The Three C's for Urban Science Education

Using students' thorough engagement in popular culture as a model, Mr. Emdin developed tools to immerse them just as deeply in their classroom learning.

By Chris Emdin

ON AN unseasonably warm fall afternoon, I stood in the back of a chemistry classroom in one of the most economically disadvantaged urban areas in the U.S. and watched a sea of sleepy black and brown faces painted with confusion, frustration, and indifference as their teacher taught them a chemistry lesson. At the front of the room, the teacher practically did pirouettes in a dance of atomic models, electric charges, and absorption and emission spectra. At one point, he struck the board with a ruler in an effort to get the students' attention. The noise succeeded, but only for a few seconds, and he was unable to keep their interest or spark any excitement as he continued to plow doggedly through the rest of the lesson.

Students engaged in coteaching in a chemistry laboratory. The two students on the left instruct the students on the right on the lab procedures. (Photo courtesy of the author.)

About two minutes after the students had returned to their afternoon stupor, the sound of a rap song drifted through an open window from a passing car. Practically all the students sat up and almost simultaneously began nodding their heads to the beat. They looked up at one another and smiled. Some mouthed the words of the song under their breath, as they gave each other knowing glances that were acknowledged by slight head nods and brief eye contact. The song generated an obvious emotional energy in the classroom that the teacher's chemistry lesson could not evoke.

As the car drove past, the sound of the song dis-

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Photo of Chris Emdin courtesy of Teachers College Department of External Affairs.

solved into muffled bass and a faint drum pattern, and its distinctive beat trickled into silence, replaced by the repetitive ticking of the clock at the front of the classroom. The teacher returned to his lesson, and the smiles that had filled the students' faces slowly melted into blank stares and looks of indifference, as they returned to their previous somnolence.

This episode was just one of many surreal moments that drew me to explore the question of why urban students do not engage with science and what can be done about it. In each of my roles as teacher, administrator, and researcher in urban public schools, I have been struck by the magnitude of the separation between the culture of school science and that of urban students. Teachers seem to come from a world that is completely removed from that of the students, who seem to communicate in a kind of code that strengthens their connections to one another while it deepens their alienation from the world of science.

In my research, I have found evidence of this separation by looking at students' scores on standardized tests, their lack of participation in science classrooms, and their decisions to choose careers far removed from the sciences. Consequently, one of the main foci of my work — and a theme that resonates throughout my dissertation — is the search for effective approaches to science instruction in urban schools that will allow students and teachers to have shared positive experiences about science.

In order to fulfill this quest, I needed to understand that the powerful connection students have with their peers and their distinct cultural understandings (often expressed in music and in the ways they teach and learn from one another) are points of entry that educators and researchers must use to engage students in science. I also needed to understand that finding ways to bridge the cultural misalignments that divide school science and urban students would require both practical and theoretical innovation. By innovation here I mean a reinvention of age-old approaches to effective teaching that have been espoused by schools of education and constructivist educators and called a "student-centered" curriculum. What I sought to do was take the term "student centered" out of the realm of the ideal and beyond the language of cliché and deploy it for action to meet the needs of students in urban schools.

In the paragraphs that follow, I will outline briefly what I call the three C's — a set of tools that can be used to improve urban science education — and describe the ways that they can support students who have traditionally been marginalized. These three aligned and closely connected tools are at the crux of my research and provide practical ways to engage students in learning science.

As with all tools, they come with instructions and have to be used properly in order to produce a desired outcome. Using the three C's well means changing traditional approaches to teaching and being willing to look at the urban science classroom in new ways. The urban science classroom must be seen as more than just a place where students learn science; it must be seen as a field to be studied and understood by both teachers and students while both engage in teaching and learning science. This changed way of thinking requires a redefinition of teacher and student and what their roles are in the science classroom.

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The first of the three C's has to do with the expansion of roles, the new look at the classroom, and the call for developing connections between students and science. Such a change in viewpoint cannot be adopted without creating a space for open dialogue about the science classroom, a process in which all participants take the role of student and teacher and share responsibility for the success of everyone in the classroom. The open dialogue I refer to is called a Cogenerative Dialogue.

The second of the three C's concerns the shared role of teacher and student as coteachers and is implemented, not surprisingly, through a process dubbed Coteaching. This tool allows students to learn science and then teach it and teachers to learn about student culture and then use what they learn. Much research on Cogenerative Dialogue and Coteaching has been conducted by Ken Tobin and his colleagues at the University of Pennsylvania and the CUNY Graduate Center.

The final C refers to Cosmopolitanism, which is a term rarely heard in discussions of science education. It refers to the idea that, despite their evident differ-

ences, humans share an ethical responsibility for one another. In urban science education, it requires that both students and teachers take responsibility for teaching one another what they do not know — about science, teaching science, and each other. Cosmopolitanism is rooted in philosophy, and *Cosmopolitanism: Ethics in a World of Strangers* (Norton, 2006), by Kwame Anthony Appiah, provides an informative overview of this idea.

COGENERATIVE DIALOGUES

Cogenerative Dialogues ("cogens") are conversations in which people come together to discuss a social field where they have had — and will continue to have — a shared experience. The goal of these cogens is to jointly construct a plan of action for improving the social field and future experiences in it. In urban science classrooms, the shared classroom experiences of teachers and students provide the material from which cogens start, as teachers invite students to discuss something that they all know about — their thoughts about the classroom. The invitation is extended as part of the teachers' concern for the students. It is not a requirement, a punishment, or a plea for help. It is a call for the students to share their opinions and expertise in a joint effort to understand.

