practices grounded in science education research. To this end data need to be collected from a variety of sources. Within schools data on student achievement, behavioral incidents, physical plant status, science resources, and teacher qualification need to be aggregated. At the community level an inventory of science-rich resources need to be compiled. This inventory could include science museums, botanical gardens, parks, research universities, and science-related businesses. In addition to these resources service organizations with a mission to aid education can also be inventoried. Once this data is collected and analyzed a plan of action can be formulated with teachers, administrators, students, parents and community partners. This is a radical departure from the old paradigm of "professor knows best" but it is the only solution that allows for the voices of all parties to contribute to improving the current state of urban science education.

Over the next three months I will conduct a review of urban science education literature as an initial step in preparing a research proposal. The primary purpose of the review is to find supporting evidence for my micro-level study. My research questions will flow from this analysis of the literature. I will submit an IRB proposal for the study by the end of November. Pending review board approval of the study I will begin relationship building with one local secondary school. Concurrently I will investigate funding sources I can use to support this endeavor. My institution has made a commitment to support work focused on addressing issues in our surrounding community so I'm fairly confident that I would be able to secure some internal funding.