The setting for the cogens is usually a classroom arranged so that participants sit in a circle. The groups meet before or after school or during lunch, and students and the teacher can talk about the issues and concerns they are having with the science class. These conversations turn up some profound insights into the nature of the classroom because students and the teacher discuss what they see in the classroom, and the personal experiences of participants (things often left unsaid or ignored) are brought to the fore.

In this type of setting, students' perspectives about science, their inherent motivation to succeed in the discipline, their issues with certain topics, the lack of effectiveness of the ways they have been taught, and various other issues within the classroom are examined. Teachers can express their frustration with teaching students who are unresponsive and share their thoughts and beliefs about students and the reasoning that underlies their specific instructional approaches. In each such dialogue, the entire group decides upon a single issue that is deemed most pressing, and each participant decides upon a plan of action that he or she will enact in the classroom to address the issue.

In the cogens I have been involved in, only four to six participants take part at a time. Students are welcome to invite friends or to opt out of the discussions as the groups get larger. Only a few rules guard the discussions: first, no voice is privileged over any other; second, each participant has an equal turn to talk; and, last, a plan of action has to be cogenerated to improve the social field where participants share the experience.

After being involved in cogens and seeing their plans of action being successfully implemented in the classroom, students who took part in my research project began to grow more actively involved in classroom tasks and in science. Students who were once not interested in anything the teacher had to say began to ask questions, participate in classroom activities and projects, and score higher on classroom exams. Participating in the cogens had enabled them to be more active in discussions both about science content and about the nature of teaching and learning in the classroom.

The students videotaped their science classrooms and the cogens so that they could have discussions about specific lessons after class. At the same time that the students and teachers were studying and discussing the videotapes in cogens, the student scores on conventional markers, such as exams and class participation, increased. Over time, it became evident that students were able to understand science in new ways because they were engaged in these dialogues.

COTEACHING

Armed with a belief that their voices mattered, the students exhibited a newfound interest in and knowledge about physics and chemistry, and they began to express a desire to involve their peers in science as well. Their newly developed sense of agency in science class immediately translated into a desire to teach their peers.

Coteaching traditionally involves two teachers working with the same group of students, but in the classrooms in my research, we enacted coteaching with the

students as teachers. When students understood a concept clearly, they would walk to the front of the class and conduct lessons for their peers, or they would teach in pairs or small groups. In some cases, the teachers became students themselves as they observed the ways that students taught one another. Teachers would take notes on the analogies, words, or examples that students employed when teaching other students and use them in their own lessons. In order to maintain some organization in the process, the coteaching sessions were planned into the teachers' lessons and became a part of regular classroom practice.

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As I mentioned above, the classroom lessons, cogens, and coteaching sessions were videotaped. These tapes were available for both teachers and students to watch, and they became an important means by which students could revise their understanding of content and teachers could revise their pedagogy. This process of examining the workings of the science class led to instances in which the students had been such active participants in the cogens and in the classroom that they wanted to take part in their own cogens beyond the two times a week that were initially scheduled. Students began enacting their own cogens and, in them, developed new ways to help those who were not doing well. This emerging responsibility that they accepted for one another became the seedbed for the germination of a cosmopolitan ethos among the students in the science classes and slowly filtered out into the school.

COSMOPOLITANISM

In my research, I view the philosophical idea of cosmopolitanism as an extension of a single cogen group (where participants share a responsibility for one another in order to meet shared goals) into multiple cogen groups throughout the classroom or the school. This means that all members of the groups become active participants in the larger processes of examining teaching and learning that extend beyond the group.

Subscribing to a cosmopolitan outlook requires a retooling of the power differentials in the classroom, so that all the students can be a part of the science and of the process of teaching and learning. The approach also works toward the creation of both a shared responsibility and a shared understanding of what works and what doesn't when it comes to science classrooms. The understanding of what works and what does not varies from class to class, but the shared responsibility for one another's learning remains the same. In other research, I discuss how such understanding can be shared across communities when similar conversations surrounding the ways to teach and learn science are shared with students from similar backgrounds. In essence, when we can extend the cogen from a single discussion group to many, we are working toward cosmopolitanism.

CONCLUSIONS

So far, I have briefly discussed the three C's for teaching science in urban schools and elaborated on some of the benefits of using them. The information received from and the insight provided by these research tools are beyond the scope of this article.[1] Through this work, many new theoretical frameworks for looking at science classrooms were developed, including the notion of corporate and communal classrooms, the emergence of student rituals as integral to looking at how students learn science, the importance of having students as science education researchers and authors, and the implications for teaching science of understanding the ethnic and racial divides in urban areas.

Finally, and most important, when students and teachers used the tools discussed here to develop shared understandings about teaching and learning science, I witnessed the same smiles, positive emotional energy, and deep connections that the rap song had triggered when I visited that steamy chemistry classroom on a fall afternoon long ago.

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1. More in-depth outcomes of this study were published in Christopher Emdin, "Exploring the Contexts of Urban Science Classrooms, Part 1: Investigating Corporate and Communal Practices," *Cultural Studies of Science Education*, April 2007, pp. 319-50; and idem, "Exploring the Contexts of Urban Science Classrooms, Part 2: The Emergence of Rituals in the Learning of Science," *Cultural Studies of Science Education*, April 2007, pp. 351-92. An article by students who participated in this research, "A Metalogue on Urban Schools and Science Classrooms: Student Voices on Research Products," by Lasleen Bennett, Jessica Collins, and Christopher Emdin, appears in Part 2.